Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
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વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન Microbiology વિષયનાં અભ્યાસક્રમ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓને તથા ડિપાર્ટમેન્ટના વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૪–૨૫ થી અમલમાં આવેલ NEP-2020 અંતર્ગત વિજ્ઞાન વિદ્યાશાખાનાં સ્ટ્રકચર મુજબનો B.Sc. Microbiology Sem-1 & 2 નો Major, Minor, MDC અને SEC નાં અભ્યાસક્રમમાં પ્રેકટીકલનાં પેપરમાં સુધારા સાથે રિવાઈઝ કરેલ અભ્યાસક્રમ માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૪/૦૫/૨૦૨૪ ની સભાનાં ઠરાવ ક્રમાંકઃ૦૩ થી મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણને એકેડેમિક કાઉન્સિલની તા.૦૧/૩/૨૦૨૪ની સભાનાં ઠરાવ ક્રમાંકઃ૧૦૪ અન્વયે માન. કુલપતિશ્રીને આપેલ સત્તા અંતર્ગત માનનીય ઈ.ચા.કુલપતિશ્રી ધ્વારા મંજૂર કરેલ છે. જેની આથી જાણ કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

ક્રમાંક : એસ./Microbio:ogy/સિલેબસ/પરિપત્ર/૧૫૦૯૨/૨૦૨૪
તા.૧૧–૦૭–૨૦૨૪

કુલસચિવ

પ્રતિ,

૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન Microbiology વિષયનો અભ્યાસક્રમ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રી. .. ...આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

Veer Narmad South Gujarat University

Surat

B.Sc. (Microbiology) Semester I Syllabus

NEP

(Effective from June 2024)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. MICROBIOLOGY

B. Sc. in Microbiology is a three-year Bachelor degree course which can be pursued after passing 12th Science. The subject includes the study of different forms of microorganisms and the development of microbiology. It mainly focuses on the understanding of the versatile metabolism of the varied microorganisms and the wide applicability of these life forms in environmental remediation, health and diseases, food and dairy as well as applying them for industrial and commercial utility. The course includes the study of allied subjects for the better understanding and use of microorganisms.

Program Outcome:

- ✓ Students shall learn various aspects of microbiology such as bacteriology, virology, algology, microbial physiology, bacterial genetics, immunology, biochemistry, rDNA technology.
- ✓ Students shall gain knowledge of applied microbiology such as industrial microbiology, environmental microbiology, industrial microbiology, food and dairy microbiology.
- ✓ Students shall learn about the presence of microorganisms in air, water, soil and its role in developing a sustainable environment.
- ✓ Students shall acquire the awareness regarding the importance of microorganisms in plant, animal, human health and diseases.
- ✓ Students shall gain knowledge of microbial technology and its applications in the production of industrially important microbial products.
- ✓ Students shall become aware of the role of microbes in the development of molecular biology and the advancements in genetic modifications technologies.
- ✓ Generate skilled manpower ready to use by industries in various sectors.

Program specific outcome:

- ✓ Students will develop the skill to observe, isolate, identify and cultivate microorganisms.
- ✓ Students will acquire and demonstrate proficiency in good laboratory practices in microbiology laboratories.
- ✓ Students will develop practical skills of tools and techniques used to study microbiology.
- ✓ Students will develop oral and written communication skills, effective presentation skills and interpretation skills from observed results.
- ✓ Students will be graduates in microbiology who shall understand the societal problems and play a vital role by providing microbial solutions.
- ✓ Students will be able to build their careers in public and global health, environmental organizations, food, pharmaceuticals and fermentation industries.

B. Sc. MICROBIOLOGY

Teaching & Evaluation Scheme

F. Y. B. Sc. Semester – I

MAJOR (MJ) COURSE: CREDIT 04 (03 THEORY + 01 PRACTICAL)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	Internal marks (CEE)	External marks (SEE)	Total marks (CCE+ SEE)	Duration of external exams (h)
MB-MJ-101	Fundamentals of Microbiology	03	03	35	35	70	01:30
MBP-MJ-101	Fundamentals of Microbiology Practicals	01	02	15	15	30	02:00
MB-MJ-102	Microscopy and Staining Techniques	03	03	35	35	70	01:30
MBP-MJ-102	Microscopy and Staining Techniques Practicals	01	02	15	15	30	02:00
Total				100	100	200	

MINOR (ME)-DOMAIN SPECIFIC / ELECTIVE COURSE: Credit 04 (02 Theory + 02 Practical)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	Internal marks (CEE)	External marks (SEE)	Total marks (CCE+SE E)	Duration of external exams (h)
MB-ME-101	Eukaryotic Cell Structure	02	02	25	25	50	01:00
MBP-ME-101	Practicals	02	04	25	25	50	04:00
Total				50	50	100	

OR

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	Internal marks (CEE)	External marks (SEE)	Total marks (CCE+SEE)	Duration of external exams (h)
MB-ME-102	Essentials of Biochemistry	02	02	25	25	50	01:00
MBP-ME-102	Practicals	02	04	25	25	50	04:00
Total				50	50	100	

MULTIDISCIPLINARY COURSE (MDC): CREDIT 04 (THEORY)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	Internal marks (CEE)	External marks (SEE)	Total marks (CCE+ SEE)	Duration of external exams (h)
MB-MDC-101	Environment Studies	04	04	50	50	100	02:00

OR

MULTIDISCIPLINARY COURSE (MDC): CREDIT 04 (02 THEORY + 02 PRACTICALS)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	Internal marks (CEE)	External marks (SEE)	Total marks (CCE+SEE)	Duration of external exams (h)
MB-MDC-102	Microbes in our Life	02	02	25	25	50	01:00
MB-MDC-102	Practicals	02	04	25	25	50	04:00
Total				50	50	100	

SKILL ENHANCEMENT COURSE (SEC): CREDIT 02 (01 THEORY + 01 PRACTICALS)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	Internal marks (CEE)	External marks (SEE)	Total marks (CCE+SEE)	Duration of external exams (h)
MB-SEC-101	Basics of Microbiology Laboratory	01	01	13	13	26	00:30
MB-SEC-101	Practicals	01	02	12	12	24	02:00
Total				25	25	50	

MB-MJ-101
FUNDAMENTALS OF MICROBIOLOGY

1. Course description

Course Code: MB-MJ-101
Course title: Fundamentals of Microbiology
Course type: Major
Course Credits: 03

2. Course Overview and Course objectives

Microbiology is one of the youngest biological sciences. This course introduces the students with Microbiology as a multifaceted science, history of inventions related to microbiology and microbes as well as development in microbiology. It also deals with a detailed explanation of the scope of microbiology.

Course Objectives:

- ✓ To introduce microbiology as a subject to first year students
- ✓ To describe position and importance of microorganisms in the living world
- ✓ To introduce various groups of microorganisms and to learn their distribution in nature.
- ✓ To learn microbial discovery and its role in disease development
- ✓ To study development of pure culture, immunology, agricultural microbiology, chemotherapy, virology etc. along with the growth of microbiology

3. Course Content

UNIT 1	INTRODUCTION TO MICROBIOLOGY
1.1	An Introduction to Microbiology
1.2	Microbiology: A Multifaceted Science
1.3	Position of Microorganisms in living world
1.4	Major Group of Microorganisms
1.5	Distribution of Microorganisms in Nature

UNIT 2	HISTORY & SCOPE OF MICROBIOLOGY
2.1	The discovery of Microbial World and Microscope
2.2	The Spontaneous Generation Controversy
2.3	Discovery of Microbial Effect on Organic Matter
2.4	Discovery of the role of Microbes in Causation of
2.5	Disease History of Virology
2.6	Applied areas of Microbiology

UNIT 3	DEVELOPMENT IN MICROBIOLOGY
3.1	Pure Culture Techniques
3.2	Immunology
3.3	Agricultural Microbiology
3.4	Chemotherapy
3.5	Virology
3.6	Modern Immunology
3.7	Molecular biology and biotechnology

MBP-MJ-101
FUNDAMENTALS OF MICROBIOLOGY PRACTICALS

1. Preparation of bacteriological and mycological broth / agar medium
2. pH measurement and adjustment
3. Microscopic examination of living microorganisms:
   (a) Observation of hay infusion by Wet Mount Technique.
   (b) Observation of bacterial Motility by Hanging Drop technique
4. Introduction to common instruments/ equipment in microbiology laboratory: Autoclave, Incubator, Hot air oven, Laminar air flow, Centrifuge, Bacteriological Filter, pH meter, Colorimeter, Anaerobic jar, Colony counter.
5. Observation of morphological characteristics of Yeast under bright field/ Dark Field and Phase Contrast microscope.
6. Observation of morphological characteristics of fungi under bright field/ Dark Field and Phase Contrast microscope
7. Observation of morphological characteristics of protozoa under bright field/ Dark Field and Phase Contrast microscope

4. Student Learning Outcomes:

- ✓ After studying this course students will be able to understand the basics of Microbiology and microorganisms.
- ✓ They will learn about various areas of microbiology along with their scope and significance.
- ✓ They will come to know about the discovery of microbes, how they cause diseases, their role in ecology, recycling of organic and inorganic matter etc.
- ✓ Moreover, students will also learn about the development of various fields along with progress in microbiology.

Recommended Learning Resources:

- Modi H. A., (2014), A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93-5070-1010)
- Willey J., Sandman K. and Wood D., (2020), Prescott's Microbiology, 11th Edition, McGraw Hill, (978-1-260-57002-1)
- Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition., Aditya Publications, Ahmedabad.
- Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya Publications, Ahmedabad.
- Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)
- Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition. New Age International Publishers, (ISBN: 978-9386418302**)**

MB-MJ-102

MICROSCOPY AND STAINING TECHNIQUES

1. Course description

Course Code: MB-MJ-102
Course title: Microscopy and staining techniques
Course type: Major
Course Credits: 03

2. Course overview and Course Objectives:

The main aspect of this paper is to study and understand the Basic principle of microscopy. It focused on different types of fundamental and advanced microscopy techniques. The course also includes the basics of stains and staining techniques.

Course Objectives:

- ✓ To study the principle of light and its optics
- ✓ To gain an understanding of numerical aperture and resolving power and the working of condensers and oculars.
- ✓ To acquire knowledge of different types of microscopies and its working principle
- ✓ To learn about types of dyes and principle of staining

3. Course Content

UNIT 1	BASIC PRINCIPLES OF MICROSCOPY AND DYES
1.1	General Principles of optics & Structure of light
1.2	Objectives – Numerical Aperture, Resolving power Immersion objectives - Depth of focus, Equivalent focus, working distance of uncovered objects & covered objects, Chromatic aberrations in objectives
1.3	Oculars – Huygens, Compensating, Flat field Condenser
1.4	Dyes: Acidic & basic dyes, chromophore
1.5	Staining solutions: Intensifier, mordant

UNIT 2	LIGHT MICROSCOPY
2.1	Bright field microscope
2.2	Dark field microscope
2.3	Phase contrast microscope
2.4	Differential Interference Contrast Microscope
2.5	Fluorescence microscope
2.6	Confocal microscopy
2.7	Theories of staining
2.8	Preparation and staining of specimens
2.9	Staining of bacteria: simple, differential, microchemical, cytological

UNIT 3	ELECTRON MICROSCOPY
3.1	Transmission Electron microscope
3.2	Scanning Electron microscope
3.3	Electron Cryotomography
3.4	Scanning probe microscopy
	3.4.1 Scanning tunnelling microscope
	3.4.2 Atomic force microscope

MBP-MJ-102

MICROSCOPY AND STAINING TECHNIQUES PRACTICALS

1. Study of bright field compound microscope: Components, use and care.
2. Measurement of microorganisms (Micrometry) using Ocular and Stage micrometer.
3. Monochrome staining by Acidic and Basic dye.
4. Differential Gram staining.
5. Acid fast staining.
6. Spirochaete staining: Negative staining and direct.
7. Microchemical staining: metachromatic granules

4. Student Learning Outcomes:

- ✓ Students shall gain an understanding of the relevance of resolving power and numerical aperture in microscopy
- ✓ Students shall learn different types of microscopy and its uses
- ✓ Students shall understand the types of electron microscopy and its applications in microbiology
- ✓ Students shall gain an insight regarding stains and dyes

- ✓ Students shall develop skill of different staining techniques

Recommended Learning Resources:

- Willey J.M., Sherwood L.M. and Woolverton C.J., (2017) Prescott's Microbiology, 9th and 10thEdition McGraw - Hill Education (ISBN: 978-981-3151-26-0)
- Salle A. J., (1984) Fundamental Principles of Bacteriology, 7th Edition, Tata McGraw – Hill, (ISBN:0-07-099-562-1)
- Pelczar, Chan and Krieg, (2001), Microbiology-Concepts and Application, 5th Edition, McGraw-Hill, (ISBN: 9780074623206)
- Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya Publications, Ahmedabad.
- Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya Publications, Ahmedabad.
- Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Edication (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)
- Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition. New Age International Publishers, (ISBN: 978-9386418302).

MB- ME-101

EUKARYOTIC CELL STRUCTURE

1. Course description

Course Code: MB- ME-101
Course title: Eukaryotic cell structure
Course type: Minor- Elective
Course Credits: 02 + 02

2. Course Overview and Course objectives

The course includes the study of eukaryotic cell structure and the components of eukaryotic cells. It includes the detailed study of the structure and function of cell wall and cell membrane. The course includes the understanding of various cell organelles and their importance.

Course Objectives:

- ✓ Introduce the students to the basics of cell.
- ✓ Describe the structure and function of the cell wall and cytoplasmic membrane.
- ✓ Introduce students to the varied cell organelle's structure and their functions.

3. Course Content

UNIT 1	EUKARYOTIC CELL STRUCTURE
1.1	An overview of eukaryotic cell structure
1.2	Cell wall
1.3	Cytoplasmic membrane
1.4	Cytoplasm
1.5	Nucleus

UNIT 2	CELL ORGANELLES
2.1	Endoplasmic reticulum
2.2	Eukaryotic ribosomes
2.3	Mitochondria
2.4	Chloroplast
2.5	Golgi apparatus
2.6	Lysosomes
2.7	Vacuoles
2.8	Centrioles
2.9	Flagella

MBP- ME-101

EUKARYOTIC CELL STRUCTURE PRACTICALS

1. Observation and examination of yeast cell.
2. Observation and examination of fungal cell.
3. Observation and examination of algal cell.
4. Observation and examination of protozoa.
5. Observation of different eukaryotic cells (permanent slides).
6. Staining of nuclear material.
7. Examination of cell organelles in paramecium.

Student Learning Outcomes:

- ✓ Students shall learn the structure and functions of cell wall and cell membrane as well as cytoplasm and nucleus.
- ✓ They will learn the structure and functions of varied cell organelles.

Recommended Learning Resources:

- Modi H. A., (2014), A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93-5070-1010)
- Willey J., Sandman K. and Wood D., (2020), Prescott's Microbiology, 11th Edition, McGraw Hill, (978-1-260-57002-1)

MB-ME-102

ESSENTIAL OF BIOCHEMISTRY

1. Course description

Course Code: MB- ME-102
Course title: Essential of Biochemistry
Course type: Minor Elective
Course Credits: 02 + 02

2. Course Overview and Course objectives

The course includes the study of atoms and molecules and the solubility of compounds in the solution. It also covers the knowledge of acids and bases and the maintenance of pH. The course includes the understanding of biological compounds and the chemical reactions.

Course Objectives:

- ✓ To learn the fundamentals of atoms and molecules
- ✓ To study the solubility of compounds and its presence in solutions
- ✓ To understand acid and base and its role in pH maintenance
- ✓ To introduce biological compounds and its role in chemical reactions

3. Course Content

UNIT 1	BIOCHEMISTRY FOR MICROBIOLOGY
1.1	Atoms and molecules
1.2	Solubility of compounds
1.3	Concentration of compounds in solution
1.4	Acids, Bases and pH

UNIT 2	BIOCHEMICAL COMPOUNDS AND CHEMICAL REACTIONS
2.1	Important biological compounds
2.2	Introduction to chemical reactions
2.3	Ionization of water
2.4	Buffering against pH changes in biological systems
2.5	Water as reactant

MBP-ME-102

ESSENTIAL OF BIOCHEMISTRY PRACTICALS

1. Preparation of standard solutions.
2. Preparation of buffer solutions.
3. Adjustment of pH.
4. Preparation of molar solution
5. Preparation of molal solution
6. Preparation of normal solution.
7. Solubility test of compounds (Starch, gelatin, lipid).

4. Student Learning Outcomes:

- ✓ Students shall acquire knowledge of atoms and molecules, solubility of compounds and pH.
- ✓ They shall learn about important biological compounds and chemical reactions as well as the role of water as reactants.

Recommended Learning Resources:

- Satyanarayan U., and Chakrapani U., (2013), Biochemistry, Elsevier (9788131236017)
- Rodwell V. W., Bender D. A., Botham K. M., Kennelly P. J., Weil P. A., Harper's Biochemistry, McGraw Hill Education.
- Aneja K. R., (2007), Experiments in Microbiology, Plant Pathology and Biotechnology, New age International
- Godkar P. B., And Godkar P. D., (2003), Textbook of Medical Laboratory Technology, Bhalani Publishing House, Mumbai, India
- Mukherjee K. L., (1962), Medical Laboratory Technology- A procedure manual for routine diagnostic tests. McGraw Hill Education Pvt. Ltd. New Delhi.
- Pelczar M. J., Chan E.C.S Chan, Krieg N. R., (2011), Microbiology: An application-based approach, Tata McGraw Hill Education Private Limited.

MULTIDISCIPLINARY COURSE (MDC)

MB-MDC-101

ENVIRONMENT STUDIES

1. COURSE DESCRIPTION:

Course Code: MB-MDC-101
Course title: Environment Studies
Course type: Multidisciplinary
Course Credits: 04

2. Course Overview and Course objectives:

The Environmental Studies course explores the environment, natural resources, ecosystems, biodiversity, and environmental pollution. Students gain an understanding of sustainable practices, conservation strategies, and the impact of human activities on the environment, fostering a holistic approach to environmental stewardship. Critical thinking, problem-solving, and communication skills are developed to address environmental challenges effectively.

Course Objectives:

- ✓ To gain knowledge regarding natural resources and their conservation
- ✓ To understand basic aspects of biodiversity
- ✓ To learn about ecosystem and energy flow
- ✓ To sensitize about different types of pollution.

3. Course Content:

UNIT 1	IMPORTANCE OF ENVIRONMENTAL AND STUDIES NATURAL RESOURCES
1.1	Definition, Scope, and Importance of Environmental Studies
1.2	Introduction to Natural Resources
1.3	Renewable and Non-renewable Resources
1.4	Energy Conservation
1.5	Role of Individual in Conservation of Resources

UNIT 2	ECOSYSTEMS
2.1	Concept of Ecosystem
2.2	Structure and Function of Ecosystem: Producer, Consumer and Decomposer
2.3	Energy Flow in the Ecosystem
2.4	Food chains, Food webs and Ecological pyramids

UNIT 3	BIODIVERSITY
3.1	Introduction to Ecosystem Diversity
3.2	Biogeographic Classification of India
3.3	Value of Biodiversity
3.4	Hotspots of Biodiversity

UNIT 4	ENVIRONMENTAL POLLUTION
4.1	Definition and Classification of Pollutants
4.2	Sources, Effect and Control of: 4.2.1 Air Pollution 4.2.2 Water Pollution 4.2.3 Soil Pollution 4.2.4 Marine Pollution 4.2.5 Noise pollution 4.2.6 Thermal Pollution
4.3	Solid Waste Management
4.4	Disaster Management

4. Students Learning Outcomes:

- ✓ Students will learn about Environment and its importance and how it is being polluted by humans and also steps to reduce pollution.
- ✓ Students will understand how natural resources are misused and its prevention, difference between renewable source and non-renewable sources and various conservation methods to conserve nature and its resources.
- ✓ Students gain ideas regarding construction of food chain and food web by primary producers to consumers and also role of decomposers in it.
- ✓ Even students will have an idea of waste management collected from domestic waste, industrial waste, etc. and how to manage situations during any kind of disaster caused by nature.

Recommended Learning Resources:

- Bharucha, E. (2005). *Textbook of Environmental Studies for Undergraduate Courses*. University Press.

- Singh, Y. K. (2006). *Environmental Science*. New Age International.
- Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition. New Age International Publishers, (ISBN: 978-9386418302)
- Dubey R. C. and Maheshwari D. K., (2002), Practical Microbiology, S. Chand & company.
- Benson H. J., (2002), Microbiological Applications: Laboratory Manual in General Microbiology, McGraw Hill.

MULTIDISCIPLINARY COURSE (MDC)

MB-MDC-102

MICROBES IN OUR LIFE

1. Course description

Course Code: MB-MDC-102
Course title: Microbes in our Life
Course type: Multidisciplinary
Course Credits: 2 + 2

2. Course Overview and Course objectives

The course includes the study of the usefulness of microorganisms as well as the harmful aspects of living microbial entities. The course shall envisage the applications of microorganisms in routine life activities.

Course Objectives:

- ✓ To give basic idea to the students regarding beneficial activities and role of microbes in our day-to-day life and research as well
- ✓ To understand how microbes are harmful to humans as well as other industrially important materials.

3. Course Content

UNIT 1	BENEFICIAL MICROBES
1.1	Beneficial activities of microbes
1.2	Microorganisms as source of food
1.3	Microbes in industry, enzymes production, leaching, fat production, retting of fibers, dairy industry, medicine, agriculture
1.4	Microbes as tools for biological research

UNIT 2	DETRIMENTAL MICROBES
2.1	Harmful activities of microorganisms
2.2	Microbes in water supply
2.3	Microbes in Textile, paper, leather and rubber, optical instruments and wood deterioration
2.4	Microorganisms and diseases in man: basic concepts

MBP-MDC-102

MICROBES IN OUR LIFE PRACTICALS

1. Observation of bacteria from curd.
2. Grading the quality of milk by MBRT test.
3. Direct microscopic observation of Microorganisms in polluted water (Hanging Drop method).
4. Observation of stained bacteria in spoiled food/ vegetables.
5. Observation of stained fungi in spoiled food/ vegetables.

4. Student learning outcome:

- ✓ Students will learn about the benefits of microorganisms in day-to-day life and how microbes can be used as food or in making food products.
- ✓ Students will learn about microbes which harm humans by causing various diseases.
- ✓ Students will gain ideas regarding microorganisms causing deterioration and degradation on some natural or manmade products.

Recommended Learning Resources:

- Modi. H. A. (2014) A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93-5070-1010)
- Purohit S.S. Microbiology Fundamentals and applications, 7th Ed, (2019) Agrobios.
- Patel R.J. and Patel R.K. (2016) Experimental microbiology, 9th Edition. Aditya Publication,
- Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition. New Age International Publishers,

- Dubey R. C. and Maheshwari D. K., (2002), Practical Microbiology, S. Chand & company.
- Benson H. J., (2002), Microbiological Applications: Laboratory Manual in General Microbiology, McGraw Hill.

SKILL ENHANCEMENT COURSE

MB-SEC-101

Basics of Microbiology Laboratory

1. Course Description:

Course code: MB-SEC-101
Course title: Basics of Microbiology laboratory
Course type: Skill based
Course credits: 01 + 01

2. Course Overview:

This course will offer greater understanding to microbiology students about prerequisites of microbiology experiments. It will help students to understand about various lab ware, how to handle them, clean them, sterilize them etc. Students will also gain fundamental knowledge regarding how to grow microbes on suitable media as well.

Course Objectives:

- ✓ The main objective is to provide knowledge and basic concepts of techniques used in microbiology laboratories.
- ✓ Students will get acquainted with glassware and plastic ware used in the laboratory, even how to clean and sterilize them, inoculation, handling of Petri dishes, etc.
- ✓ Disposal also plays an important role in laboratories as it may be risky if not handled properly.
- ✓ Students will learn how to prepare Medias as well as adjusting the pH of media according to type of microorganisms.

3. Course Content

UNIT 1	LABORATORY GLASSWARES
1.1	Laboratory glassware and accessories
	1.1.1 Laboratory glassware
	1.1.2 Laboratory plastic ware
	1.1.3 Other accessories
	1.1.4 Miscellaneous glassware and accessories
1.2	Cleaning and sterilization of glassware
1.3	Disposal of laboratory wastes and cultures

UNIT 2	MICROBE HANDLING TECHNIQUES
2.1	The need for proper techniques
2.2	Importance of Aseptic techniques
2.3	Sterilizing inoculating wire loops and needles
2.4	Preparation of suspension
2.5	Inoculation and Transfer of culture
2.6	Handling a Petri dish
2.7	Streaking and spreading of suspension on Petri dish
2.8	Incubation of Petri dish, slant and broth tubes
2.9	Preparation and staining of smear

MBP-SEC-101

BASICS OF MICROBIOLOGY LABORATORY PRACTICALS

1. Rules and safety in microbiology laboratory.
2. Preparation of temporary and permanent cotton plugs.
3. Preparation of chromic acid.
4. Washing and packaging of glassware for sterilization.
5. Preparation and staining of smear.
6. Disposal of laboratory waste.

4. Student learning outcome:

- ✓ Students will learn about how to clean and use laboratory glassware and plastic ware.
- ✓ Students will also learn how to dispose of used media and cultures so as no environmental contamination occurs.
- ✓ Students will learn about handling and sterilization of wire loops, media handling, and preparation of smear for staining, serial dilution for isolation of microorganisms.
- ✓ Students will learn to prepare media by weighing, autoclaving and adjusting pH of medium, etc.

Recommended Learning Resources:

- Patel R. J. & Patel K. R. (2016). Elementary Microbiology Vol I, 9th Ed., Aditya Publications, Ahmedabad.
- Aneja K. R., (2007), Experiments in Microbiology, Plant Pathology and Biotechnology, New age International.



Veer Narmad South Gujarat University

Surat

B.Sc. (Microbiology) Semester II Syllabus

NEP

(Effective from June, 2024)

B. Sc. MICROBIOLOGY

Teaching & Evaluation Scheme
F. Y. B. Sc. Semester – II

MAJOR (MJ) COURSE: CREDIT 04 (03 THEORY + 01 PRACTICAL)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams (h)
MB-MJ-201	Microbial Diversity	03	03	35	35	70	01:30
MBP-MJ-201	Microbial Diversity Practicals	01	02	15	15	30	04:00
MB-MJ-202	Bacterial and Archaeal cell Structure and Function	03	03	35	35	70	01:30
MBP MJ 202	Bacterial and Archaeal cell Structure and Function Practicals	01	02	15	15	30	04:00
Total				100	100	200	

MINOR (ME)-DOMAIN SPECIFIC / ELECTIVE COURSE: Credit 04 (02 Theory + 02 Practical)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams (h)
MB-ME-201	Biophysics	02	2	25	25	50	01:00
MBP-ME-201	Biophysics Practicals	02	4	25	25	50	04:00
Total				50	50	100	

OR

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams (h)
MB-ME-202	Atypical Prokaryotes	02	2	25	25	50	01:00
MBP-ME-202	Atypical Prokaryotes Practicals	02	4	25	25	50	04:00
Total				50	50	100	

MULTIDISCIPLINARY COURSE (MDC): CREDIT 04 (THEORY)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams (h)
MB-MDC-201	Remedies of Environment Pollution	04	04	50	50	100	02:00

SKILL ENHANCEMENT COURSE (SEC): CREDIT 02 (01 THEORY + 01 PRACTICALS)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams (h)
MB-SEC-201	Conventional Methods for Identification of Bacteria	01	01	13	13	26	00:30
MBP-SEC-201	Practicals	01	02	12	12	24	02:00
Total				25	25	50	

OR

SKILL ENHANCEMENT COURSE (SEC): CREDIT 02 (THEORY)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams (h)
MB-SEC-202	Maintenance of Laboratory Equipment	02	02	25	25	50	01:00

MB-MJ-201

MICROBIAL DIVERSITY

1. Course Description:

Course Code: MB-MJ-201
Course title: Microbial diversity
Course type: Major
Course Credits: 03

2. Course Overview:

Microorganisms occurs in the form of unity and diversity. The microbial world is diverse with more than 10 million different types of microorganisms inhabiting the planet earth. This course introduces the students with various groups of microorganisms, their mode of reproduction, nutrition, and their economic importance.

Course Objectives:

- ✓ To introduce microbiology different groups of microorganisms to students.
- ✓ To study structure of diverse group of organisms.
- ✓ To study their habitat, growth, reproduction, and nutritional requirements of different groups of organisms.
- ✓ To learn economic importance of various groups in aspect of their role towards nature.

3. Course Content:

UNIT 1	Bacteria
1.1	Proteobacteria
1.2	Gram-Positive bacteria
1.3	Cyanobacteria
1.4	Other major phyla
1.5	Archaea

UNIT 2	Fungi
2.1	Fungal distribution
2.2	Fungal structure
2.3	Fungal reproduction
2.4	Economic importance of fungi

UNIT 3	Algae & Protozoa
3.1	Introduction
3.2	Habitat and Distribution
3.3	Structural organization of cell
3.4	Nutrition and physiology
3.5	Economic importance

MBP MJ 201

MICROBIAL DIVERSITY PRACTICALS

1. Identification of economically important fungi. (9 genera) (*Aspergillus, Penicillium, Mucor, Rhizopus, Curvularia, Helminthosporium, Cunninghamella, Fusarium*, *Alternaria*)
2. Study of permanent slides of algae (*Volvox, Spirogyra*, Diatoms)
3. Study of permanent slides of Cyanobacteria (*Nostoc, Anabaena*)
4. Study of permanent slides of Protozoa (*Amoeba, Paramoecium, Euglena*).
5. Observation of diverse morphology and arrangement of cells in bacteria by gram stain.
6. Observation of filamentous bacteria from soil. (Actinomycetes)
7. Cultivation of algae
8. Cultivation of protozoa

4. Student Learning Outcomes:

- ✓ After studying this course student will be able to understand basics of different groups of microorganisms.

- ✓ They will learn in detail about microorganism's habitat, nutritional requirements, mode of reproduction, etc.
- ✓ They will learn the economic importance of different groups of organisms.
- ✓ They will learn the difference between prokaryotes, eukaryotes cell organization.

Recommended Learning Resources:

- Madigan, T, M., & Martinko, J.M. (2012). Brock Biology of Microorganisms, 13th Ed., Benjamin Cummings.
- Willey J., Sandman K. and Wood D., (2020), Prescott's Microbiology, 11th Edition, Mc Graw Hill, (978-1-260-57002-1).
- Modi H. A., (1996), Elementary Microbiology: An Introduction to Microbial World, Vol II, Ekta Prakashan, Nadiad.
- Pelczar, M. J., & Chan, E. C. S. (1998). Microbiology, 5th Ed., Tata-McGraw-Hill.
- Aneja, K.R., (2003). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, 4th edition, New Age International Publishers.
- Cappuccino, J.G., (2016). Microbiology: A Laboratory Manual, 11th ed., Pearson Education (Singapore) Pvt. Ltd.
- Patel, R. J., & Patel, K. R., (2011). Experimental Microbiology, Vol. 2, 8th ed., Aditya.
- Patel, R. J., & Patel, K. R., (2015). Experimental Microbiology, Vol. 1, 9th ed., Aditya.

MB-MJ-202

BACTERIAL AND ARCHAEAL CELL STRUCTURE AND FUNCTION

1. Course Description:

Course Code: MB-MJ-202
Course title: Bacterial and archaeal cell structure and function
Course type: Major
Course Credits: 03

2. Course Overview:

Everywhere we are surrounded with lots of bacteria. They are procaryotic in nature as far as cell structure and morphology is concern and are quite different from eukaryotes. Thus, it is important to know the detailed insights of these prokaryotic cells.

Course Objectives:

- ✓ To study size, shape, arrangements of bacterial and archaeal cells.
- ✓ To study structure and functions of internal and external cell structures of bacterial cells.
- ✓ To learn about structure and significance of procaryotic cell walls and cell membranes.

3. Course Content:

UNIT 1	Cell Morphology and Cell Inclusions
1.1	Major cell morphologies and biology
1.2	Cell size and significance of smallness
1.3	Surface area to volume ratio and its significance
1.4	Lower limits of cell size
1.5	Cell inclusions
1.6	Endospores
1.7	Gas vesicles
1.8	Ribosomes and nucleoids

UNIT 2	Cell Wall and Cytoplasmic Membrane
1.1	Cytoplasmic membrane in bacteria & archaea
1.2	The functions of cytoplasmic membrane
1.3	The cell wall of bacteria
1.4	Outer membrane of gram-negative bacteria
1.5	Cell wall of archaea

UNIT 3	Cell Surface Structures and Function
1.1	Cell surface layers, pilli, fimbriae
1.2	Flagella and motility
1.3	Gliding motility
1.4	Microbial taxes

MBP MJ 202

BACTERIAL AND ARCHAEAL CELL STRUCTURE AND FUNCTION PRACTICALS

1. Cell wall staining by Dyar's method,
2. Capsule staining by Maneval's method,
3. Spore staining by Snyder's modification of Dorner's method
4. Cytoplasmic membrane staining
5. Flagella staining by Leifson's method
6. Nucleic acid staining by Robinow's method

4. Student Learning Outcomes:

- ✓ After studying this course student will be able to understand basics of bacterial and archaeal cell structure.

- ✓ They will learn in detail about bacterial internal and external cell structures like vesicles, inclusion granules, endospores, ribosomes, freely lying genetic material-nucleoid, locomotory organelle flagella, pilli etc.
- ✓ They will learn the detailed structures of cell wall and cell membrane including role played by them.

Recommended Learning Resources:

- Madigan, T, M., & Martinko, J. M. (2008). Brock Biology of Microorganisms, 12th Ed., Benjamin Cummings.
- Madigan, T, M., & Martinko, J.M. (2008). Brock Biology of Microorganisms, 14th Ed., Benjamin Cummings.
- Willey J., Sandman K. and Wood D., (2020), Prescott's Microbiology, 11th Edition, Mc Graw Hill, (978-1-260-57002-1)
- Modi H. A., (1996), Elementary Microbiology: An Introduction to Microbial World, Vol I & II Ekta Prakashan, Nadiad,
- Pelczar, M. J., & Chan, E. C. S. (1998). Microbiology, 5Ed., Tata-McGraw-Hill.
- Aneja, K.R., (2003). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, 4th edition, New Age International Publishers.
- Cappuccino, J.G., (2016). Microbiology: A Laboratory Manual, 11th ed., Pearson Education (Singapore) Pvt. Ltd.
- Patel, R. J., & Patel, K. R., (2011). Experimental Microbiology, Vol. 2, 8th ed., Aditya.
- Patel, R. J., & Patel, K. R., (2015). Experimental Microbiology, Vol. 1, 9th ed., Aditya.

MB-ME-201

BIOPHYSICS

1. Course Description:

Course Code: MB-ME-201
Course title: Biophysics
Course type: Minor/elective
Course Credits: 02

2. Course Overview:

This interdisciplinary course introduces the basic concepts of physics and their applications in biology for better understanding of various biological processes at cellular and molecular level. This knowledge will empower the students to develop a basic understanding about the principles and

concepts of Biophysics and will enable the students to develop quantitative approaches to solve physical/biological problems.

Course Objective:

- ✓ Students will learn basic concepts of physics and apply them to study the physicochemical properties of biomolecules.
- ✓ Students will learn to investigate the light absorption properties of biomolecules through lasers.
- ✓ Students will gain knowledge about the basic concept of waves and electrostatic interaction for biomolecule perspective.

3. Course Content:

UNIT 1	General physico-chemical and quantum principles
1.1	Electronic structure of atom
1.2	Ionic bond, covalent bonds, hydrogen bonds, Vander Waals forces
1.3	Electric dipoles, Polarization and induced Dipoles, Casimir interactions
1.4	Pauli exclusion principle, ionization energy, electron affinity and chemical bonding, electronegativity, and strong bond
1.5	Interatomic potential for strong bonds and weak bonds, Bond energies
1.6	Thermodynamic equilibrium and laws of thermodynamics
1.7	Entropy, enthalpy, free energy, internal energy
1.8	Diffusion, osmosis, osmotic pressure, osmoregulation, surface tension

UNIT 2	Electrostatics, Waves and Lasers
1.1	Introduction to electrostatics: concept of charge in Gauss's law, line charge, surface charge, electric potential, and field
1.2	Superposition principle and superposition of waves: Young's double slit interference
1.3	Diffraction: diffraction through a single slit/ double slit and grating
1.4	Resolving power, resolution of the eye
1.5	Lasers: Principle, population inversion, He-Ne Laser, characteristics of laser, Applications of lasers in medical science
1.6	Polarization of EM wave, Nicol prism, Doppler effect
1.7	Effects of vibrations in humans; physics of hearing, hearbeat

MBP-ME-201

BIOPHYSICS PRACTICAL

1. Determination of the acceleration due to gravity using bar pendulum.
2. Determination of the frequency of an electrically maintained tuning fork by Melde's Experiment.
3. Determination of the wavelength of laser source through diffraction of
   (1) Single slit,
   (2) Double slit.
4. Determination of the coefficient of Viscosity of water by capillary flow method (Poiseuille"s method).
5. Verification of Beer Law
6. Verification of Malus law (Polarization of electromagnetic radiations)
7. Dispersion of laser beam

4. Student Learning Outcomes:

- ✓ Student shall gain an understanding of the physico-chemical principles of molecules and bonding.
- ✓ Student shall learn the fundaments of thermodynamics and the principle of quantum mechanics.
- ✓ Students shall get an insight of electrostatics, waves, and lasers.

Recommended Learning Resources:

- David Freifelder (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology. 2nd edition. W.H. freeman and Company.
- Keith Wilson and John Walker (2005). Principles and Techniques of Biochemistry and Molecular Biology. 6th edition. Cambridge University Press.
- N. K. Bajaj (2008). The Physics of Waves and Oscillations. 5th edition. Tata McGraw Hill.
- Christopher R. Jacobs, Hayden Huang, Ronald Y. Kwon (2012). Introduction to cell mechanics and Mechanobiology 1st editon. Garland Science (Taylor & Francis Group). ISBN: 978-0-8153-4425-4.
- Principles of Biochemistry by A. L. Lehninger, D.L. Nelson and M.M. Cox, CBS Publishers, New Delhi, 1993.
- Biochemistry by L. Stryer, W.H. Freeman and Co., Newyork 1997.
- Conformation of Carbohydrates by V.S.R. Rao, P.K. Qasba, P.V. Balaji and R. Chandrasekaran, Harwood Academic Publishers, 1998.

- Biophysics, W. Hoppe. *et. al*., Springer - Verlag, 1989.
- Biophysics, Pattabhi N. and Gautham, N. Narosa Publishing House, New Delhi, 2002.
- Essentials of Biophysics. Narayanan, P., New Age International (P) Ltd. Publishers, New Delhi, 2000.

MB- ME- 202
ATYPICAL PROCARYOTES

1. Course Description:

Course Code: MB-ME-202
Course Title: Atypical prokaryotes
Course Type: Minor
Course Credit: 02

2. Course Overview:

Usually, students learn in detail about typical structure and functions of prokaryotic cell. But there are many other prokaryotic lives different than that of such typical structure. Atypical procaryotes like Rickettsia, Chlamydia, Mycoplasma, Actinomycetes, Cyanobacteria are examples of such atypical procaryotes, and students will learn them here in ample detail.

Course Objectives:

- ✓ To introduce various groups of atypical procaryotes and to learn their distribution in nature
- ✓ To learn historical perspectives, typical characteristics and importance of atypical procaryotes

3. Course Content:

UNIT 1	Atypical prokaryotes I
1.1	Rickettsia
1.2	Chlamydia
1.3	Mycoplasma
1.4	L-forms

UNIT 2	Atypical prokaryotes II
2.1	Bdellovibrio
2.2	Photosynthetic bacteria
2.3	Archaeobacteria
2.4	Actinomycetes

MBP-ME-202

ATYPICAL PROCARYOTES PRACTICALS

1. Preparation of media for isolation and cultivation of Actinomycetes.
2. Isolation of Cyanobacteria from soil/water.
3. Isolation of Cyanobacteria from paddy field.
4. Isolation of Actinomycetes from soil.
5. Study of permanent slides of Nostoc, Anabaena, Oscillatoria, Spirulina
6. Demonstration of Cyanobacterial symbiosis in Azolla.
7. Study of special features of:
   A. Cyanobacteria: Nostoc, Anabaena, Oscillatoria, Spirulina
   B. Actinomycetes
   C. Mycoplasma

4. Student Learning Outcomes:

- ✓ After studying this course student will be able to understand basics groups of atypical prokaryotes like Rickettsia, Chlamydia, Mycoplasma, Actinomycetes, Cyanobacteria, methanogens etc.
- ✓ They will come to know about discovery of atypical bacteria, how do they cause diseases, their role in ecology, fix nitrogen etc.

Recommended Learning Resources:

- Modi H. A., (1996), Elementary Microbiology, Akta Prakashan, (ISBN: 978-93-5070-1010)
- Pelczar M.J., Chan E.C.S, Craig N.R., (2010), Microbiology: An application-based approach, Tata Mc Graw Hill, (ISBN: 0-07-015147-4)
- Dubey R.C. and Maheshwari D.K, (2005), practical Microbiology, S. Chand publication, (ISBN: 81-219-2153-8)

MB-MDC-201

REMEDIES TO ENVIRONMENT POLLUTION

1. Course Description:

Course Code: MB-MDC-201
Course title: Remedies to Environment Pollution
Course type: Multidisciplinary
Course Credits: 04

2. Course Overview:

There are numerous ways to pollute the environment. The causes of environmental issues can range greatly, from excessive pesticides washing into our water supply to carbon dioxide emissions damaging our atmosphere. The treatments for pollution differ depending on the type of pollution. The goal of the course is to increase student's understanding about various pollution and possible solution to prevent or prevent environment pollution.

Course Objectives:

- ✓ To understand the sources of air pollution and systems of polluted air removal.
- ✓ To understand the technologies to control different types of water pollution.
- ✓ To understand the basics of soil pollution and in situ and ex situ methods for remediation of soil pollution.

3. Course Content:

UNIT 1	Air Pollution and its Remediation
1.1	Types and Sources of Air Pollutants
1.2	Problems of air pollution
1.3	Air Pollution Control Equipment and Systems

UNIT 2	Water Pollution and its Remediation
2.1	Surface water and surface water pollutants
2.2	Ground water and ground water pollutants
2.3	Pollution Control Technology

UNIT 3	Soil Pollution and its Remediation
3.1	The Basics of Soil Pollution
3.2	Industrial Practices and Soil Contamination

UNIT 4	Remediation Techniques
4.1	Removal of Dry Particulate Matter.
4.2	Removal of Gaseous Pollutants: Stationary Sources
4.3	Removal of Gaseous Pollutants: Mobile Sources.
4.4	Pollution Control Technology: Underground Storage Tanks
4.5	Pollution Control Technology: Groundwater Remediation
4.6	Remediation of UST -Contaminated Soils
	4.6.1 In situ technologies
	4.6.2 Non-In Situ Technologies

4. Student Learning Outcomes:

- ✓ Student will gain knowledge of air pollution causes and Air Pollution Control equipment and systems.
- ✓ Student will gain knowledge of water pollutants and control technologies.
- ✓ Student will gain knowledge of soil pollution and remediation techniques for soil pollution removal.

Recommended Learning Resources:

- ➢ The Science of Environmental Pollution. Frank R. Spellman, second edition, CRC Press Taylor & Francis. ISBN: 978-1-4398-1302-7
- ➢ Pollution Causes, Effects and Control, 5th Edition, R M Harrison. RSC publication, ISBN: 978-1-84973-648-0

SKILL ENHANCEMENT COURSE

MB-SEC-201

CONVENTIONAL METHODS FOR IDENTIFICATION OF BACTERIA

1. Course Description:

Course code: MB-SEC-201
Course Title: Conventional Methods for Identification of Bacteria
Course type: Skill based
Course credits: 01+01

2. Course overview:

This course is mainly designed to study the different isolation techniques for pure cultures as well as mixed cultures. In order to identify and classify an unknown microorganism it is first necessary to learn the characteristics of different microorganisms. Techniques included in this course help us to do so.

Course Objectives:

- ✓ To introduce students to different isolation techniques.
- ✓ To study morphological, growth, colonial, nutritional and biochemical characteristics of different bacteria.
- ✓ To bring awareness in students about the Culture Collection Centers.
- ✓ To study how to maintain and preserve cultures.

3. Course Content:

UNIT 1	Introduction to Bacterial Cultures
1.1	Pure Culture
1.2	Mixed Culture
1.3	Origin of pure culture technique
1.4	Techniques for Isolation
	1.4.1. Streak plate
	1.4.2. Pour plate
	1.4.3. Spread plate
	1.4.4. Serial dilution
1.5	1.4.5. Enrichment culture technique
1.6	Single cell isolation
1.7	Isolation of anaerobe

UNIT 2	Study of pure cultures
2.1	Morphological characterization
2.2	Cultured characterization
	2.2.1. Colony Characteristics on solid media
	2.2.2. Growth Characteristics on liquid media
	2.2.3. Growth Characteristics on agar slants
	2.2.4. Growth Characteristics on agar stabs
2.3	Nutritional requirements and Biochemical characteristics
2.4	Culture collection Centers
	2.4.1. Role of culture collection centers
	2.4.2. Worldwide status of culture collection centers
	2.4.3. Some Important culture collection centers
2.5	Maintenance and preservation of cultures

MBP-SEC-201

CONVENTIONAL METHODS FOR IDENTIFICATION OF BACTERIA PRACTICALS

1. Techniques for isolations and identification of microorganisms
   a) Streak plate technique
   b) Pour plate technique
   c) Spread plate technique

2. Techniques for cultivation of bacteria
   a) Broth cultivation
   b) Stab cultivation
   c) Slant cultivation

3. Cultivation of anaerobic bacteria
4. Isolation of bacteria by loop dilution technique

4. Students learning outcome.

- ✓ Students are introduced to different types of bacterial cultures and techniques for isolation, which is a basic requirement for a microbiology student.
- ✓ Different Pure culture characteristics are also introduced in this course which can help later to identify organisms that can be used for medical purpose, Industrial purpose and Food technology.

Recommended Learning Resources:

- Modi H. A. (2014), A handbook of elementary microbiology, Shanti Prakashan, (ISBN: 978-93-5070-1010)
- Cappuccino J. G. (2016) Microbiology; A laboratory manual, 11th Edition. Pearson Education (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)
- Tortora G.J. and Funke B.R. (2016), Microbiology an Introduction, 12th Edition Pearson (ISBN: 9781292099149)
- Pelczar, chan and Krieg (2001), Microbiology-concepts and Application, 5th Edition, McGraw-Hill, (ISBN: 9780074623206)
- Patel R. J. and Patel R. K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya.

MB-SEC-202

MAINTENANCE OF LABORATORY EQUIPMENT

1. Course Description:

Course code: MB-SEC-202
Course title: Maintenance of Laboratory Equipment
Course type: Skill based Course
Course credits: 02

2. Course overview:

The paper focuses on various maintenance aspects of microbiology laboratory equipment such as pH meter, weigh balance, biological safety cabinet, centrifuge, microscope, incubator.

Course Objectives:

- ✓ To study the operational principles of various instruments
- ✓ To learn about various components and controls of routine laboratory instruments
- ✓ To gain an insight of maintenance and validation of various laboratory instruments.

3. Course Content:

UNIT 1	Basic Instruments-I
1.1	pH meter 1.1.1 Operational principle 1.1.2 pH meter components 1.1.3 General calibration procedure 1.1.4 General maintenance
1.2	Balance 1.2.1 Operational principle 1.2.2 Components of balance 1.2.3 General calibration procedure 1.2.4 General maintenance
1.3	Centrifuge 1.3.1 Operational principle 1.3.2 Components of centrifuge 1.3.3 Routine maintenance 1.3.4 Appropriate management and storage

UNIT 2	Basic Instruments-II
2.1	Microscope 2.1.1 Operational principle 2.1.2 Potential problems with microscope 2.1.3 General maintenance of microscope 2.1.4 Cleaning of microscope and care
2.2	Biological safety cabinet 2.2.1 Operational principle 2.2.2 Use of biological safety cabinet 2.2.3 Decontamination of the cabinet 2.2.4 Routine and Specialized maintenance
2.3	Incubator 2.3.1 Operational principle 2.3.2 Incubator controls 2.3.3 Routine maintenance and use of the incubator

4. Student's Learning Outcomes:

- ✓ Students will learn about operational principles, purpose and components of instruments routinely used for buffer and microbial media preparation.
- ✓ Students will gain knowledge about operational principles, various components and general maintenance of the instrument used routinely for centrifugation and microscopic examination.
- ✓ Students will understand the process of operating and maintenance of biological safety cabinet and incubator routinely used in microbiology laboratory.

Recommended Learning Resources:

- ➢ Maintenance Manual for Laboratory Equipment, 2nd ed. (2008) World Health Organization World Health Organization & Pan American Health Organization. https://apps.who.int/iris/handle/10665/43835
- ➢ Laboratory Instruments Operations and Maintenance, Sushant Punekar (2012) Biotech Books. ISBN- 9788176222457.
- ➢ Principles of Laboratory Instruments (1993) Larry E. Schoeff, Robert Henry Williams, Mosby-Year Book. ISBN- 9780801674891.

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વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન Microbiology વિષયનાં અભ્યાસક્રમ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૪–૨૫થી અમલમાં આવનાર S.Y. B.Sc. Microbiology Sem.- 3 & 4 Major, Minor, MDC અને SEC નો અભ્યાસક્રમ માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૪/૦૫/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંકઃ૦૨ અન્વયે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાના અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલ તા.૧૫/૦૬/૨૦૨૪ની સભાનાં ઠરાવ ક્રમાંકઃ૨૨ થી સ્વીકારી મંજૂર કરેલ છે. જેની આથી જાણ કરવામાં આવે છે.

માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૪/૦૫/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંકઃ૦૨

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૪–૨૫ થી અમલમાં આવનાર S.Y.B.Sc. Microbiology Sem.- 3 & 4 Major, Minor, MDC અને SEC નો અભ્યાસક્રમ સર્વાનુમતે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૧૫/૦૬/૨ ૦૨૪ની ઠરાવ ક્રમાંકઃ ૨૨

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૪–૨૫થી અમલમાં આવનાર S.Y.B.Sc. Microbiology Sem.- 3 & 4 Major, Minor, MDC અને SECનો અભ્યાસક્રમ માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૪/૦૫/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંકઃ૦૨ અન્વયે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાના અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

ક્રમાંક : એસ./Microbiology/ સિલેબસ/પરિપત્ર/૧૨૭૯૬/૨૦૨૪
તા.૧૯–૦૬–૨૦૨૪

કુલસચિવ

પ્રતિ,

૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન Microbiology વિષયનો અભ્યાસક્રમ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓ. તથા ડિપાર્ટમેન્ટનાં વડાશ્રી.....આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.

૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.

૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

એકેડેમિક કાઉન્સિલ તા. 15-06-2024
ખાખત....22.....બિડાણ/પરિશિષ્ટ....08.....

Veer Narmad South Gujarat University

Surat

B. Sc. (Microbiology) Semester III Syllabus

NEP

(Effective from June 2024)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. MICROBIOLOGY
Teaching & Evaluation Scheme

S. Y. B. Sc. Semester – III
MAJOR (MJ)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams
MB-MJ-301	Microbial nutrition and growth	02	02	25	25	50	01
MBP-MJ-301	Microbial nutrition and growth practicals	02	04	25	25	50	04
MB-MJ-302	Control of microorganisms	02	02	25	25	50	01
MBP-MJ-302	Control of microorganisms practicals	02	04	25	25	50	04
MB-MJ-303	Virology	04	04	50	50	100	02

MULTIDISCIPLINARY COURSE (MDC)

Course code	Course title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams
MB-MDC-301	Marine Microbiology	04	04	50	50	100	02

SKILL ENHANCEMENT COURSE (SEC)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams
MB-SEC-301	Microbiological Media	02	02	25	25	50	01

MB-MJ-301

Microbial Nutrition and Growth

1. Course Description:

Course Code: MB-MJ-301
Course Title: Microbial Nutrition and Growth
Course Type: Major
Course Credits: 02

2. Course Overview:

The main objective of this paper is to understand diversified nutritional requirements of microorganisms and their cultivation using various media. It also focuses on bacterial and archaeal reproduction, cell cycle, growth curve and effect of various environmental factors on growth of microorganisms.

Course Objectives:

- To study various nutritional requirements of bacteria.
- To describe methods for selective nutrient uptake by bacteria from environment.
- To introduce about bacterial growth curve that shows the preparation, division, growth and death of the bacterial cells.
- To learn composition of media that provide essential nutrients and minerals to support the growth of microorganisms in the laboratory.
- To study microbial growth in natural environment and the effect of environmental conditions on microbial growth.

3. Course Content:

UNIT 1	Nutrition and Cultivation
1.1	Common nutritional requirements
1.2	Requirements of carbon, hydrogen, oxygen and electrons
1.3	Nutritional types of microorganisms
1.4	Requirements of Nitrogen, Phosphorus, Sulphur and growth factors
1.5	Cultivation of microbes: Media and laboratory conditions
1.6	Environmental Factors affecting microbial growth
	1.6.1 Solutes and water activity
	1.6.2 pH
	1.6.3 Temperature
	1.6.4 Oxygen concentration
	1.6.5 Pressure
	1.6.6 Radiation

UNIT 2	Bacterial Growth and Measurement
2.1	Bacterial and Archaeal reproduction by binary fission
2.2	Bacterial cell cycle
2.3	Bacterial growth curve
2.4	Maintenance and preservation of microbial cultures
2.5	Microbial population size measurement
2.6	Chemostat and turbidostat for continuous culture

MBP-MJ-301

Microbial Nutrition and Growth Practicals (02 credits)

1. Techniques for isolation of bacteria: a) Streak plate method b) Pour plate method c) Spread plate method
2. Study of cultural and growth characteristics of bacteria
3. Cultivation of anaerobic microorganisms
4. Turbidometric measurement of bacterial growth
5. Study on the influence of oxygen on growth of bacteria
6. Study on the influence of temperature on microbial growth
7. Study on the influence of pH microbial growth
8. Study on the influence of osmotic pressure on microbial growth

4. Student Learning Outcomes:

- After studying this course student will learn about various sources of nutrients and energy required for the microbial growth and development.
- They will learn about growth curve and the mathematical calculation for the time taken for the bacterial population to double in number.
- They will be able to determine the microbial response to variable growth conditions, varied physical factors in the environment affecting microbial growth and define the optimal growth parameters for a given bacterium.
- They will know how to obtain pure cultures, to grow and count microbial cells, and to cultivate and isolate microorganisms.

Recommended Learning Resources:

- Willey J.M., Sherwood L.M. and Woolverton C.J., (2017) Prescott's Microbiology, 10th Edition, McGraw - Hill Education, (ISBN: 978-981-3151-26-0)
- Willey J.M., Sherwood L.M. and Woolverton C.J., (2008) Prescott, Harley and Klein's Microbiology, 7th Edition, McGraw - Hill Education, (ISBN: 978-007-126727-4)
- Pelczar, Chan and Krieg, (2001), Microbiology-Concepts and Application, 5th Edition, McGraw-Hill, (ISBN: 9780074623206)
- Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 1, 9th ed., Aditya.
- Patel, R. J., & Patel, R. K., (2011). Experimental Microbiology, Vol. 2, 9th ed., Aditya.

- Cappuccino, J.G., (2016). *Microbiology: A Laboratory Manual,* 11th ed., Pearson Education (Singapore) Pvt. Ltd.
- Aneja, K.R., (2003). *Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology,* 4th edition, New Age International Publishers.

MB-MJ-302

Control of Microorganisms

1. Course Description:

Course Code: MB-MJ-302
Course Title: Control of Microorganisms
Course Type: Major
Course Credits: 02

2. Course Overview:

The paper includes the study of control and destruction of microorganisms. It includes the physical and chemical methods to control pathogen and prevent their transmission and to reduce or eliminate microbes responsible for the contamination of food water and other substances.

Course objectives:

- The main objective is to provide knowledge regarding the control and destruction of microorganisms.
- To understand criteria for selection of antimicrobial agents.
- To study in detail the principles of microbial control.
- To comprehend the role of various physical and chemical agents in the control of microorganisms.
- To acquire the ability to select the control agent for removal of microbes in the environment.

3. Course Content:

UNIT 1	**Microbial control: Fundamentals and physical methods for microbial control**
1.1	Terminology of microbial control
1.2	Microbial death rates
1.3	Mode of Action of Antimicrobial agents
1.4	The selection of microbial control methods
1.5	Mechanical & Physical methods for control
	1.5.1 Heat
	1.5.2 Refrigeration & Freezing

	1.5.3 Dessication & Lyophilization 1.5.4 Filtration 1.5.5 Osmotic pressure 1.5.6 Radiation

UNIT 2	**Chemical methods for microbial control**
2.1	Choosing a microbicidal chemical
2.2	Factors affecting germicidal activity of chemicals
2.3	Halogens
2.4	Phenols & its derivatives
2.5	Alcohols, hydrogen peroxide and related germicides
2.6	Chemicals with surface action: Detergents
2.7	Heavy metals
2.8	Aldehydes
2.9	Gaseous sterilants and disinfectants

MBP-MJ-302

Control of Microorganisms Practicals (02 credits)

1. Study the effect of antiseptics and disinfectants on bacteria
2. Study the effect of action of U.V. rays on bacteria
3. Study the effect of heavy metals on bacteria
4. Evaluation of alcohol and betadine effectiveness as a skin antiseptic
5. Determination of phenol coefficient
6. Determination of TDP
7. Determination of TDT

4. Student learning outcome:

- Students will understand the mode of action of various antimicrobial agents, factors affecting action of antimicrobial agents.
- Students shall be able to select the suitable microbial control agents and method.
- Students will learn about physical and mechanical methods employed for microbial control and their mode of action.
- Students will be able to understand how chemical agents and their antimicrobial activity works on microorganism. One will study the criteria for selection of chemical agent and various factors that interfere with mode of action of chemical agents.
- Students will understand about the mechanism of chemicals and their action on microbes, which will help to eliminate organisms causing disease or acting as contaminant in various industries like food, pharmaceutical etc.

Recommended Learning Resources:

- Bauman R. W., (2003), *Microbiology, Pearson/ Benjamin –Cummings*, 5th Edition, (ISBN: 0-8-537590-2).
- Cowan M. K. and Talaro K. P., (2014), *Microbiology-A systems Approach*, 4th edition Mc Graw Hill Higher Education, (ISBN: 978-0073402437).
- Denise Anderson, Sarah Salm, Deborah Allen, () *Nester's Microbiology- A Human Perspective*, 8th edition, Mc Graw Hill Higher Education, (ISBN: 0-07-121493-3).
- Pelczar, M. J., & Chan, E. C. S. (1998). Microbiology, 5th Ed., Tata-McGraw-Hill.
- Wiley, J., & Sherwood, L. (2015). Prescott, Harley, and Klein's Microbiology, 10th Ed., McGraw-Hill Higher Education, (ISBN: 9780073402406).
- Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 1, 9th ed., Aditya.
- Patel, R. J., & Patel, R. K., (2011). Experimental Microbiology, Vol. 2, 9th ed., Aditya.
- Cappuccino, J.G., (2016). *Microbiology: A Laboratory Manual,* 11th ed., Pearson Education (Singapore) Pvt. Ltd.
- Aneja, K.R., (2003). *Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology,* 4th edition., New Age International Publishers

MB-MJ-303

Virology

1. **Course Description:**

Course Code: MB-MJ-303
Course Title: Virology
Course Type: Major
Course Credits: 04

2. **Course Overview:**

The aim of the paper is to realize the increasing importance of virology. Students shall learn the origin, basic structure of virus and its classification. It teaches the cultivation, enumeration, and reproduction of virus. The paper also includes viral role in disease and cancer.

Course objectives:

- To learn basics of structural features, classification and cultivation of viruses.
- To know about medically important virus families.
- To study concept of replication strategies of viruses.
- To gain insight of the emerging viruses and its host specificity
- To gain knowledge about viral hosts like bacteria, plant, fungi, and protozoa.

3. **Course Content:**

UNIT 1	Introduction to Viruses
1.1	History of virology
1.2	General characteristics of viruses
1.3	Origin of viruses
1.4	Components of viruses
1.5	Host range and specificity of viruses

UNIT 2	Viral taxonomy and cultivation
2.1	Classification of viruses
2.2	Emerging viruses
2.3	SARS-CoV-2
2.4	Cultivation of viruses
2.5	Enumeration of viruses

UNIT 3	Replication of viruses
3.1	Bacteriophage replication
3.2	Replication of T-even Phage
3.3	Lysogeny
3.4	Replication of Animal Viruses
3.5	Latent Viral Infection

UNIT 4	Viruses and Sub Viral Particles
4.1	Viruses and Teratogenesis
4.2	Virus Like Agents: Viroids, Satellites and Prions
4.3	Viruses and Cancer
4.4	Plant Viruses
4.5	Viruses of Fungi and Protists
4.6	Insect Viruses

4. Students Learning Outcome:

- Students shall get insights about viruses its origin, its structure and symmetry.
- Students shall learn about classification and cultivation techniques of viruses.
- Students shall understand virus replication and shall learn the differences between lytic and lysogenic cycles.
- Students shall gain understanding about various virus like particles, viral hosts and role of virus in cancer.
- Students shall become aware of the emerging strains of viruses and their implications on human health.

Recommended Learning Resources:

- Black, J. G. Microbiology: Principles and Explorations. Hoboken, NJ: Wiley.
- Willey J. M, Sherwood L M. & Woolverton C. J., (2017), Prescott's Microbiology, 7th and 10th ed., Mc Graw – Hill science.
- Pelczar, M. J., & Chan, E. C. S. (1998). Microbiology, 5th Ed., Tata-McGraw-Hill.
- Denise Anderson, Sarah Salm, Deborah Allen, () *Nester's Microbiology- A Human Perspective*, 8th edition, Mc Graw Hill Higher Education, (ISBN: 0-07-121493-3).

MULTIDISCIPLINARY COURSE (MDC)
MB-MDC-301

Marine Microbiology

1. Course Description:

Course Code: MB-MDC-301
Course Title: Marine Microbiology
Course Type: Multidisciplinary
Course Credits: 04

2. Course Overview:

This course study includes information of marine environment and marine drug therapy. It also focuses on economic importance of marine biology and details study of microorganisms present in marine environment.

Course objectives:

- To introduce to the students the importance of different marine microorganism which sequester large amounts of carbon and produce much of world's oxygen by photo synthesis.
- The students should be aware that marine microbes are uniquely important to life. Since life most likely began in oceans. Marine microorganisms are the closet living descendants to the original forms of life.
- The students shall gain awareness of the drug likeness properties found in the marine environment.
- The economic value of products obtained from marine microorganisms are depicted as a bird's eye view in this course. As marine microorganisms serve as the foundation of all marine food webs, recycling major elements and producing useful products.

3. Course Content:

UNIT 1	Marine Microorganisms and Marine Environment
1.1	Introduction
1.2	Habitats of microorganisms
1.3	Distribution of Marine Microorganisms
1.4	Marine Microorganisms
	1.4.1 Phytoplanktons
	1.4.2 Zoo planktons
	1.4.3 Red algae
	1.4.4 Brown Algae
	1.4.5 Green Algae
	1.4.6 Multicellular Algae
1.5	Physico Chemical Properties of Marine Environment
1.6	Zonation of Ocean

UNIT 2	Economic Marine Biology
2.1	Fermented food products, surfactants, biopolymers, Enzymes, Calcium carbonate precipitation, Formation of manganese modules, Role of microorganisms in the settling of invertebrate larvae.
2.2	Spoilage of sea food
2.3	Fish diseases
	2.3.1 Bacterial pathogens associated with disease in marine animals
	2.3.2 Fungal pathogens associated with disease
2.4	Reservoir for human pathogens

UNIT 3	Marine Pollution
3.1	Causative factors and impacts
3.2	Metabolism of heavy metals
3.3	Biofouling
3.4	Corrosion
3.5	Biodegradation of pollutants

UNIT 4	Marine Drug Therapy
4.1	Antibiotics
4.2	Antiviral Compounds
4.3	Antitumor Compounds
4.4	Marine Toxins

4. Students learning Outcome

- ✓ The students shall be introduced to all marine microorganisms as well as their physico chemical properties.

- ✓ Students shall gain insight regarding the effects of marine pollution looking to the present scenario in marine environment.
- ✓ The students will be enriched with the different products obtained from marine environment and their marine drug like compounds obtained from the sea.

Recommended Learning Resources:

- Modi H. A. (1996), Elementary microbiology – Vol. II (An introduction to microbial world), Akta Prakashan.
- Erach Bharucha (2018), Textbook of Environmental Studies, Universities Press, (ISBN: 978-81- 7371-862-5)
- Shah Alkesh I. and Rajput Krishna R. (2018), Marine Science, New Popular Prakashan, Surat, (ISBN: 978-93-87554-01-6)
- N K Pillai (1990) Marine biology and Ecology, Himalaya Publishing House, Bombay.

SKILL ENHANCEMENT COURSE (SEC)

MB-SEC-301

Microbiological Media

1. Course description:

Course code: MB-SEC-301
Course title: Microbiological media
Course type: Skill enhancement course
Course credits: 02 Theory

2. Course overview:

The purpose of this paper is to enrich students with theoretical knowledge related to different types of media used in cultivation and identification of bacteria and fungi. It will give deep understanding regarding different media used in microbiological laboratories routinely.

Course Objectives:

- To go through different types of media used to cultivate bacteria and fungi in microbiology laboratories.
- To learn basics of various biochemical test used to identify bacteria.

Course Content:

UNIT 1	Different Types of Media
1.1	Cultivation of microbes: Culture media, common ingredients, solidifying agents, types of media
1.2	Bacteriological media:
1.2.1	General: Nutrient agar medium, Trypticase soy agar medium,
1.2.2	Selective and differential: MacConkey's agar medium, Mannitol salt agar medium, EMB agar medium, Endo's agar medium, Wilson and Blair's agar medium
1.2.3	Enrichment: Ashby's mannitol agar medium, Fluid thioglycolate medium, tetrathionate broth medium
1.3	Pigment enhancing/observation: King's agar medium, Milk agar medium
1.4	Mycological media: potato dextrose agar medium, Rose Bengal agar medium, Czapek Dox Thoms' agar medium, Sabouraud's agar medium

UNIT 2	Biochemical Test Media
2.1	Tests based on carbohydrate utilization: Carbohydrate fermentation test, Methyl red test, Voges-Proskauer's test Citrate utilization test
2.2	Tests based on utilization of nitrogenous compounds: Indole test, H_2S production test, Urea hydrolysis test, Nitrate reduction test, Deamination test, Decarboxylation test
2.3	Test based on the decomposition of large molecules: Starch, Casein, Gelatin and Lipid hydrolysis test
2.4	Miscellaneous test: Triple sugar iron agar test, Oxidase and Catalase test

4. Student Learning Outcomes:

- Students shall gain a comprehensive understanding of different types of media used in cultivation and selective isolation of bacteria and fungi.
- Students shall develop proficiency in the use of various media to identify the bacterial isolates based on biochemical test, which will enhance their skill in conventional bacteriological identification.

Recommended Learning Resources:

- Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 1, 9th Ed., Aditya publication
- Cappuccino, J. G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 6th Ed., Pearson Education (Singapore) Pvt. Ltd.



Veer Narmad South Gujarat University

Surat

B. Sc. (Microbiology) Semester IV Syllabus

NEP

(Effective from June, 2024)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. MICROBIOLOGY

Teaching & Evaluation Scheme

S. Y. B. Sc. Semester – IV

MAJOR (MJ)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams
MB-MJ-401	Microbial Taxonomy	02	02	25	25	50	01
MBP-MJ-401	Microbial Taxonomy Practicals	02	04	25	25	50	04
MB-MJ-402	Microbial ecosystems	02	02	25	25	50	01
MBP-MJ-402	Microbial ecosystems Practicals	02	04	25	25	50	04
MB-MJ-403	Enzymology	04	04	50	50	100	02

Minor Elective (ME)

Course Code	Course Title	Course Credit	Teaching Schedule Hrs./ week	External Marks	Internal Marks	Total Marks	Duration of external exams
MB-ME-401	Biomolecules	02	02	25	25	50	01
MBP-ME-401	Practicals	02	04	25	25	50	04

Skill Enhancement Course (SEC)

Course code	Course Title	Course credit	Teaching schedule Hrs./ week	External marks	Internal marks	Total marks	Duration of external exams
MB-SEC-401	Algal growth and its application	01	01	13	12	25	0.5
MB-SECP-401	Practicals	01	02	12	13	25	02

MB-MJ-401
Microbial Taxonomy

1. Course description:

Course code: MB-MJ-401
Course title: Microbial Taxonomy
Course type: Major
Course credits: 02

2. Course Overview:

Microbial taxonomy includes the study of classification of microorganisms based on the characteristics such as morphology, biochemistry, and genetics. The course includes the study of the principle of taxonomy and categorizing these organisms into taxa, domain, family, order, class, phylum and genus. The classification helps in the understanding of the evolutionary relatedness and the role of organisms in ecological cycles.

Course Objectives:

- To understand the principles and methods of microbial classification and nomenclature.
- To learn the characteristics of microorganisms and its role in its classification.
- To gain an understanding of microbial diversity and its evolutionary relatedness.
- To be updated with the trends of microbial taxonomy and developments.

3. Course Content:

UNIT 1	Classification of Microorganism: Methods & Identification
1.1	The Study of Phylogenetic Relationships
1.2	The Three Domains
1.3	The Taxonomic Hierarchy
1.4	Classification of Prokaryotes
1.5	Scientific Nomenclature
1.6	Methods of classification and identification
	1.6.1 Morphological and Biochemical Characteristics
	1.6.2 Serology
	1.6.3 Phage typing
	1.6.4 Nucleic acid hybridization
	1.6.5 Ribotyping and Ribosomal RNA Sequencing

UNIT 2	The World of Archea & Bacteria
2.1	Domain archea
2.2	General features of archea
2.3	Classification of archea
2.4	Aerobic Gram negative rods and cocci
2.5	Facultative anaerobic Gram negative rod

2.6	Gram positive cocci
2.7	Endospore forming Gram positive cocci

MBP-MJ-401

Microbial Taxonomy Practicals (02 credits)

1. Study of biochemical reactions
2. Study of decomposition of large molecules: hydrolysis of starch, gelatin, casein, lipid
3. Study of intracellular enzymatic activity: Deaminase, Catalase, Dehydogenase, Oxidase
4. Study of pure culture (morphological, cultural and biochemical characteristics) of *Escherichia coli* and *Klebseilla mobillis* (formerly *Enterobacter aerogenes*)
5. Study of pure culture (morphological, cultural and biochemical characteristics) of *Proteus vulgaris*, *Serratia marcescens* and *Pseudomonas aeruginosa*.
6. Study of pure culture (morphological, cultural and biochemical characteristics) of *Bacillus megaterium*, *Bacillus subtilis*, *Bacilllus cereus*.
7. Study of pure culture (morphological, cultural and biochemical characteristics) of *Staphylococcus aureus*, *Staphylococcus epidermidis*.

4. Student Learning Outcomes:

- Students shall gain a comprehensive understanding of the principles of microbial Classification.
- Students shall develop proficiency in the methods used for the identification and Classification of microorganisms.
- Students shall learn about the domain archaea and its classification
- Students shall gain knowledge of the gram negative and gram-positive Bacteria.

Recommended Learning Resources:

- Tortora, G. J., Funke B. R., Case, C. L., (2016). Microbiology; An introduction, 12th Ed Pearson.
- Wiley, J., & Sherwood, L. (2013). *Prescott, Harley, and Klein's Microbiology*, 10th Ed., McGraw-Hill Science/Engineering/Math, ISBN: 9780073402406.
- Mc Arthur, J. Vaun (2006). *Microbial Ecology: An Evolutionary Approach*, Academic Press. ISBN 0123694914.
- Mitchell R., Gu Pelzar Ji Dang, Chan and Krieg, (1993), *Microbiology-Concepts and Application*, International Edition, McGraw-Hill.
- Cappuccino, J. G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 10th Ed., Pearson Benjamin Cummings.
- Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 1, 9th Ed., Aditya.
- Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 2, 9th Ed., Aditya.
- Cappuccino, J. G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 6th Ed., Pearson Education (Singapore) Pvt. Ltd.
- Aneja, K.R., (2003). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers.

MB-MJ-402

Microbial Ecosystems

1. Course description:

Course code: MB-MJ-402
Course title: Microbial ecosystems
Course type: Major
Course credits: 02

2. Course Overview:

Microbial ecology is concerned with microbial processes that occur in ecosystem. It explains how nutrient availability and environmental factors influence microbial growth in various ecosystems. The objective of the paper is to give an understanding of the varied microbial interactions and its impact in sustenance of ecosystem.

Course Objectives:

- To comprehend the role of microbial evolution in ecological development.
- To learn the methods for the study of microbial ecology.
- To gain an understanding of biogeochemical cycling and effect of global climate change.
- To develop insight about microbial interactions.
- To understand the role of microorganisms in ecosystem.

3. Course Content:

UNIT 1	Biogeochemical Cycling & Microbial Interactions
2.1	Carbon cycle
2.2	Nitrogen cycle
2.3	Phosphorus cycle
2.4	Sulfur cycle
2.5	Interaction between elemental cycle
2.6	Microbial interactions
	2.6.1 Mutualism: The rumen ecosystem, Microbe-insect mutualism
	2.6.2 Co-operation & Commensalism
	2.6.3 Predation & Parasitism
	2.6.4 Amensalism
	2.6.5 Competition

UNIT 2	Microorganisms and Ecosystems
2.1	Microorganisms in terrestrial environments
2.2	Soils as an important microbial habitat
2.3	Microbe-plant interaction
	2.3.1 Phyllosphere, rhizosphere, rhizoplane microorganisms

	2.3.2 Mycorrhizae
2.4	Nitrogen fixation by Rhizobia
2.5	Microorganisms in aquatic environments
	2.5.1 Distribution of microorganism in aquatic environment
2.6	Techniques for study of aquatic environments
2.7	Role and importance of aquatic microbial ecosystems

MBP-MJ-402

Microbial Ecosystems Practicals (02 credits)

1. Quantitative analysis of soil microflora by standard plate count
2. Isolation of non-symbiotic nitrogen fixing aerobic bacteria – Azotobacter spp.
3. Isolation of symbiotic Rhizobium spp. from root nodules of legume plants.
4. Isolation of halophilic microorganisms from seawater sample.
5. Enrichment and cultivation of Actinomycetes from soil sample.
6. Cultivation of yeast.
7. Cultivation of fungi from soil samples.

4. **Student Learning Outcomes:**

- Students shall get an understanding of biogeochemical cycling.
- Students shall gain knowledge of microbial interactions and its significance.
- Students shall gain knowledge of distribution and role of microorganisms in different habitats and ecosystems.
- Students shall gain an insight of microbial role in ecosystem.

Recommended Learning Resources:

- Ronald M. Atlas & Richard Bartha (2005) *Microbial Ecology: Fundamentals and Applications*, 4th Ed., Pearson Education. ISBN: 81-297-0771-3.
- Wiley, J., & Sherwood, L. (2013). *Prescott, Harley, and Klein's Microbiology*, 10th Ed., McGraw-Hill Science/Engineering/Math, ISBN: 9780073402406.
- Mc Arthur, J. Vaun (2006). *Microbial Ecology: An Evolutionary Approach*, Academic Press. ISBN 0123694914.
- Mitchell R., Gu Pelzar Ji Dang, Chan and Krieg, (1993), *Microbiology-Concepts and Application*, International Edition, McGraw-Hill.
- Tortora G.j., and Funke B.R. (2016), *Microbiology an Introduction*, 12 Ed., Benjamin Cummings.
- Cappuccino, J. G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 10th Ed., Pearson Benjamin Cummings.
- Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 1, 9th Ed., Aditya.
- Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 2, 9th Ed., Aditya.
- Cappuccino, J. G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 6th Ed., Pearson Education (Singapore) Pvt. Ltd.
- Aneja, K.R., (2003). Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers.

MB-MJ-403

ENZYMOLOGY

1. **Course Description**

Course Code: MB-MJ-403
Course Title: Enzymology
Course Type: Major
Course Credits: 04

2. **Course Overview:**

Enzymology provides a foundational understanding of enzymes, the biological catalysts essential for life processes. This course covers enzyme structure, function, and classification, exploring their significance in various biochemical pathways. It also includes the understanding of enzyme mechanisms and regulation, gaining insight into their role in health and disease.

Course Objectives:

- To classify enzymes based on their mechanisms and catalytic properties.
- To dissect enzyme-substrate interactions and types of enzymes.
- To grasp the fundamental principles and applications of enzymology in diverse fields.
- To develop insight about enzyme specificity and regulation.
- To understand the biological role of enzymes.

2. **Course Content:**

UNIT1	Introduction to enzymology, Nomenclature and Classification
1.1	History
1.2	Chemical and physical properties of enzymes
1.3	Nomenclature & classification of enzymes
1.4	Factors affecting enzyme activity

UNIT2	Enzyme Types & Mechanism of Enzyme Action
2.1	Types of enzymes
	2.1.1 Coenzymes
	2.1.2 Isoenzymes
	2.1.3 Metalloenzymes
	2.1.4 Abzymes
	2.1.5 Ribozymes
2.2	The Active Site
	2.2.1 Fischer's Lock & key hypothesis
	2.2.2 Koshland induced fit hypothesis

UNIT 3	Enzyme Specificity & Regulation
3.1	Chemical nature & characteristics of enzymes
3.2	Enzyme Specificity
	3.2.1 Group Specificity
	3.2.2 Absolute Specificity
	3.2.3 Stereo chemical specificity
3.3	Enzyme regulation & Inhibition

Unit 4	Purification & Importance of Enzymes
4.1	Purification of enzymes
4.2	Biological role of enzymes
4.3	Application of enzymes

4. Student Learning Outcomes:

- Students shall get an understanding of enzyme nomenclature and classification.
- Students shall gain knowledge of enzyme mechanisms.
- Students demonstrate a comprehensive understanding of the structure and function of enzymes, including their role as biological catalysts.
- Students shall gain an insight of biological role and purification of enzymes.

Recommended Learning Resources:

- Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. (2020). Prescott's Principles of Microbiology, 11th Edition, McGraw Hill (978-1-260-57002-1)
- Jain, J., Jain, N., & Jain, S. (2016). Fundamentals of Biochemistry. https://openlibrary.org/books/OL13131701M/Fundamentals_of_Biochemistry.
- Delvin, S. (2000). *Enzymes*. SARUP & SONS, New Delhi. ISBN: 81-7625-123-2.
- Devika, R., (2011), Enzymes. Vijay Nicole Imprints Private Limited. ISBN: 978-81-8209-292-1.

MINOR (ME)-DOMAIN SPECIFIC / ELECTIVE

MB-ME-401

Biomolecules

1. Course Description:

Course Code: MB-ME-401
Course Title: Biomolecules
Course Type: Minor
Course Credits: 02+02

2. Course Overview:

This paper gives an understanding about biomolecules found in all living organisms including microbes. Students shall learn important biomolecules such as proteins, carbohydrates, lipids and nucleic acids. They shall become aware of the structure, types, classification and functions of biomolecules.

Course Objectives:

- To understand the structure and function of the major classes of biomolecules including proteins, nucleic acids, carbohydrates, and lipids.
- To explore the chemical properties and interactions that govern biomolecular structure and function.
- To foster an understanding for the complexity and diversity of biomolecules and their central role in the functioning of living organisms.

3. Course Content:

Unit 1	Amino acids & Proteins
1.1	General Structure of Amino acids
1.2	Optical Isomer of Amino acids
1.3	Classification & properties of Amino acids
1.4	Function of Proteins
1.5	Elemental Composition of Protein
1.6	Structure and properties of Proteins
1.7	Classification of Proteins

Unit 2	Carbohydrates
2.1	Introduction of Carbohydrates
2.2	Function of Carbohydrates
2.3	Classification of Carbohydrates

2.4	Monosaccharide
2.5	Disaccharides
2.6	Polysaccharides

Unit 3	Lipids
3.1	Introduction of Lipids
3.2	Classification of Lipids
3.3	Function of Lipids
3.4	Fatty acids
3.5	Triacylglycerols
3.6	Test to Check Purity of Fats & Oils
3.7	Phospholipids
3.8	Glycolipids & Lipoprotein
3.9	Steroids (Cholesterols & Ergosterols)
3.10	Amphipathic Lipids

Unit 4	Nucleic Acid
4.1	Introduction of Nucleic Acids
4.2	Function of Nucleic Acids
4.3	Composition of Nucleic Acids
4.4	Structure of DNA
4.5	Organization of DNA
4.6	Structure and types of RNA

MBP-ME-401

Biomolecules Practical (02 credits)

1. Qualitative analysis of carbohydrates (Glucose, Maltose, Xylose, Lactose, Fructose)
2. Qualitative analysis of proteins (Casein, Albumin, Globulin and Peptones)
3. Estimation of DNA – Diphenylamine Reaction.
4. Determination of an Iodine number of fat.
5. Determination of the Saponification number of fat (Demonstration).

4. Student Learning Outcomes:

- ✓ Student shall understand structure and classification of amino acids. Student shall gain knowledge about structure and functions of proteins.
- ✓ Enable the students to understand the classification of carbohydrates and its functions.

- ✓ Student shall obtain knowledge about lipids, their classification and its importance. Unit
- ✓ Acquire knowledge of the structure of nucleic acids and its denaturation. Student shall learn the structure and functions of RNA and its types.

Recommended Learning Resources:

- Satyanarayana, U. (2013). *Biochemistry*. Elsevier Health Sciences. ISBN: 978-813123601-7
- Jain, J. L. (2004). *Fundamentals of biochemistry*. S. Chand Publishing.ISBN-10: 8121924537; ISBN-13: 978-8121924535
- Campbell, M. K., Farrell, S. O., & McDougal, O. M. (2016). *Biochemistry*. Cengage Learning.ISBN-13: 978-0-8400-6858-3; ISBN-10: 0-8400-6858-1
- Patel, R. J., & Patel, R. K., (2015). Experimental Microbiology, Vol. 2, 9th ed., Aditya.
- Ranjana Chawla, (2003), Practical Clinical Biochemistry, 3d Edition, Jaypee
- David T Plummer (2003), An introduction to Practical Biochemistry, 3d Edition, Tata McGraw Hill.

MB-SEC-401

Algal growth and its application

1. Course Description:

Course Code: MB-SEC-401
Course Title: Algal growth and its application
Course Type: Skill Based
Course Credits: 01+01

2. Course Overview:

This paper offers an in-depth exploration of algal biology, cultivation, and utilization in various fields. This course delves into the diverse range of algae species, their growth requirements, and cultivation techniques, including photo bioreactors and open ponds. Students will investigate the physiological and environmental factors influencing algal growth and productivity.

Course Objectives:

- To learn collection and identification of algal culture
- To study of basic and applied science behind the production of mass culture
- To teach students about commercial applications and future potential of algae

3. Course Content:

Unit 1	**Introduction to algae**
1.1	Characteristics of Algae
1.2	Algal classification and distribution
1.3	Media for cultivation of algae
1.4	Techniques for cultivation of algae

Unit 2	**Application of algae**
2.1	Algae as food and fodder
2.2	Single cell protein (Spirulina): Its application as food supplement
2.3	Cyanobacteria as biofertilizers
2.4	Economic importance of algae: Agar-Agar, Alginate, Carrageenin and biofuels

MB-SECP-401

Practicals

1. Collection of algae from local water bodies and their microscopic examination
2. Microscopic study of different algal species using permanent slides or preserved specimens
3. Isolation and identification of economically important algae (Spirulina)
4. Estimation of protein form Spirulina
5. Isolation of cyanobacteria (blue green algae) from paddy fields

4. Student Learning Outcomes:

On the successful completion of the course, student will be able

- To isolate and identify different types of algae
- Acquire the knowledge of algal growth requirement and cultivation.
- Learn laboratory skill, lab organization & nutritional importance of different algae.
- Understand the economic importance of algae.

Recommended Learning Resources:

- Srivastava, H.N. 1999. Algae. Pradeep publications, Meerut.
- Sharma, O.P. 2004. A textbook of Algae. Tata McGraw- Hill publishing Company Limited, New Delhi.
- Bilgrami, K.S. and Saha, L.C. 2012. A textbook of Algae. CBS Publishers & Distributors Pvt. Ltd., New Delhi.
- Pandey, S.N., Misra, S.P., and Trivedi, P.S. 1997. A textbook of Botany, Vol. II, Vikas Publishing House Pvt. Ltd.
- Dubey, R. C. (2009). Multicolour Textbook of Biotechnology. S. *Chand and Co., New Delhi*, 71-80.
- Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2001). Textbook of microbiology. *MC Graw-Hill publications, 5th edn, New York, 1193*, 504-508.
- Aneja, K. R. (2018). Experiments in microbiology, plant pathology, tissue culture and microbial biotechnology.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

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B.Sc. (Microbiology) Semester V & VI
Syllabus as per NEP 2020
(3 Years Degree & 4 Years Honors/Honors with Research)

(Effective from June, 2025)

POs for All UG Science Programs

PO-01: Scientific Knowledge & Conceptual Understanding: Develop a strong foundation in scientific principles, theories and concepts across disciplines, fostering interdisciplinary learning, advance knowledge and problem-solving abilities.

PO-02: Analytical & Critical Thinking: Apply critical thinking and analytical reasoning to evaluate scientific data, hypotheses and real-world problems, leading to evidence-based conclusions.

PO-03: Research & Inquiry-based Learning: Develop investigative skills through experimentation, data analysis and scientific inquiry to contribute to research and innovation.

PO-04: Laboratory & Technical Skills: Gain hands-on experience with laboratory techniques, instrumentation and computational tools relevant to scientific research and industry applications.

PO-05: Digital & Computational Literacy: Utilize digital tools, computational techniques and emerging technologies such as AI, bioinformatics and statistical modelling to enhance scientific learning and problem-solving.

PO-06: Environmental & Societal Responsibility: Understand the role of science in addressing environmental, health and societal challenges, promoting sustainability and ethical responsibility.

PO-07: Effective Communication & Collaboration: Develop proficiency in scientific communication, both written and oral, for effective dissemination of knowledge while collaborating in multidisciplinary teams.

PO-08: Innovation & Entrepreneurship: Foster an entrepreneurial mind-set by applying scientific knowledge for innovation, technology development, and industry-oriented applications. Develop sustainable solutions to address real-world challenges in research and environmental management.

PO-09: Lifelong Learning & Professional Growth: Cultivate curiosity and adaptability for continuous learning, equipping students for higher education, research, and professional careers.

PO-10: Ethical Leadership & Value-based Education: Develop leadership qualities, ethical values, and a sense of responsibility in applying science for societal progress, aligning with Indian knowledge systems and global perspectives.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Microbiology

Teaching and Evaluation Scheme

Semester – V & VI

[Academic Year of Implementation 2025-26]

Semester – V (Major)

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/ Practical Marks	Credit
			Duration (Hours)	(CCE) Internal Marks	(SEE) External Marks		
MB – MJ - 501	Applied and Environmental Microbiology	2 hrs.	1 hrs.	25	25	50	02
MBP – MJ - 501	Applied and Environmental Microbiology Practicals	4 hrs.	6 hrs.	25	25	50	02
MB – MJ - 502	Vedic Microbiology	2 hrs.	1 hrs.	25	25	50	02
MBP – MJ - 502	Vedic Microbiology Practicals	4 hrs.	6 hrs.	25	25	50	02
MB – MJ - 503	Food & Dairy Microbiology	2 hrs.	1 hrs.	25	25	50	02
MBP – MJ - 503	Food & Dairy Microbiology Practicals	4 hrs.	6 hrs.	25	25	50	02
			Total	150	150	150 (T) + 150 (P)	12

Semester – V (Minor Elective)

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours)	(CCE) Internal Marks	(SEE) External Marks		
MB – ME - 501	Quality Control and Quality Assurance	2 hrs.	1 hrs.	25	25	50	02
MBP – ME - 501	Quality Control and Quality Assurance Practicals	4 hrs.	6 hrs.	25	25	50	02
MB – ME - 502	Analytical Instrumentation & Techniques	2 hrs.	1 hrs.	25	25	50	02
MBP – ME - 502	Analytical Instrumentation & Techniques Practicals	4 hrs.	6 hrs.	25	25	50	02
			Total	100	100	100 (T) + 100 (P)	08

Semester – V (SEC)

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/ Practical Marks	Credit
			Duration (Hours)	(CCE) Internal Marks	(SEE) External Marks		
MB – SEC - 501	Hematology	1 hrs.	00.30 hrs.	12	13	25	01
MBP – SEC - 501	Hematology Practicals	2 hrs.	3 hrs.	12	13	25	01
			Total	24	26	50	02

Semester – VI (Major)

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/ Practical Marks	Credit
			Duration (Hours)	(CCE) Internal Marks	(SEE) External Marks		
MB – MJ - 601	Medical Microbiology	2 hrs.	1 hrs.	25	25	50	02
MBP – MJ - 601	Medical Microbiology Practicals	4 hrs.	6 hrs.	25	25	50	02
MB – MJ - 602	Immunology	2 hrs.	1 hrs.	25	25	50	02
MBP – MJ - 602	Immunology Practicals	4 hrs.	6 hrs.	25	25	50	02
MB – MJ - 603	Industrial Microbiology	2 hrs.	1 hrs.	25	25	50	02
MBP – MJ - 603	Industrial Microbiology Practicals	4 hrs.	6 hrs.	25	25	50	02
			Total	150	150	150 (T) + 150 (P)	12

Semester – VI (Minor Elective)

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/ Practical Marks	Credit
			Duration (Hours)	(CCE) Internal Marks	(SEE) External Marks		
MB – ME - 601	Genomics & Proteomics	2 hrs.	1 hrs.	25	25	50	02
MBP – ME - 601	Genomics & Proteomics Practicals	4 hrs.	6 hrs.	25	25	50	02
			Total	50	50	50 (T) + 50 (P)	04

Teaching Methodology and Evaluation

- Teaching methodology includes Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment Laboratory work, Journal preparation. The medium of instruction will be in **ENGLISH** only for students opting Microbiology as a **MAJOR, MINOR** & **SEC** subjects.

Internal Evaluation Theory (CCE)

Sr. No.	Exam Pattern	50 Marks	37 Marks	25 Marks	12 Marks
1.	Class Assignment	07	06	03	02
2.	Home Assignment	08	06	03	02
3.	Attendance	10	05	04	03
4.	Class Test	25	20	15	05

Internal Evaluation Practical (CCE)

Sr. No.	Exam Pattern	25 Marks	12 Marks
1.	Attendance	05	02
2.	Viva voce/Quiz	10	05
3.	Lab Work Assessment	10	05

Program-Specific Outcomes for B.Sc. Microbiology

Program-Specific Outcomes (PSOs) define what students should achieve after completing a Microbiology program. The program Outcome includes

1. Core Knowledge in Microbiology:

- Understand the fundamental concepts of microbiology, including microbial diversity, structure, function and classification.
- Explain the role of microorganism in human health, industry, agriculture and the environment.

2. Practical and Laboratory Skills:

- Perform basic microbiological techniques such as microbial staining, culturing, isolation and enumeration.
- Utilize aseptic techniques and biosafety measures in handling microorganisms.
- Operate laboratory instruments effectively.

3. Applied and Industrial Microbiology:

- Understand the role of microorganisms and their application in food, pharmaceuticals, biotechnology and environmental science.
- Demonstrate knowledge of fermentation processes, microbial biotechnology and their industrial significance.
- Demonstrate the ability to work effectively in a team and encourage entrepreneurial thinking, fostering innovative solutions and collaborative problem-solving skills.

4. Disease and Health-Related Microbiology:

- Identify pathogenic microorganisms and understand their role in infectious diseases.
- Explain antimicrobial resistance, immunity and the role of microbes in public health.

5. Critical Thinking and Problem-Solving:

- Analyze scientific data, interpret experimental results and troubleshoot laboratory issues.
- Apply microbiological knowledge to solve real-world problems in healthcare, industry, environmental management and sustainability.

6. Ethical and Professional Responsibilities:

- Follow ethical guidelines in microbiological research and laboratory work.
- Adhere to safety protocols and regulatory standards in microbiology-related fields.

A four year under graduate program with honours in Microbiology will help the students to gain theoretical knowledge and practical skills, preparing them for careers in health care, pharmaceuticals industries, food and dairy, clinical applications and research. The program helps the students to pursuit higher education and provides a strong foundations to make a career in allied fields of genetics, bioinformatics, biotechnology, genetic engineering, medical microbiology, environment and agriculture.

T. Y. B. Sc. Semester – V
MAJOR

EFFECTIVE FROM: 2025-26

MB-MJ-501

COURSE CODE	**MB-MJ-501**
COURSE TITLE	**APPLIED AND ENVIRONMENTAL MICROBIOLOGY**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- This course provides general introductions to the diverse roles of microorganisms in natural and artificial environments.
- It will cover topics including; water and air microbiology; role of microorganisms in air and water pollution, water purification and processes involved in wastewater treatment and its disposal.

COURSE OUTCOME: CO1

- Students will be able to understand about presence of various microorganisms and their role in air and soil.
- Students will know about various sample collection methods which provide information about air and soil microbial flora as well as methods used for air sanitization.
- Students will be able to understand physical, chemical characteristics of soil and its analysis.

COURSE OUTCOME: CO2

- Students will be able to understand about presence of various microorganisms and their role in drinking water and waste water.
- Students will know about various sample collection methods which provide information about drinking water and wastewater microbial flora as well as understand the physical and chemical characteristics of wastewater.
- Students will be able to understand drinking water purification and wastewater treatment process.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

UNIT 1	AIR AND SOIL MICROBIOLOGY
1.1	**SECTION A: Aero microbiology**
1.1.1 **1.1.2** **1.1.3** **1.1.4**	Composition of air Microorganisms in air Enumeration of bacteria in air Air Sanitation
1.2	**SECTION B: Microbiology of Soil**
1.2.1 **1.2.2** **1.2.3** **1.2.4**	Physical characteristics of soil Types of Microorganisms in soil Quantitative examination of soil Qualitative studies of soil organisms

UNIT 2	MICROBIOLOGY OF DOMESTIC WATER AND WASTEWATER
2.1 **2.2** **2.3** **2.4**	Water purification Determining sanitary quality Wastewater Treatment Processes Measuring treated wastewater quality

REFERENCES:

- Willey, J. M., Sherwood, L., and Woolverton, C. J. (2017). Prescott's Microbiology, 10th Edition., New York: McGraw-Hill Education. (978-981-3151-26-0).
- Pelczar, Chan and Krieg, (2001), *Microbiology-Concepts and Application*, 5th Edition., McGraw-Hill. (ISBN:978-0-07-462320-6)
- Salle, A. J., (1993). Fundamental Principles of Bacteriology, 7th Edition., Tata-McGraw-Hill (ISBN:0-07-099562-1)
- Purohit, S. S., (2006). Microbiology: Fundamentals and Applications, 7th Edition., Agrobios (India).
- Metcaff & Eddy Inc, (2002), Wastewater engineering: Treatment and Reuse, 4th Edition, McGraw Hill higher education. (ISBN: 9780070495395)
- Schaechter, M. (2004), The desk encyclopaedia of microbiology, 2nd Edition., Elsevier Academic Press.
- Karnwal, A. & Said Al-Tawaha, A. R. M. (2022). Environmental Microbiology: Advanced Research and multidisciplinary Applications Bentham books.
- Perkins, D. (2023). Introduction to environmental microbiology. American Academic Publisher.

E-RESOURCES:

- Microorganisms in air their importance [https://youtu.be/xtAaSWnrPRA?si=PA8T8K6Rjsqg115f]
- Air sampling methods [https://youtu.be/uB-EG8wt6UQ?si=TSq0wJiXs4t7ExJr]
- Water quality parameters [https://youtu.be/aYccflECWVg?si=iT1-8CQLrcgbZkVJ]
- Wastewater treatment [https://www.britannica.com/technology/wastewater-treatment]
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

PRACTICALS
MBP-MJ-501

COURSE CODE	**MBP-MJ-501**
COURSE TITLE	**APPLIED AND ENVIRONMENTAL MICROBIOLOGY PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 30 hrs. = 60 hrs.
TEACHING PER WEEK	04 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE OUTCOME:

CO1: Students shall gain knowledge regarding the technique to study the technique to enumerate the microorganisms present in air.
CO2: Students shall develop the expertise regarding the techniques for analysing the quality of drinking water.
CO3: shall learn the technique for water analysis and develop the skills to analyse and assess the potability of drinking water.
CO4: Students shall learn to determine the types of microorganisms present in the soil sample.
CO5: Students shall develop skill to examine and enumerate the number of microbial flora present in the soil sample.
CO6: Students shall be aware of the treatment of drinking / wastewater by in person visit.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 To CO6						

1. Study of air microflora by settling plate technique.
2. Microbiological analysis of drinking water by MPN and PA test.
3. Detection of coliforms (Presumptive, Confirmed and Completed test).
4. Quantitative examination (SPC) of soil microflora.
5. Qualitative examination of soil microflora.
6. Visit to drinking / wastewater treatment plant.

REFERENCES:

1. Patel, R. J., & Patel, R. K., (2022). Experimental Microbiology, Vol. 1, 10th Edition, Aditya.
2. Aneja, K. R., (2003). Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers
3. Standard method for examination of water and wastewater published by APHA

MB-MJ-502

COURSE CODE	**MB-MJ-502**
COURSE TITLE	**VEDIC MICROBIOLOGY**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- This course provides fundamental knowledge of Vedic Microbiology which bridges ancient wisdom with modern microbiology for sustainable health.
- It will cover topics including; Basic principles of Vedic Microbiology, Science of pathogenic germs (KRIMIS), ancient prophylaxis towards diseases and Ayurveda.
- Explores traditional microbial techniques for food, medicine, and Ayurvedic microbiology.

COURSE OUTCOME: CO1

Upon completion of this course, students will be able to:

1. Understand microbial concepts within the Vedic and Ayurvedic framework.
2. Analyze ancient texts for microbial relevance in disease, medicine and fermentation.

COURSE OUTCOME: CO2

Upon completion of this course, students will be able to:

1. Explore microbial applications in Ayurveda, traditional health practices, and Vedic sustainability.
2. Integrate Vedic knowledge with modern microbiological practices.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

UNIT 1	**FUNDAMENTALS OF VEDIC MICROBIOLOGY AND THE SCIENCE OF KRMIS**
1.1	**SECTION A: Historical Perspectives and Basic Principles of Vedic Microbiology**
1.1.1	The origin of Vedas & Concept of Vedic period
1.1.2	Gurus of Vedic Microbiology
1.1.3	Major Characteristics of Microorganisms as per Vedas and other Sanskrit texts
1.1.4	Various names of the Krimis
1.1.5	Major groups of Krimis in Vedas & Shape and Color of Krimis
1.2	**SECTION B: Human Health and Pathogenic Germs (KRIMIS)**
1.2.1	Microbial diversity & Microbial Disease described during Vedic period
1.2.2	Ksudrarog in Humans
1.2.3	Pandemic/Epidemic diseases during Vedic Period
1.2.4	Disease defense by good health
1.2.5	Precautions for spread of Infectious Microorganisms

UNIT 2	**THE SCIENCE OF WELLNESS: PREVENTING INFECTIONS AND THE SCIENCE OF AYURVEDA**
2.1	**SECTION A: Prevention from Infections (Prophylaxis)**
2.1.1	Precautions for spread of Infectious Microorganisms
2.1.2	Elimination of Microorganisms by Sun rays & its Germicidal properties
2.1.3	Eradication of pathogens by medicinal plants
2.1.4	Eradication of Microbes by Vaca
2.1.5	Significance of Hawan/Yajna & Scientific Validation of Agnihotra
2.2	**SECTION B: Science of Ayurveda**
2.2.1	Introduction
2.2.2	Tridosas
2.2.3	Body Constitution
2.2.4	Mental Components
2.2.5	Health Care

REFERENCES:

- R. C. Dubey. (2021). Vedic Microbiology, 1st Ed., Motilal Banarsidass International. (978-93-90696-33-8).
- Chakradhar F. and Shriji Kurup (2007), 1st Ed., Dilip and Dipika Doctor International Vedic Vision, New York, In association with Indian Foundation for Vedic Science (81-87710-45-4)

- Lakshmi Chandra Mishra, (2004), Scientific Basis for Ayurvedic Therapies, CRC press LLC (0-8493-1366-X)

E-RESOURCES:

- **https://www.youtube.com/live/-iUTvvkE91w?si=JWcXh6rd-z1d_5DF**
- **https://www.youtube.com/live/0jAyxYWQmew?si=0tg_0Ry__fr6RnJd**
- **https://youtu.be/jYOVCLVLjbI?si=5GBJvlv3z73LQ3Vb**
- **https://youtu.be/QIAfZZGD3ZU?si=xt97KObtJl7Wd9Hk**
- **https://youtu.be/S1-17TeZvV0?si=kGQ_m6Mr4fwwoemw**
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

PRACTICALS
MBP-MJ-502

COURSE CODE	**MB-MJ-502**
COURSE TITLE	**VEDIC MICROBIOLOGY PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 30 hrs. = 60 hrs.
TEACHING PER WEEK	04 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

CO1: Students shall gain insights regarding the usage of traditional herbs and spices to inhibit the disease causing microorganisms.
CO2: Students shall learn about the effect of agnihotra in reducing the number of microorganisms.
CO3: Students shall also gain knowledge for the importance of sunlight and its effect on the growth of microorganisms.
CO4: Students shall gain skill to ferment rice and for the detection of LAB in fermented rice water
CO5: Students shall gain skill to ferment rice and for the detection of LAB in fermented buttermilk
CO6: Students shall gain access to usage of Prakruti Prashikshan App and develop an insight regarding its importance

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 To CO6						

1. Evaluation of traditional herbs & spices extracts against pathogens.
2. Effect of Agnihotra on Airborne Microbial Load.
3. Effect of Sunrays on the microorganisms.
4. LAB count in fermented rice water.

5. LAB count in fermented buttermilk.
6. Survey on Prakruti Prashikshan App.

REFERENCES:

- R.C. Dubey & D.K. Maheshwari (2008), Practical Microbiology, S. Chand Publication.
- Patel, R. J., & Patel, R. K., (2022). Experimental Microbiology, Vol. 1, 10th Edition, Aditya.
- Aneja, K. R., (2003). Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers.
- Kailasapathy J. P. T. K., (2010). Fermented Foods and Beverages of the World, CRC Press, Taylor & Francis Group.

MB-MJ-503

COURSE CODE	**MB-MJ-503**
COURSE TITLE	**FOOD AND DAIRY MICROBIOLOGY**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- This course provides general information regarding food spoilage, how to prevent spoilage and microbiological examination of food.
- It covers the topic of using microbes in fermentation as well as food and feed.

COURSE OUTCOME: CO1

- Students shall be acquainted with various types of food contamination and spoilage by different microorganisms, their preservation techniques
- Students shall learn about the different methods for testing and grading milk quality.

COURSE OUTCOME: CO2

- Student acquaint themselves with various alcoholic beverages and their production technology and fermented food and dairy products.
- They shall understand different microorganisms that can be used as food and their involvement in producing various fermented foods.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						

CO2						

UNIT 1	**FOOD AND DAIRY**
1.1	**SECTION A: Food Microbiology**
1.1.1	Food spoilage: Intrinsic and extrinsic factors
1.1.2	Methods used to control food spoilage
1.1.3	Detection of food-borne pathogens
1.1.4	Food Safety and Standards (Food Products Standards and Food Additives) Regulation, 2011: Preservatives
1.2	**SECTION B: Milk Microbiology**
1.2.1	Sources of microorganisms in milk
1.2.2	Diseases from raw milk consumption
1.2.3	Methods of testing and grading of milk
1.2.4	Microscopic and cultural techniques
1.2.5	Quantitative examination of milk
1.2.6	Preservation of milk by pasteurization

UNIT 2	**MICROBIOLOGY OF FERMENTED FOODS**
2.1	**SECTION A: Fermented Food Products**
2.1.1	Traditional Fermented Food of India
2.1.2	Fermented Milks
2.1.3	Cheese Production
2.1.4	Production of fermented Food and beverages: Wines & Champagnes, Beers and Ales, Bread and other Fermented foods
2.2	**SECTION B: Microorganisms as Food, Feed & Supplements**
2.2.1	SCP Product of Spirulina and Yeast biomass
2.2.2	Mushroom cultivation methods and control of pathogens and pests
2.2.3	Prebiotics, Probiotics and Synbiotics

REFERENCES:

- Willey, J.M., Sherwood, L., and Woolverton, C.J. (2017). Prescott's microbiology, 11th Ed., New York: McGraw-Hill Education. (978-1-260-57002-1).
- Frazier, W. C. and Westhoff, D. C., (2006). Food Microbiology, 4thEd., Tata Mc-Graw Hill, India.
- Dubey, R. C. (2014). Textbook of Biotechnology, 5th Ed., S. Chand.

- Purohit, S. S. (2006). Microbiology: Fundamentals and Applications, 7th Ed., Agrobios (India**)**
- Pelczar, M. J. and Chan, E. C. S. (1998). Microbiology, 5th Ed., Tata-McGraw-Hill.
- Rawat K., Kumari A., Kumar S., Kumar R. and Gehlot R., (2018), Traditional Fermented Products of India, 7(4), pp 1873-1882.
- Ortiz Alvarenga, V. (Ed.). (2024). Basic protocols in predictive food microbiology. Springer.
- Amaresan, N., Dharumadurai, D., & Babalola, O. O. (Eds.). (2023). Food microbiology based entrepreneurship: Making money from microbes. Springer Nature.
- https://www.fssai.gov.in/upload/uploadfiles/files/Food_Additives_Regulations.pdf, pp: 424-427

E-RESOURCES:

- **https://youtu.be/ms_yBSEfsWk?si:7LaBL3krGoeyv6g3**
- **https://youtu.be/0XXIntGsBog?si:lbphWB8gh8yIcXeC**
- **https://youtu.be/nZKaU5uAA28?si:KYEvjlOvuQ-ES_uo**
- **https://youtu.be/W2V8eqEZ3Y0?si:hyoi-qhlRhFIyLWU**
- **https://youtu.be/LjOQeaVxmsw?si:VG0HL3JmCRnjwdZx**
- **https://youtu.be/JHzEkjVDaSo?si:KK9vjjlwXVz312Tw**
- **http://ecoursesonline.iasri.res.in/mod/page/view.php?id:5168**
- **https://dhanusmicronotes.blogspot.com/2020/06/microbiological-analysis-of-milk.html**
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

PRACTICALS
MBP-MJ-503

COURSE CODE	**MB-MJ-503**
COURSE TITLE	**FOOD AND DAIRY MICROBIOLOGY PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 30 hrs. = 60 hrs.
TEACHING PER WEEK	04 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE OUTCOME:

CO1: Students shall develop skills to quantify the bacterial count of milk sample and also characterize the types of microorganisms present in milk.

CO2: Students shall develop skills to quantify the bacterial count of food sample and also characterize the types of microorganisms present in food.

CO3: Students shall develop skills of fermentation and prepare wine by fermentation of grapes.
CO4: Students shall gain skill to enumerate the microorganisms by Aerobic Plate Count.
CO5: Students shall gain expertise on the methods for detection of *Staphylococcus aureus*.
CO6: Students shall gain expertise on the Method for enumeration of *Enterobacteriaceae*

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 TO CO6						

1. Bacteriological analysis of milk- qualitative & quantitative method.
2. Bacteriological analysis of food- qualitative & quantitative method.
3. Fermentation of grapes for wine making.
4. Method for enumeration of Aerobic Plate Count (APC).
5. Method for detection of *Staphylococcus aureus*.
6. Method for enumeration of *Enterobacteriaceae*.

REFERENCES:

1. Patel, R. J., & Patel, R. K., (2022). Experimental Microbiology, Vol. 1, 10th Edition, Aditya.
2. Aneja, K. R., (2003). Experiments in Microbiology 4thed. Experiments in microbiology, Plant Pathology, Tissue Culture, and Mushroom Production Technology, New Age International Publishers.
3. Manual of Methods of Analysis – Microbiological Analysis of Food and Water, May 2024, Govt. of India-FSSAI.

MINOR

MB-ME-501

COURSE CODE	**MB-ME-501**
COURSE TITLE	**QUALITY CONTROL & QUALITY ASSURANCE**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- This course introduces microbiology students to quality control and assurance in pharmaceutical and laboratory settings. It covers GMP, GLP, regulatory compliance, and microbial safety, ensuring students understand quality standards and their applications in microbiological testing and pharmaceutical production.

- Students will learn to apply quality assurance principles, conduct stability testing, control microbial contamination, and follow biosafety guidelines. The course emphasizes regulatory compliance, risk assessment, and quality audits, preparing them for careers in laboratory management and pharmaceutical quality control.

COURSE OUTCOME: CO1

- Students will develop a strong understanding of quality assurance principles, GMP, and TQM, ensuring adherence to industry standards in pharmaceutical and microbiology laboratories.
- They will also gain insights into accreditation, certification, and regulatory frameworks such as ISO, NABL, and QCI, enabling them to assess and maintain laboratory quality effectively.

COURSE OUTCOME: CO2

- Students will learn to apply Good Laboratory Practices (GLP), hazard analysis, and quality auditing to improve laboratory safety and operational efficiency.
- Additionally, they will acquire expertise in biosafety protocols, sterilization techniques, and microbial contamination control, ensuring safe and effective microbiological testing in pharmaceutical and public health laboratories.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

UNIT 1	**QUALITY ASSURANCE & QUALITY MANAGEMENT CONCEPT**
1.1	**SECTION A: Quality Assurance & Management**
1.1.1 **1.1.2** **1.1.3** **1.1.4** **1.1.5** **1.1.6**	Quality assurance – Objectives of Quality Assurance Current Good Manufacturing Practices Quality Control & Quality Assurance – Objectives of Quality Control Total Quality Management (TQM) -Definitions, Key Elements, Advantages, TQM in drug Industry Internal Quality Control Formulating Quality control charts
1.2	**SECTION B: Accreditation & Certification**
1.2.1 **1.2.2** **1.2.3** **1.2.4** **1.2.5** **1.2.6** **1.2.7**	Introduction ISO 15189:2007 Medical Laboratories ISO 15189:2007 Medial Laboratories: Requirements for Quality & Competence. Quality Council of INDIA NABL Clinical Laboratory Improvement Amendments (CLIA) of 1988 (USA) Clinical and Laboratory Standard Institute (CLSI)

UNIT 2	GOOD LABORATORY PRACTICES & GUIDELINES
2.1	**SECTION A: Good Laboratory Practices**
2.1.1	WHO good practices for pharmaceutical microbiology laboratories
2.1.2	General guidelines for the establishment, maintenance and distribution of chemical reference substances
2.1.3	Microbiological Hazard Analysis and Audit: The Practice
2.2	**SECTION B: Guidelines**
2.2.1	Biosafety Guidelines for Public Health Laboratories.
2.2.2	General Principles of Biosafety
2.2.3	Biosafety Cabinets
2.2.4	Good Microbiological Techniques-Safe laboratory procedures
2.2.5	Sterilization and Disinfection Procedures Biomedical Waste Management

REFERENCES:

- Organization, W. H. (2024). Quality assurance of pharmaceuticals: a compendium of guidelines and related materials. Volume 2. Good manufacturing practices and inspection. World Health Organization.
- Godkar, P. B. and Godkar, D. P. (2014). Textbook of Medical Laboratory Technology,3rd Ed., Volume 1, Bhalani Publication House Mumbai, India.
- Baird, R. M., Hodges, N. A. and Denyer, S. P. (2006). Handbook of Microbiological Quality Control, Special Indian Ed., CRC Press.
- Hewitt, S. (2003). Microbiological Assay for Pharmaceuticals Analysis: A Rational Approach, CRC Press.
- Tambwekar, S. (2009). Handbook of Quality Assurance in Laboratory Medicines, B.I. Publications.

E-RESOURCES:

- https://www.njlm.net/articles/PDF/2351/40437_CE%5BRa1%5D_F(SHU)_PF1(AG_OM)_PFA(SHU)_PB(AG_OM)_PN(SHU).pdf&ved=2ahUKEwic7_qbt_KLAxWvumMGHSpxGpMQFnoECDsQAQ&usg=AOvVaw04AHdfRHkECY1aEBnCPK2p
- https://www.cdc.gov/labs/pdf/SF__19_308133-A_BMBL6_00-BOOK-WEB-final-3.pdf
- https://ncdc.mohfw.gov.in/wp-content/uploads/2024/04/File608.pdf
- SWAYAM (https://swayam.gov.in/)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

PRACTICALS

MBP-ME-501

COURSE CODE	**MB-ME-501**
COURSE TITLE	**QUALITY CONTROL & QUALITY ASSURANCE PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 30 hrs. = 60 hrs.
TEACHING PER WEEK	04 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE OUTCOME:

CO1: Students shall develop an insight regarding the quality control and become proficient to prepare and Interpret the quality of data from Levey-Jennings Chart.

CO2: Students shall gain skills to perform the Sterility Testing of Pharmaceutical Products and determine the sterility of the product.

CO3: Students shall become aware regarding the Microbial Limit Testing of Non-Sterile products.

CO4: Students shall develop skill to monitor the environment of Pharmaceutical Labs.

CO5: Students shall develop skill to monitor the Quality Control of Water for Pharmaceutical use.

CO6: Students shall become skilful in documentation Practices and learn validation of analytical methods.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO6						

1. Preparation and Interpretation of Levey-Jennings Chart.
2. Sterility Testing of Pharmaceutical Products (Direct inoculation).
3. Microbial Limit Testing of Non-Sterile Products.
4. Environmental Monitoring in Pharmaceutical Labs.
5. Quality Control of Water for Pharmaceutical Use.
6. Good Documentation Practices and Validation of Analytical Methods.

REFERENCES:

1. Godkar, P. B. & Godkar, D. P. (2014). Textbook of Medical Laboratory Technology, 3rd Ed., Volume 1, Bhalani Publishing House, Mumbai.
2. WHO (2024). Quality Assurance of Pharmaceuticals: A Compendium of Guidelines and Related Materials, Volume 2. WHO Technical Report Series.
3. USP (United States Pharmacopeia) 43-NF 38. Microbiological Examination of Nonsterile Products: Microbial Enumeration Tests.
4. Baird, R. M., Hodges, N. A., & Denyer, S. P. (2006). Handbook of Microbiological

Quality
Control: Pharmaceuticals and Medical Devices, CRC Press. (Page No. 221-238).
5. WHO (2024). Quality Assurance of Pharmaceuticals: Water for Pharmaceutical Use, WHO Technical Report Series.
6. Hewitt, S. (2003). Microbiological Assay for Pharmaceutical Analysis: A Rational Approach, CRC Press.

MB-ME-502

COURSE CODE	**MB-ME-502**
COURSE TITLE	**ANALYTICAL INSTRUMENTATION & TECHNIQUES**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- This course provides general information regarding different instruments, working principles and able to interpret experimental data and relate these techniques to advancements in molecular biology.
- It covers the usage of instruments and techniques for betterment of future.

COURSE OUTCOME: CO1
Students will understand the theoretical principles and applications of instruments in numerous ways like quantitative and qualitative analysis by identification of substance, concentration determination, etc.

COURSE OUTCOME: CO2
Student acquaint themselves by learning analytical techniques, which helps them to implement in various fields, like Medicine, Environment, Genetic disorders, Agriculture, etc. for human welfare.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

UNIT 1	EQUIPMENTS & INSTRUMENTS
1.1	Spectrometry
1.2	Colorimetry and Photometry
1.2.1	Filter Photometers and Spectrophotometers
1.2.2	Infrared and Raman Spectroscopy
1.3	Flow Cytometry
1.4	Laminar Air Flow
1.5	Biosafety cabinets

UNIT 2	ANALYTICAL TECHNIQUES
2.1	Electrophoresis
2.2	Blotting techniques
2.3	Chromatography
2.4	Polymerase chain reaction

REFERENCES:

- Godkar, P. B., & Godkar, D. P. (2014). *Textbook of medical laboratory technology*. Bhalani publishing house. 3rd Edition, Volume 1 (ISBN: 978 93 81496 19 0).
- Wilson, K., & Walker, J. (Eds.). (2010). *Principles and techniques of biochemistry and molecular biology*. Cambridge university press. 7thEdition (ISBN: 978-0-521-17874-7).
- Ghosal, S., & Avasthi, A. S. (2018). *Fundamentals of bioanalytical techniques and instrumentation*. PHI Learning Pvt. Ltd. (ISBN: 978-93-87472-39-6).
- Skoog, D. A., Holler, F. J., & Crouch, S. R. (2007). *Instrumental analysis*. Cengage learning (ISBN: 978-81-315-0542-7).
- Murray, P. R., Baron, E. J., Jorgensen, J. H., Landry, M. L., & Pfaller, M. A. (2005). Manual of Clinical Microbiology. Ed. 9th (ISBN: 1-55581-255-4).

Recommended learning E-RESOURCES:

- **https://youtu.be/EQXPJ7eeesQ?si=Rjc8-lDUUR4XnUhQ**
- **https://youtu.be/pxC6F7bK8CU?si=5qES7H9e2pHFK2yK**
- **https://youtu.be/OiukFtC8E04?si=CSbcNgtQseIiRHpP**
- **https://youtu.be/hue2TrYXY54?si=p0nwF-DHqqCb1nL8**
- **https://youtu.be/hLzQ9pMUF6k?si=YEYsxmogCuO37XNU**
- **https://youtu.be/PvHvx7k7UPU?si=Fq0TK3zSLl3_Tgbr**
- **https://youtu.be/wBrNbbAIAFo?si=aTqDUR7uCL_UsD2q**
- **https://youtu.be/saJIWFUGEbw?si=R29hCLBIt0nNQstD**
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

PRACTICALS
(MBP-ME 502)

COURSE CODE	**MBP-MJ-502**
COURSE TITLE	**ANALYTICAL INSTRUMENTATION & TECHNIQUES PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 30 hrs. = 60 hrs.
TEACHING PER WEEK	04 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE OUTCOME:

CO1: Students shall learn to preparation the phosphate buffer and also develop skill to use pH meter to determine pH.

CO2: Students shall develop skill to estimate Amino acids/Sugar by paper chromatography.

CO3: Students to determine the unknown concentration of a coloured solution and gain skill to use Photometric instruments.

CO4:. Students shall learn the turbidometric method and prepare the Mac Farland scale.

CO5: Students shall gain knowledge of Horizontal gel electrophoresis and its application.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 TO CO5						

1. Preparation of 200 ml phosphate buffer and Determination of pH by using a pH meter.
2. Estimation of Amino acids/Sugar by paper chromatography.
3. Determination of unknown concentration of a colored solution by Photometric method.
4. Demonstration of Horizontal gel electrophoresis.
5. Study of Mac Farland scale by turbidometric method.

References:

- Godkar, P. B., & Godkar, D. P. (2014). *Textbook of medical laboratory technology*. Bhalani publishing house. 3rd Edition, Volume 1 (ISBN: 978 93 81496 19 0).
- Patel R. J. and Patel R.K. (2016) Experimental microbiology Volume II, 9th Edition. Aditya Publications, Ahmedabad.

SEC

MB- SEC -501

COURSE CODE	**MB- SEC -501**
COURSE TITLE	**HAEMATOLOGY**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	01 Credits X 15 hrs. = 15 hrs.
TEACHING PER WEEK	01 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENTS:

- This course provides general introduction to the principles of hematology.
- The course will also describe the different types of blood cells and their precursors in the bone marrow.
- It will cover the topics of determination of hemoglobin, Red blood cell indices, Microscopic study of blood smear.
- The course will discuss the blood diseases and important laboratory findings regarding them.

COURSE OUTCOME: CO1

- Student shall learn about the diverse scopes and importance of hematology in medical practice.
- Students will learn to identify and describe the different types of blood cells, including red blood cells, white blood cells and platelets.
- Students will understand the principles, potential errors, interpretation and clinical significance for accurate diagnosis in hematology.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						

UNIT 1	FUNDAMENTALS OF HAEMATOLOGY
1.1	Introduction to haematology, Components of blood and their functions
1.2	Haematopoietic system of the body
1.3	Collection and processing of blood specimen
1.4	Determination of haemoglobin concentration: Cynmethaemoglobin method
1.5	Determination of haematocrit
1.6	Red blood cell indices
1.7	Enumeration of formed elements
1.8	Differential count and examination of stained blood smears
1.9	Interpretation of laboratory findings in haematology: Anaemia, leukaemia and miscellaneous disorders

REFERENCES:

- Mukherjee, K. L. (1988). Medical Laboratory Technology, Vol 1, 3rd Ed., Tata McGraw Hill Publishing.
- Godkar, P. B. (2003). Textbook of Medical Laboratory Technology, Vol.2, 3rd Ed., Bhalani Publishing House.
- Cheesbrough, M. (2006). District Laboratory Practice in Tropical Countries – Part-2nd Ed., Cambridge University Press.
- Ochei, J. and Kolhatkar, A. (2000). Medical Laboratory Science-Theory and Practice, Tata McGraw Hill.

E-RESOURCES:

- **https://youtu.be/0deCbmh7PHs?si=dJXS0kRdJzXDFEjs**
- **https://youtu.be/XBaJSwXbwFw?si=YiDrhiOX7YlLPK7b**
- **https://youtu.be/9vf_sdn53LQ**
- **https://youtu.be/mAmwdDdbkUI?si=Kd43flpkm2OCikGv**
- **https://youtu.be/6CqptdZyUaU?si=kdEEL52wX0-RvawL**
- **https://www.youtube.com/watch?v=0deCbmh7PHs**
- **https://www.youtube.com/watch?v=XBaJSwXbwFw&t=66s**
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

SEC PRACTICAL

(MBP-ME 502)

COURSE CODE	**MBP-ME-502**
COURSE TITLE	**HAEMATOLOGY PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	01
TOTAL ENGAGEMENT	01 Credits X 30 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE OUTCOME:

CO1: Students shall develop skills to separate serum and plasma from blood.

CO2: Students shall learn to estimate haemoglobin by Cyanmethaemoglobin / Sahli's method.

CO3: Students shall become skilful to determine the total count of RBC and WBC.

CO4: Students shall acquire the ability to Differentiate the leucocytes and determine the blood count of Leucocytes.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO4						

1. Separation of serum and plasma from blood.
2. Estimation of haemoglobin by Cyanmethaemoglobin / Sahli's method.
3. Total count of RBC and WBC.
4. Differential count of Leucocytes.

Recommended Learning Resources

1. Patel, R. J., & Patel, R. K., (2022). Experimental Microbiology, Vol. 1, 10th Edition, Aditya.
2. Godkar, P. B. (2003). Textbook of Medical Laboratory Technology, Vol.2, 3rd Ed.,Bhalani Publishing House.

T. Y. B. Sc. Semester – VI

MAJOR

EFFECTIVE FROM: 2025-26

MB-MJ-601

COURSE CODE	**MB-MJ-601**
COURSE TITLE	**MEDICAL MICROBIOLOGY**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- This comprehensive curriculum explores the complex interactions between pathogens, their virulence factors, and hosts, providing a deep understanding of the mechanisms underlying infectious diseases.
- Specifically, this course covers the interactions between pathogens and hosts that lead to infection, the emergence, development, and control of disease outbreaks, various modes of microbial infection, including: Vector-borne transmission, Direct contact transmission, Foodborne transmission, Waterborne transmission, Airborne transmission, Healthcare-Associated Infections (HAIs).

COURSE OUTCOME: CO1

- Students shall learn to describe the principles of pathogenicity, virulence factors in microorganisms, patterns and transmission dynamics of infectious diseases.
- Students shall develop skills to analyze the factors contributing to the emergence and re-emergence of infectious diseases.
- Students shall develop insight regarding epidemic rise, control, and prevention strategies.
- Students shall be able to interpret the impact of emerging and re-emerging diseases, as well as healthcare-associated infections (HAIs), on public health.

COURSE OUTCOME: CO2

- Students will be able to understand the role of various modes of transmission in causing infectious diseases and pathogenicity of disease causation.
- Students shall become skillful to Identify and determine the causative agents of various infectious diseases from clinical samples.
- Students shall gain an understanding regarding the principles of prevention and treatment strategies of infectious diseases including vaccination and immunization, antibiotic therapy, environmental and behavioral interventions.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

UNIT 1	PATHOGENICITY, INFECTIOUS DISEASE AND EPIDEMIOLOGY
1.1	**SECTION A: Host microbe interaction to cause infection**
1.1.1 1.1.2 1.1.3	Principle of infectious disease Establishment of infection Virulence factors
1.2	**SECTION B: Epidemiology**
1.2.1 1.2.2 1.2.3 1.2.4 1.2.5 1.2.6	Basic concepts of Epidemiology Chain of infection Epidemiological studies Public health Surveillance and Remote sensing Emerging and Re-Emerging infectious disease Nosocomial infection

UNIT 2	INFECTIOUS DISEASE
2.1	**SECTION A: AIR-BORNE, CONTACT AND VECTOR BORNE DISEASES**
2.1.1 2.1.2 2.1.3 2.1.4 2.1.5 2.1.6 2.1.7 2.1.8 2.1.9 2.1.10	Tuberculosis Influenza Pneumonia COVID-19 Aspergillosis Staphylococcal infections Syphilis AIDS Malaria Dengue
2.2.	**SECTION B: FOOD AND WATER-BORNE DISEASES**
2.2.1 2.2.2 2.2.3 2.2.4	*E. coli* Gastroenteritis Salmonellosis Amoebic dysentery Hepatitis

REFERENCES:

- Willey, J. M., Sherwood, L., and Woolverton, C. J. (2017). Prescott's microbiology, 10th Ed., New York: McGraw-Hill Education (978-981-3151-26-0).
- Bauman, R. W. (2012). Microbiology: With diseases by body system (4th ed.). Pearson Education (978-0-321-73267-5).
- Nester, E.W. (2012) Microbiology: A Human Perspective. 8th Edition, McGraw-Hill, Boston (ISBN- 9780072919240) .

- Greenwood, D., Slack, R., and Barer, M. (2012). Medical Microbiology A Guide to Microbial Infections, 18th Ed., Churchill Livingstone, Elsevier (978-070-2040-90-0).
- Pelczar, Chan, and Krieg (1993). Microbiology – Concepts and Application International Ed., McGraw-Hill Education (0-07-462320-6).
- Ananthnarayan, R and Paniker C. K. (2009). Textbook of Microbiology, 7th Ed., Universities Press (India) Pvt. Limited (9788173716744).
- Goering, R. V., Dockrell, H. M., Zuckerman, M., & Chiodini, P. L. (2019). Mims' medical microbiology and immunology (6th ed.). Elsevier.
- Carroll, K. C., & Pfaller, M. A. (Eds.). (2023). Manual of clinical microbiology (13th ed.). ASM Press; John Wiley & Sons.

E-RESOURCES:

- **https://www.youtube.com/watch?v=PBmdlnEgAJY**
- **https://www.youtube.com/watch?v=GKzXWctAMuw&t=34s**
- **https://www.youtube.com/watch?v=fJ7RKwdLl-I&t=26s**
- **https://www.youtube.com/watch?v=-kYfs1_bC0c**
- **https://www.youtube.com/watch?v=q1P3QupjhYo**
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

PRACTICALS
MBP-MJ-601

COURSE CODE	**MB-MJ-601**
COURSE TITLE	**MEDICAL MICROBIOLOGY PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 30 hrs. = 60 hrs.
TEACHING PER WEEK	04 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE OUTCOME:

CO1: Students shall gain skill to relate the suspected organisms associated with the medical problems related to blood and determine the isolated causative agent from the clinical blood sample.

CO2: Students shall gain skill to relate the suspected organisms associated with the medical problems related to blood and determine the isolated causative agent from the clinical stool sample.

CO3: Students shall gain skill to relate the suspected organisms associated with the medical problems related to blood and determine the isolated causative agent from the clinical purulent exudates, wound, and abscess sample.

CO4: Students shall gain skill to relate the suspected organisms associated with the medical problems related to blood and determine the isolated causative agent from the clinical

urine sample.

CO5: Students shall be able to determine the susceptible antibiotic against the isolated pathogen and conclude the MIC.

CO6: Students shall learn about arthropod vector (Aedes/Anopheles) and malarial parasite.

MBP MJ-601
Medical Microbiology Practical

1. Bacteriological investigation of medical problems related to blood.
2. Bacteriological investigation of medical problems related to stool.
3. Bacteriological investigation of medical problems related to purulent exudates, wound, and abscess.
4. Bacteriological investigation of medical problems related to urine.
5. Determination of Antibiotic Susceptibility (Agar disc method) and MIC.
6. Study of arthropod vector (Aedes/Anopheles) and various stages of malarial parasite in RBCs using permanent slides.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO6						

Recommended Learning Resources

- Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 1, 9th Ed., Aditya.
- Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 2, 9th Ed., Aditya.
- Cappuccino, J.G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 6th Ed., Pearson Education (Singapore) Pvt. Ltd.
- Cappuccino, J.G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 10th Ed., Pearson Benjamin Cummings.
- Aneja, K.R., (2003). Experiments in Microbiology, Plant Pathology, Tissue Culture And Mushroom Production Technology, New Age International Publishers.

MB-MJ-602

COURSE CODE	**MB-MJ-602**
COURSE TITLE	**IMMUNOLOGY**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- This course provides general introductions to the Immune system, innate host resistance, and adaptive immunity. It will cover topics including; Adaptive immunity, Immune defense mechanism and immune defects like immune tolerance, autoimmune diseases, immunodeficiencies and hypersensitivity.

COURSE OUTCOME: CO1:

- Students will be able to differentiate between the innate and adaptive immune systems.
- Students will be able to describe the concepts of antigen recognition, T-cell and B-cell activation and antibody production.

COURSE OUTCOME CO2:

- Students will be able to use what they've learned to explain the causes and consequences of immune dysfunctions, such as autoimmune diseases and immunodeficiencies.
- Students will be able to describe the concepts of immune tolerance and immune defects like autoimmune diseases and hypersensitivity.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

UNIT 1	**INNATE HOST RESISTANCE AND ADAPTIVE IMMUNITY**
1.1	**SECTION A: Innate host resistance**
1.1.1 **1.1.2** **1.1.3** **1.1.4** **1.1.5**	Innate resistance and adaptive defence Physical and mechanical innate barriers Chemical mediators of Innate immunity Cells of the immune system: Structure and functions Lymphoid organs of the Immune system
1.2	**SECTION B: Adaptive Immunity**
1.2.1 **1.2.2** **1.2.3** **1.2.4** **1.2.5**	Antigens and its properties Types of Adaptive Immunity Recognition of foreignness T-cell B-cell

UNIT 2	DEFENSE MECHANISM, IMMUNIZATION AND IMMUNE DEFECTS
2.1	**SECTION A: Immune defense mechanism**
2.1.1 **2.1.1.1** **2.1.1.2** **2.1.2** **2.1.2.1** **2.1.3**	Innate defense mechanism: Phagocytosis Inflammation Antibody: Structure, types & functions Clonal selection theory Vaccines: Types and vaccination schedule in India
2.2	**SECTION B: Immune defects**
2.2.1 **2.2.2** **2.2.3** **2.2.4**	Immune tolerance Autoimmune diseases Immunodeficiencies Hypersensitivity (Type I, II, III & IV)

REFERENCES:

- Willey, J. M., Sherwood, L., and Woolverton, C.J. (2017). Prescott's Microbiology, 10th Edition., New York: McGraw-Hill Education. (978-981-3151-26-0).
- Owen, J. A, Punt, J., Stranford, S. A. and Jones, P. P. (2013). Kuby Immunology, 6th Ed., W. H. Freeman and Company.
- Delves, P. J., Martin, S. J., Burton, D. R. and Roitt, I. M. (2011). Roitt's Essential Immunology, 6th Ed., Wiley-Blackwell Publishers.
- Abbas, A. K., Lichtman, A. H. and Pillai, S. (2012). Cellular and Molecular Immunology, 7th Ed., Elsevier-Saunders Publication.
- Mohapatra, A. D., & Sahu, P. S. (Eds.). (2024). Advances in immunology and immuno-techniques: Updated concepts and recent applications. Springer.

E-RESOURCES:

- **https://youtu.be/BFeJlxIldAI?si=cJjdj2XA-0y1I-ad**
- **https://youtu.be/5lrAehqruco?si=piL8H3kXpVw_4ViW**
- **https://youtu.be/bserR4ZDDAQ?si=TJXxvuaCdBgbmRzZ**
- **https://youtu.be/RjInWRFecuE?si=jld4ADeUNn41r_6O**
- **https://youtu.be/uc6IV85mf3s?si=1QtWiX88PCg-HulW**
- **https://youtu.be/TNK3WyEI3r8?si=yUCXAfAcu_JB66wg**
- **https://youtu.be/2YK5vBUm9C8?si=aT4e9VQoGzTIUX6E**
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

MBP MJ-602
PRACTICALS

COURSE CODE	**MB-MJ-602**
COURSE TITLE	**IMMUNOLOGY PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

This course provides general introductions to the Immune system, innate host resistance, and adaptive immunity. It will cover topics including; Adaptive immunity, Immune defense mechanism and immune defects like immune tolerance, autoimmune diseases, immunodeficiencies and hypersensitivity.

COURSE OUTCOME:

CO1: Students shall learn about typhoid disease and its detection. Students shall gain knowledge regarding the titre determination and interpreting the severity of the disease. Students shall be serologically discriminate infections caused by *Salmonella typhi*, *Salmonella paratyphi* A and *Salmonella paratyphi* B.

CO2: Students shall become skilful to screen for syphilis and detect the occurrence of syphilis by using RPR test.

CO3: Students shall develop skill in antigen detection of widely spread diseases like HIV and HBs Ag by using rapid flow through method.

CO4: Students will be getting knowledge about different phagocytic and lymphocytic cells of Immune system of human in blood sample.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

1. Widal test by Dreyer's double dilution technique.
2. Detection of Syphilis by RPR test (Qualitative).
3. Detection of HIV by rapid flow through method.
4. Detection of HBsAg by rapid flow through method.
5. ABO blood grouping (slide method)

6. Observation and Identification of Phagocytic and Lymphocytic cells of immune system From human blood.

REFERENCES:

1. Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 1, 9th Ed., Aditya.
2. Patel, R. J. and Patel, R. K. (2015). Experimental Microbiology, Vol. 2, 9th Ed., Aditya.
3. Cappuccino, J.G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 6th Ed., Pearson Education (Singapore) Pvt. Ltd.
4. Cappuccino, J. G. and Sherman N. (2005). Microbiology: A Laboratory Manual, 10th Ed., Pearson Benjamin Cummings.
5. Gurtler, V. & Pavia, C. S. (2020) Immunological Methods in Microbiology (Vol 47) Elsevier.

MB-MJ-603

COURSE CODE	**MB-MJ-603**
COURSE TITLE	**INDUSTRIAL MICROBIOLOGY**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- This course provides general introductions to the diverse roles of microorganisms in industrial microbiology
- It will cover topics including; screening of industrially important microorganisms, strain improvement, media designing, and fermenter design and down steam processes.

COURSE OUTCOME: CO1

- Students will be able to understand the evolution of fermentation technology, the historical advancements in industrial microbiology and the key components of the fermentation process.
- Students will be able to understand the screening techniques, inoculum development for industrial applications, culture maintenance, and strain improvement techniques.
- Students will be able to understand industrial microbial strains and fermentation media, the role of fermentation media composition in optimizing microbial growth and metabolite production.

COURSE OUTCOME: CO2

- Students will be able to understand the bioreactor design and operations and fermentation processes to optimize industrial applications.

- Students will be able to assess the impact of bioreactor types and operating conditions on microbial productivity.
- Students will be able to apply downstream processing techniques for cell harvesting, disruption, and product recovery in industrial microbiology.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

UNIT 1	**FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY**
1.1	**SECTION A: Development of industrial microbiology**
1.1.1 1.1.2 1.1.3 1.1.4	Historical developments in fermentation technology Isolation of microorganism and culture collections Screening for new metabolites Screening Techniques: Primary and Secondary
1.2	**SECTION B: Industrially Important Strains and fermentation**
1.2.1 1.2.2 1.2.3 1.2.4 1.2.5	Industrial Strains and strain improvement Strain stability Inoculum development Fermentation media Fermentation types and process

UNIT 2	**BIOREACTOR & PRODUCT RECOVERY**
2.1	**SECTION A: Bioreactor Components and Design**
2.1.1 2.1.2 2.1.3	Bioreactor Design of Bioreactor Bioreactor types
2.2	**SECTION B: Product Recovery**

2.2.1 2.2.2 2.2.3 2.2.4 2.2.5 2.2.6	Cell harvesting Cell disruption Product recovery Distillation Finishing step Product development

REFERENCES:

- Patel, A. H. (2016). Industrial Microbiology, 2nd Ed., Trinity press; An imprint of Laxmi publications Pvt. Ltd. (978-9385750250).
- Waites, M. J. (2001). Industrial microbiology: An Introduction,1st Ed., Blackwell publishing. (978-0632053070).
- Shivkumar, P. K., Joe, M. M. and Sukesh, K. (2010). An Introduction to Industrial Microbiology, S. Chand Publishers. (978-8121935197).
- Okafor, N. (2007). Modern Industrial Microbiology and Biotechnology. Taylor and Francis, an imprint of CRC Press. (978-1315147161).
- Stanbury, P., Whitaker, A. and Hall, S. J. (2016). Principles of fermentation technology, 3rd Ed., Butterworth-Heinemann. (978-0080999531).

E-RESOURCES:

- **https://www.youtube.com/watch?v=r04e-KvOiG4**
- **https://www.youtube.com/watch?v=pQnfildQNwI**
- **https://www.youtube.com/watch?v=SsozxmGX6cM**
- **https://www.youtube.com/watch?v=mUDXupn2Dhk**
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

PRACTICALS

MBP-MJ 603

COURSE CODE	**MB-MJ-603**
COURSE TITLE	**INDUSTRIAL MICROBIOLOGY PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 30 hrs. = 60 hrs.
TEACHING PER WEEK	04 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE OUTCOME:

CO1: Students shall develop skills to screen and characterize amylase & organic acid producing microorganisms.

CO2: Students shall develop skills to screen and characterize antibiotic producing

microorganisms.

CO3: Students shall develop skills for the lab scale production of microbial amylase.

CO4: Students shall gain knowledge of Penicillin bioassay.

CO5: Students shall develop the analytical skill for the estimation of reducing sugars by Cole's method from fermented broth.

CO6: Students shall develop the analytical skill for the estimation of protein by Folin Lowry's method from fermented broth.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 To CO5						

1. Screening of amylase & organic acid producing microorganisms.
2. Screening of antibiotic producing microorganisms.
3. Fermentative production of amylase and its estimation.
4. Bioassay of Penicillin.
5. Estimation of reducing sugars by Cole's method from fermented broth.
6. Estimation of protein by Folin Lowry's method from fermented broth.

REFERENCES:

1. Patel, R. J., & Patel, R. K., (2022). Experimental Microbiology, Vol. 1, 10th Edition, Aditya.

2. Patel, R. J., & Patel, R. K., (2022). Experimental Microbiology, Vol. 2, 10th Edition, Aditya

3. Aneja, K. R., (2003). Experiments in Microbiology 4thed. Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers.

MINOR

MB-ME-601

COURSE CODE	**MB-ME-601**
COURSE TITLE	**GENOMICS AND PROTEOMICS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 15 hrs. = 30 hrs.
TEACHING PER WEEK	02 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- The course focuses on various structural aspects of bioinformatics with respect to study of genes their functions and proteins produced by those genes.

- It also includes the fundamental concepts of genomics and proteomics and its role in genome sequencing, expression and its application in molecular biology.

COURSE OUTCOME: CO1

- Students shall learn about the fundamental principles of genomics.
- Students will gain a deep knowledge about genomics, its applications and develop proficiency in bioinformatics tools necessary to analyze large genome datasets.
- Student shall gain skills in determining the nucleotide and genome sequences, annotation and mapping.
- Students shall develop insights regarding functional and comparative genomics.

COURSE OUTCOME: CO2

- Students shall study the importance of proteome.
- Students shall gain knowledge regarding the various techniques to study proteomics and interaction of proteins.
- Students will learn the techniques for the analysis of protein expression, its modifications, protein interactions, and its applications.
- Students shall apply proteomics for the benefits of human health.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						

UNIT 1	**GENOMICS**
1.1	Genomics
1.1.1	Determining DNA sequences
1.1.2	Genome sequencing
1.2	Genome annotation
1.2.1	GO annotation for cytochrome C oxidase
1.3	Genome Mapping
1.4	Functional Genomics
1.4.1	DNA and RNA level (Transcriptomics)
1.5	Comparative Genomics

UNIT 2	PROTEOMICS
2.1	Importance and Scope of Proteomics
2.2	Technology of Protein Expression Analysis
2.3	Posttranslational Modification
2.4	Protein-Protein Interaction
2.5	Pharmaceutical proteomics

REFERENCES:

- Twyman, R. (2004). *Principles of Proteomics* (1st edition). Taylor & Francis. https://doi.org/10.4324/9780203507391
- Willey, J.M., Sherwood, L.M., & Woolverton, C. J. (2017)- 10th edition. *Prescott Microbiology*. McGraw-Hill.
- Xiong,J. (2006).. Essential Bioinformatics, 1st Ed., Cambridge University Press
- Weaver, R. (2011). EBOOK: Molecular Biology. McGraw Hill.
- Prasad, A., Bhargava, H., Gupta, A., Shukla, N., Rajagopal, S., Gupta, S., ... & Suravajhala, P. (2021). Next generation sequencing. Advances in bioinformatics, 277-302.
- Primrose, S. B., & Twyman, R. (2006). Principles of gene manipulation and genomics. John Wiley & Sons.
- Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM & Heyer LJ, Benjamin Cummings 2007; CSH Press, NY. ISBN-10: 81317155902.
- Bioinformatics and Functional Genomics – Jonathan Pevsner - 2nd edition, Wiley-Blackwell, 2009. ISBN-10: 047121004

E-RESOURCES:

- https://www.coursera.org/courses?query=proteomics
- **https://www.ncbi.nlm.nih.gov/**
- **https://www.ensembl.org/**
- **https://www.internationalgenome.org/**
- **https://www.uniprot.org/**
- **https://www.ebi.ac.uk/pride/**
- **https://www.expasy.org/**
- https://global.oup.com/academic/product/introduction-to-genomics-9780198831402
- https://www.ncbi.nlm.nih.gov/books/
- https://www.coursera.org/courses?query=proteomics
- https://www.khanacademy.org/science/biology
- https://www.youtube.com/playlist?list=PLUl4u3cNGP63O_lpsuKq6xiwvKfCmI6gR
- https://www.ibiology.org/
- https://www.ted.com/talks/eric_lander_secrets_of_the_human_genome
- SWAYAM (https://swayam.gov.in)
- SWAYAM Plus (https://swayam-plus.swayam2.ac.in)

PRACTICALS

MBP-MJ 601

COURSE CODE	**MBP-ME-601**
COURSE TITLE	**GENOMICS AND PROTEOMICS PRACTICALS**
COURSE LEVEL	300 to 399
COURSE CREDIT	02
TOTAL ENGAGEMENT	02 Credits X 30 hrs. = 60 hrs.
TEACHING PER WEEK	04 Hrs.
MINIMUM WEEKS PER SEMESTER	15 Weeks

COURSE CONTENT:

- The course focuses on various structural aspects of bioinformatics with respect to study of genes their functions and proteins produced by those genes.
- It also includes the fundamental concepts of genomics and proteomics and its role in genome sequencing, expression and its application in molecular biology.

COURSE OUTCOME:

CO1**:** Students shall learn about the genomics databases**.**
CO2: Students shall gain access to the various protein databases
CO3: Students shall retrieve data regarding the nucleotide sequences and sequences from NCBI.
CO4: Students shall learn to access the Entrez genomes page at NCBI. Students shall gain skill to correlate the nucleotide and protein sequences. Students shall become skilful in using tools and techniques to study nucleotides and proteins sequences.
CO5: Students shall study about protein separation techniques. Students shall develop proficiency in bioinformatics tools necessary to analyse large genome datasets

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO5						

PRACTICALS:

1. To study about Genomic Databases.
2. To study about Protein databases.
3. To study retrieval of gene, genome and protein sequence from NCBI.
4. To study ENTREZ, BLAST, GeneMark.
5. To study SDS-PAGE (demonstration).

REFERENCES:

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- C.S.V Murthy. 2003 Bioinformatics., Himalaya Publishing House.
- Twyman, R. 2004. *Principles of Proteomics* (1st edition). Talor & Francis. https://doi.org/10.4324/9780203507391
- Xiong,J. 2006. Essential Bioinformatics, 1st Ed., Cambridge University Press.

Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
Tel : +91 - 261 - 2227141 to 2227146, Toll Free : 1800 2333 011, Digital Helpline No.- 0261 2388888
E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

–:પરિપત્ર:–

યુનિવર્સિટીના વિજ્ઞાન વિદ્યાશાખા હેઠળના તમામ શૈક્ષણિક વિભાગોના વડાશ્રીઓ અને યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોનાં આચાર્યશ્રીઓને જણાવવાનું કે, NEP-2020 અંતર્ગત શૈક્ષણિક વર્ષ ૨૦૨૬–૨૭ થી અમલમાં આવનાર B.Sc. Microbiology Sem.-7 & 8 Honours (with OJT / without OJT) અને Honours with Research નો અભ્યાસક્રમ રિવાઈઝ કરવા નિમણૂંક કરેલ પેટા સમિતિ દ્વારા તૈયાર કરવામાં આવેલ અભ્યાસક્રમ માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૨૧/૦૫/૨૦૨૬ અને તા.૦૨/૦૬/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંકઃ૦૨ થી મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૦૪/૦૬/૨૦૨૬ની સભાના ઠરાવ ક્રમાંકઃ૨૩થી મંજૂર કરવા એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૧૮/૦૬/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંકઃ૨૧થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

(બિડાણઃઉપર મુજબ)

ક્રમાંકઃઓથો./પરિપત્ર/૧૩૬૪૯/૨૦૨૬
તા.૧૯/૦૬/૨૦૨૬

કુલસચિવશ્રી

પ્રતિ,
(૧) યુનિવર્સિટીના વિજ્ઞાન વિદ્યાશાખા હેઠળના તમામ શૈક્ષણિક વિભાગોના વડાશ્રીઓ.
(૨) યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોનાં આચાર્યશ્રીઓ.
... આપશ્રીના વિભાગ/કોલેજના સંબંધિત શિક્ષકો/વિદ્યાર્થીઓને જાણ કરી અમલ કરવા સારૂ.
(૩) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
(૪) પરીક્ષા નિયામકશ્રી,પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારૂ.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program

In

Microbiology

4 years (Honours with OJT/Research Project)

B. Sc. Sem 7 Syllabus

(Effective from Academic Year: 2026-27)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT PROGRAM TITLE	
Name of Program	Bachelor of Science (Honours with OJT/RP) In Microbiology
Program Abbreviation	B.Sc. MB
Duration	One Year
Eligibility Criteria	As per university norms
Pre-requisite	Basic concepts in the field of microbiology
Medium of Instruction	English
Objective of Program	Objective of this program is to provide Fundamental and applied knowledge of Microorganism to students. To develop Laboratory skills and to train the students in scientific thinking to prepare for carriers like health care, pharmaceutical, biotechnology, diagnostics, industry and academia and to promote awareness to students of microbial application in the field of diseases prevention, environmental sustainability and technological innovation.
Program Outcome (PO)	**PO-01: Scientific Knowledge & Conceptual Understanding:** Develop a strong foundation in scientific principles, theories and concepts across disciplines, fostering interdisciplinary learning, advance knowledge and problem-solving abilities. **PO-02: Analytical & Critical Thinking:** Apply critical thinking and analytical reasoning to evaluate scientific data, hypotheses and real-world problems, leading to evidence-based conclusions. **PO-03: Research & Inquiry-based Learning:** Develop investigative skills through experimentation, data analysis and scientific inquiry to contribute to research and innovation. **PO-04: Laboratory & Technical Skills:** Gain hands-on experience with laboratory techniques, instrumentation and computational tools relevant to scientific research and industry applications. **PO-05: Digital & Computational Literacy:** Utilize digital tools, computational techniques and emerging technologies such as AI, bioinformatics and statistical modelling to enhance scientific learning and problem-solving. **PO-06: Environmental & Societal Responsibility:** Understand the role of science in addressing

	environmental, health and societal challenges, promoting sustainability and ethical responsibility. **PO-07: <u>Effective Communication & Collaboration</u>:** Develop proficiency in scientific communication, both written and oral, for effective dissemination of knowledge while collaborating in multidisciplinary teams. **PO-08: <u>Innovation & Entrepreneurship</u>:** Foster an entrepreneurial mind-set by applying scientific knowledge for innovation, technology development, and industry-oriented applications. Develop sustainable solutions to address real-world challenges in research and environmental management. **PO-09: <u>Lifelong Learning & Professional Growth</u>:** Cultivate curiosity and adaptability for continuous learning, equipping students for higher education, research, and professional careers. **PO-10: <u>Ethical Leadership & Value-based Education</u>:** Develop leadership qualities, ethical values, and a sense of responsibility in applying science for societal progress, aligning with Indian knowledge systems and global perspectives.
Program Specific Outcomes (PSO)	**PSO1 : <u>Core Knowledge in Microbiology:-</u>** • Understand the fundamental concepts of microbiology, including microbial diversity, structure, function and classification. • Explain the role of microorganism in human health, industry, agriculture and the environment. **PSO2 : <u>Practical and Laboratory Skills:-</u>** • Perform basic microbiological techniques such as microbial staining, culturing, isolation and enumeration. • Utilize aseptic techniques and biosafety measures in handling microorganisms. • Operate laboratory instruments effectively. **PSO3 : <u>Applied and Industrial Microbiology:-</u>** • Understand the role of microorganisms and their application in food, pharmaceuticals, biotechnology and environmental science. • Demonstrate knowledge of fermentation processes, microbial biotechnology and their industrial significance.

	• Demonstrate the ability to work in teams and encourage innovation and entrepreneurship. **PSO4 : <u>Disease and Health-Related Microbiology:-</u>** • Identify pathogenic microorganisms and understand their role in infectious diseases. • Explain antimicrobial resistance, immunity and the role of microbes in public health. **PSO5 : <u>Critical Thinking and Problem-Solving:-</u>** • Analyze scientific data, interpret experimental results and troubleshoot laboratory issues. • Apply microbiological knowledge to solve real-world problems in healthcare, industry, environmental management and sustainability. **PSO6 : <u>Ethical and Professional Responsibilities:-</u>** • Follow ethical guidelines in microbiological research and laboratory work. • Adhere to safety protocols and regulatory standards in microbiology-related fields.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	■		■		■	
PO2		■			■	
PO3		■	■			
PO4				■		■
PO5		■		■	■	■
PO6			■		■	
PO7					■	■
PO8			■		■	
PO9	■	■	■	■	■	
PO10		■		■		■

STRUCTURE FOR ERP – MICROBIOLOGY – SEM – 7 Honours with OJT/RP - (UG)																	
Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit		Internal Marks		External Marks		Total	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
MAJOR 1	MB – MJ - 701	MICROBIAL GENETICS	MICROBIAL GENETICS	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 2	MB – MJ - 702	MICROBIAL METABOLISM & PHYSIOLOGICAL ADAPTATION	MICROBIAL METABOLISM & PHYSIOLOGICAL ADAPTATION	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 3	MB – MJ - 703	MICROBIAL BIOTECHNOLOGY	MICROBIAL BIOTECHNOLOGY	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MINOR ELECTIVE	MB-ME-701	FUNDAMENTALS OF CYBER SECURITY / RESEARCH METHODOLOGY	FUNDAMENTALS OF CYBER SECURITY	400-499	04	00	02.00 h	00 h	04	00	50	-	50	-	100	-
RP/OJT	MB-RP/OJT-701	RESEARCH PROJECT / ON JOB TRAINING	RESEARCH PROJECT/ ON JOB TRAINING	400-499	12		-	-	06		75		75		150	

- Cyber security syllabus will be prepared by computer science faculty and of VNSGU, Surat.
- Research methodology-I syllabus will be prepared by Adhoc. Board of Research methodology, VNSGU, Surat.

[Subject code for Theory-2603000507016001]

[Subject code for Practical-2603000507016002]

<table>
<tr><th colspan="2">MB-MJ-701 MICROBIAL GENETICS</th></tr>
<tr><td>Program Name</td><td>B. Sc Honours (Microbiology)</td></tr>
<tr><td>Semester</td><td>VII</td></tr>
<tr><td>NCrF Credit Level</td><td>06</td></tr>
<tr><td>Course Type</td><td>MAJOR</td></tr>
<tr><td>Course Subtype</td><td>MAJOR 1</td></tr>
<tr><td>Subject Type</td><td>Discipline Specific</td></tr>
<tr><td>Course Code</td><td>MB-MJ-701</td></tr>
<tr><td>Course Level</td><td>400-499</td></tr>
<tr><td>Course Title</td><td>Microbial Genetics</td></tr>
<tr><td>Credit</td><td>02</td></tr>
<tr><td>Effective From</td><td>Academic year: 2026-27</td></tr>
<tr><td>Course Outcomes (COs)</td><td>After completing this course, students will be able to:
CO-1: Explain the principles of molecular genetics including DNA replication, transcription, translation, protein processing, and genetic information flow in microorganisms.
CO-2: Analyse mechanisms of microbial gene regulation including operon systems, transcriptional control, RNA-based regulation, and signal transduction pathways.
CO-3: Analyse the causes of mutations, DNA damage, and repair mechanisms involved in maintaining genetic stability in microorganisms.
CO-4: Interpret the structure, properties, and functions of plasmids, transposons, bacteriophages, and other mobile genetic elements in microbial systems.
CO-5: Apply concepts of microbial genetics and gene transfer mechanisms in biotechnology, industrial microbiology, environmental microbiology, and microbial research applications.</td></tr>
<tr><td>Mapping between COs and PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td colspan="2">Course Content</td></tr>
<tr><td colspan="2">UNIT 1: NUCLEIC ACID STRUCTURE AND SYNTHESIS</td></tr>
</table>

1.1	*Molecular Biology and Genetic Elements:* DNA and Genetic Information Flow, Genetic Elements: Chromosomes and Plasmids overview
1.2	*DNA Replication:* Templates, Enzymes, and Replication Fork, Bidirectional Replication, the Replisome, and Proofreading
1.3	*RNA Synthesis:* Transcription in Bacteria, in Archaea
1.4	*Protein Synthesis*: Translation, Amino Acids, Polypeptides, and Proteins, Transfer RNA, Genetic Code, Mechanism of Protein Synthesis
1.5	*Protein Processing, Secretion, and Targeting:* Assisted Protein Folding and Chaperones, Protein Secretion in Gram-Negative Systems
1.6	*DNA-Binding Proteins and Transcriptional Regulation*: DNA-Binding Proteins, Negative Control- Repression and Induction, Positive Control- Activation, Global Control and the *lac* Operon, Transcription Controls in Archaea
1.7	*RNA-Based Regulation*: Regulatory RNAs, Riboswitches, Attenuation
1.8	*Regulation of Enzymes and Other Proteins*: Feedback Inhibition, Post-Translational Regulation
UNIT 2: MUTATION, PLASMIDS, GENE TRANSFER AND GENOME REARRANGEMENT	
2.1	*Mutation and DNA repair:* The causes of mutations, Repair of mutations and other types of DNA damage
2.2	*Plasmid*: Functions Encoded, Structure, Properties of Plasmids
2.3	Transformation, Artificially Induced Competence- Chemical Induction, Electroporation and Protoplast Transformation
2.4	Transduction
2.5	Conjugation and Formation of Hfr Strains & Chromosome Mobilization, mapping genes by interrupted mating, Gene Transfer in Archaea,
2.6	*Recombination*: Homologous and site-specific recombination
2.7	*Transposition*: Transposition, Mechanisms of Transposition and General Properties of Transposons

References

- Brown, T. A. (2023). *Genomes 5* (5th ed.). CRC Press. ISBN: 978-0-367-67866-1
- Henkin, T. M., & Peters, J. E. (2020). *Snyder and Champness molecular genetics of bacteria* (5th ed.). ASM Press; John Wiley & Sons. ISBN 9781555819750
- Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2014). *Lewin's GENES XI* (11th ed.). Jones & Bartlett Learning. ISBN 9781449659851
- Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2018). *Brock biology of microorganisms* (15th ed.). Pearson. ISBN 13: 978-1-292-23510-3
- Willey, J. M., Sandman, K. M., & Wood, D. H. (2023). *Prescott's microbiology* (12th ed.). McGraw-Hill Education. ISBN 978-1-265-12303-1

Online references

- https://swayam.gov.in/
- https://swayam-plus.swayam2.ac.in/

Teaching Methodology The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.
Evaluation scheme 50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-701 MICROBIAL GENETICS

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 1**
Subject Type	**Discipline specific**
Course Code	**MBP-MJ-701**
Course Level	**400-499**
Course Title	**Microbial Genetics Practical**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	Upon successful completion of this practical course, the students will be able to: **CO1:** Perform the isolation, purification and quantitative estimation of genomic DNA, plasmid DNA and RNA from microbial cells using standard molecular biology techniques. **CO2:** Execute microbial genetic experiments involving mutation induction, mutant isolation and gene expression analysis to understand microbial genetics and gene regulation. **CO3:** Demonstrate bacterial transformation techniques and interpret the role of gene transfer mechanisms in microbial genetic exchange. **CO4:** To demonstrate execution of lac-operon.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO4						

Course Content

1. Extraction of bacterial genomic DNA from bacteria and Quantitative estimation of DNA.
2. Extraction of RNA from yeast and Quantitative estimation of RNA.
3. Isolation of Plasmid DNA.
4. Isolation of Auxotrophic Mutants by Replica Plating technique.
5. Study of UV-Induced Mutation in Bacteria.
6. Induction of β-Galactosidase Activity (lac Operon Demonstration).
7. Bacterial Transformation testing using agar plate methods.

References

- Patel, R. J., & Patel, R. K. Experimental Microbiology, Vol. 1, 10th Edition, Aditya, 2022
- Patel, R.J., & Patel, R. K. Experimental Microbiology, Vol. 2, 10th Edition, Aditya, 2022.
- Aneja, K. R., Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.
- Cappuccino, J. G., Microbiology: A Laboratory Manual, 6Ed., Singapore Pearson Education Pvt. Ltd., 2005.
- Bossi, Camilli, Grundl, Experiments in Bacterial Genetics: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 2023, ISBN 978-1621824497
- Tiwari, R. P., Hoondal, G. S., & Tewari, R. (2004). Laboratory techniques in microbiology & biotechnology (1st ed.). Abhishek Publications ISBN 81-8247-077-3

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive Discussion, seminars, assignments, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

[Subject code for Theory-2603000507026001]

[Subject code for Practical-2603000507026002]

MB-MJ-702: MICROBIAL METABOLISM AND PHYSIOLOGICAL ADAPTATION

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 2**
Subject Type	**Discipline Specific**
Course Code	**MB-MJ-702**
Course Level	**400-499**
Course Title	**Microbial Metabolism and Physiological Adaptation**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1**: Explain the fundamental principles of microbial metabolism, bioenergetics, ATP synthesis, redox reactions, and energy generation mechanisms in microorganisms. **CO-2**: Describe major catabolic pathways including aerobic respiration, anaerobic respiration, fermentation pathways, autotrophy, lithotrophy, methanogenesis, and phototrophy in microorganisms. **CO-3**: Explain anabolic processes including biosynthesis of amino acids, nucleotides, lipids, peptidoglycan, and inorganic metabolic pathways such as nitrogen and sulfur metabolism. **CO-4**: Demonstrate practical skills in microbial physiology techniques including growth curve analysis, fermentation tests, anaerobic cultivation, enzymatic assays, endospore staining, and biofilm studies. **CO-5**: Apply concepts of microbial metabolism and physiological adaptations in environmental microbiology, industrial microbiology, biotechnology, metabolic engineering, and sustainable microbial processes.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■					
CO2	■					
CO3	■	■	■		■	
CO4	■	■	■		■	
CO5	■	■	■		■	■

Course Content

UNIT 1: METABOLISM AND BIOENERGETICS

1.1	Introduction to Microbial Metabolism, Important Principles and Concepts, ATP- the Major Energy Currency

1.2	Redox Reactions, Sequential Redox Reactions, Biochemical Pathways- Sets of Linked Chemical Reactions, Enzymes and Ribozymes, Metabolism regulation to maintain Homeostasis
1.3	Cellular Mechanisms for ATP Synthesis, Chemiosmotic Theory, ATP Synthase, The Proton Motive Force (PMF) Quantifying PMF, Environmental impacts on PMF
1.4	Oxidative decarboxylation of pyruvate, TCA cycle, Glyoxylate cycle, anaplerotic reactions
1.5	Electron Transport and Oxidative Phosphorylation, Aerobic respiration, Anaerobic respiration, Energy yield comparison Fermentation Pathways:
1.6	Propionate, Acetate, Lactate, Mixed-Acid and Butanediol Fermentation, and Butyrate Fermentation, Syntrophy Autotrophic Pathways: Concept of autotrophy, Calvin cycle, Reverse TCA cycle
1.7	C1 Metabolism: Acetogenesis, Methanogenesis, Methanotrophy Phototrophy (Light Reactions in Oxygenic Photosynthesis and in Anoxygenic Photosynthesis, Rhodopsin-Based Phototrophy)
UNIT 2: MICROBIAL ANABOLISM AND PHYSIOLOGICAL ADAPTATION	
2.1	Lithotrophy: hydrogen-oxidizing bacteria, Ammonia-oxidizing bacteria, Nitrite-oxidizing bacteria, Sulfur-oxidizing prokaryotes, Iron-oxidizing bacteria
2.2	Inorganic metabolisms: Assimilation and Dissimilation of Nitrate and Sulfate, Nitrogen fixation: nitrogen-fixing systems and nitrogenase
2.3	Anabolism and Biosynthesis: concept of biosynthesis, Precursor Metabolites for Biosynthesis
2.4	Lipid Synthesis: Fatty Acids and Phospholipids, Sterols and Isoprenoid Lipids, Lipopolysaccharides, Synthesis of Peptidoglycan
2.5	Two component regulatory system
2.6	Microbial stress responses: oxidative stress, physiological response to oxidative stress in *E. coli*, heat shock response, sporulation, stages of sporulation, germination and regulation in *Bacillus subtilis*, resistance properties of endospores
2.7	Prevalence, Importance, Properties, and Regulation of Biofilm Formation, Quorum Sensing, Metabolic engineering of bacteria

References

- Kim, B. H., & Gadd, G. M. (2008). Bacterial physiology and metabolism (2nd ed.). Cambridge University Press. ISBN-13 978-0-511-39322-8
- Kumar, R. R., & Prasad, S. (2011). Metabolic engineering of bacteria. Indian Journal of Microbiology, 51(3), 403–409. https://doi.org/10.1007/s12088-011-0172-8
- Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M.,; Stahl, D. A. (2018). Brock biology of microorganisms (15th ed.). Pearson.
- Moat, A. G., Foster, J. W., & amp; Spector, M. P. (2002). Microbial physiology (4th ed.). Wiley-Liss.

- Stevens, A. M., Ditty, J. L., Parales, R. E., & amp; Merkel, S. M. (2023). Microbial physiology: Unity and diversity. ASM Books / Wiley. ISBN: 978-1683673675
- Stevens, A. M., Ditty, J. L., Parales, R. E., & Merkel, S. M. (2023). Microbial physiology: Unity and diversity. ASM Books / Wiley. ISBN: 978-1683673675
- White, D., Drummond, J., & Fuqua, C. (2012). The physiology and biochemistry of prokaryotes (4th ed.). Oxford University Press.
- Willey, J. M., Sandman, K. M., & Wood, D. H. (2023). Prescott's microbiology (12th ed.). McGraw-Hill Education. ISBN 978-1-265-12303-1

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- https://swayam-plus.swayam2.ac.in/

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Evaluation scheme

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-702 MICROBIAL METABOLISM AND PHYSIOLOGICAL ADAPTATION

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 2**
Subject Type	**Discipline Specific**
Course Code	**MBP-MJ-702**
Course Level	**400-499**
Course Title	**Microbial Metabolism and Physiological Adaptation Practical**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1**: Gain practical skills to determine the growth curve of bacterial culture and analyse the effect of stress on the growth curve pattern. **CO-2**: Develop skill to estimate the sugar utilized by yeast culture. **CO-3**: Perform the technique of endospore staining and determination of the biofilm formation. **CO-4**: Demonstrate the effect of bile salts on gram positive and gram-negative bacteria.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO4						

Course Content

1. Study of Bacterial Growth Curve under stress conditions of temperature.
2. Study of Bacterial Growth Curve under stress conditions of pH.
3. Estimation of sugar utilization by yeast by DNSA method.
4. Study of Sporulation by Endospore Staining.
5. Study of Biofilm formation by tube method using crystal violet staining.
6. Determination of sensitivity of gram positive and gram-negative bacteria to bile salts.
7. Enrichment and microscopic observation of Photosynthetic Bacteria.

References

- Patel, R. J., & Patel, R. K. Experimental Microbiology, Vol. 1, 10th Edition, Aditya, 2022
- Patel, R.J., & Patel, R. K. Experimental Microbiology, Vol. 2, 10th Edition, Aditya, 2022.
- Aneja, K. R., Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.

- Cappuccino, J. G., Microbiology: A Laboratory Manual, 6Ed., Singapore Pearson Education Pvt. Ltd., 2005.
- Tiwari, R. P., Hoondal, G. S.,; Tewari, R. (2004). Laboratory techniques in microbiology ; biotechnology (1st ed.). Abhishek Publications ISBN 81-8247-077-3

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive
Discussions, seminars, assignments, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

[Subject code for Theory-2603000507036001]

[Subject code for Practical-2603000507036002]

MB-MJ-703: MICROBIAL BIOTECHNOLOGY

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 3**
Subject Type	**Discipline specific**
Course Code	**MB-MJ-703**
Course Level	**400-499**
Course Title	**Microbial Biotechnology**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1**: Explain the role of industrial microorganisms and fermentation processes in the production of primary metabolites, industrial enzymes, and microbial products. **CO-2**: Describe the microbial production technologies of organic acids, solvents, amino acids, vitamins, antibiotics, and industrially important biomolecules. **CO-3**: Analyze the production and applications of secondary metabolites, biopolymers, biofuels, agricultural bioproducts, fermented beverages, and therapeutic microbial products. **CO-4**: Interpret advanced concepts of metabolic engineering, AI-driven enzyme design, gas fermentation, microbial electrosynthesis, and intelligent bioprocess technologies. **CO-5**: Apply principles of industrial microbiology and microbial biotechnology for sustainable production systems, environmental applications, industrial processes, and entrepreneurial opportunities.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■		■			
CO2	■		■			
CO3	■	■	■			
CO4	■	■	■		■	■
CO5	■	■	■		■	■

Course content

UNIT 1: INDUSTRIAL MICROBIAL PRODUCTS AND FERMENTATION TECHNOLOGIES

1.1	Important microbes used in industrial microbiology and biotechnology: High throughput screening
1.2	Range of fermentation processes
1.3	Organic acids: Citric acid and Lactic acid
1.4	Amino acid: L-lysine; Vitamin: B12 & Riboflavin
1.5	Solvents: Ethanol and Bio-butanol
1.6	Biopolymers: PHAs and Exopolysaccharides: Xanthan.
1.7	Agricultural bioproducts: Microbial biopesticides, Siderophores and mycorrhizal biofertilizer
1.8	Alcohol-based fermented beverages: Beer and Wine
1.9	Therapeutics: mAbs, Insulin, Interferons, Antibiotics: Cephalosporins
UNIT 2: METABOLIC ENGINEERING AND INTELLIGENT PRODUCTION TECHNOLOGIES	
2.1	Industrially important enzymes
2.2	Next generation biofuels from cyanobacteria and yeasts
2.3	AI-driven enzyme design: enzymes with tailored specificities
2.4	Glycoengineered microbes: humanized glycoproteins production
2.5	Gas fermentation by C1 pathway: industrial waste gases to bioplastics and SCPs
2.6	Microbial Electrosynthesis Systems: reduction of CO_2 into value-added chemicals
2.7	Process Analytical Technology: real-time monitoring of microbial product formation
2.8	Machine learning: reinforcement learning algorithms to maximize product yield

References

- Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of fermentation technology (3rd ed.). Elsevier.
- Okafor, Nduka, and Benedict C. Okeke. *Modern Industrial Microbiology and Biotechnology*. Boca Raton, CRC Press, 2017.
- Waites, M. J., N. L. Morgan, et al. *Industrial Microbiology: An Introduction*. Oxford, Blackwell Science, 2001.
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- Stephanopoulos, Gregory, Aristos A. Aristidou, and Jens Nielsen. *Metabolic Engineering: Principles and Methodologies*. San Diego, Academic Press, 1998.
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Pharmaceutical Biotechnology: Fundamentals and Applications. 5th ed., Cham, Springer, 2019.

- Kaplan, David L., editor. Biopolymers from Renewable Resources. Berlin, Springer, 1998
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- White, Chris, and Jamil Zainasheff. Yeast: The Practical Guide to Beer Fermentation. Boulder, Brewers Publications, 2010.

- Michael C. Flickinger, Encyclopedia of Industrial Biotechnology, Wiley Publication, 2009.
- Guo, Peixuan, and Fazlul Haque, editors. RNA Nanotechnology and Therapeutics. Boca Raton, CRC Press, 2020.
- Köpke, Michael, and Sean Simpson, editors. Gas Fermentation: Carbon Capture and Utilization. Cham, Springer, 2022.
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- Smolke, Christina D., editor. The Metabolic Pathway Engineering Handbook: Fundamentals and Applications. Boca Raton, CRC Press, 2010.

Online reference

- https://swayam.gov.in/
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Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Evaluation scheme

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-703 MICROBIAL BIOTECHNOLOGY

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 3**
Subject Type	**Discipline specific**
Course Code	**MBP-MJ-703**
Course Level	**400-499**
Course Title	**Microbial Biotechnology Practical**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1**: Gain practical skills in isolation and screening the metabolite producing microorganisms**.**

	CO-2: Perform estimation of metabolites produced during fermentation. **CO-3**: Carry out fermentation of metabolites and enzyme production on large scale**.** **CO-4**: Demonstrate the industrial production of microbial products**.**

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO4						

Course Content

1. Isolation and screening of citric acid & lactic acid producing fungi.
2. Isolation and screening of EPS producing bacteria.
3. Screening of amylase- and cellulase-producing microorganisms.
4. Production of amylase/ cellulase enzyme under solid & submerged fermentation.
5. Purification of amylase/ cellulase by ammonium sulphate and dialysis to determine specific activity and fold purification.
6. CAS assay for siderophore production.
7. Spectrophotometric estimation of Riboflavin /Vitamin B12.

References

- Patel, R. J., & Patel, R. K. Experimental Microbiology, Vol. 1, 10th Edition, Aditya, 2022
- Patel, R.J., & Patel, R. K. Experimental Microbiology, Vol. 2, 10th Edition, Aditya, 2022.
- Aneja, K. R., Experiments in Microbiology 4th ed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.
- Cappuccino, J. G., Microbiology: A Laboratory Manual, 6th Ed., Singapore Pearson Education Pvt. Ltd., 2005.
- Bartzatt, R., & Wol, T. (2014). Detection and assay of vitamin B-12 (riboflavin) in alkaline borate buffer with UV/visible spectrophotometry. International Scholarly Research Notices, 2014, Article 453085.

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive
Discussions, seminars, assignments, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

[Subject code-2603000507056001]

MB-MJ-704 (BKS): TRADITIONAL PRACTICES IN MICROBIOLOGY

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR (BKS)**
Course Subtype	**MAJOR 4**
Subject Type	**Discipline specific**
Course Code	**MB-MJ-704**
Course Level	**400-499**
Course Title	**Traditional Practices in Microbiology**
Credit	**04**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	Upon successful completion of the course, students will be able to: **CO1:** Explain the scientific basis of traditional Indian knowledge systems related to agriculture, health and biotechnology. **CO2:** Evaluate traditional fermented foods and indigenous practices from microbiological and biotechnological perspectives. **CO3:** Interpret Ayurvedic concepts in relation to microbiome science and modern biomedical research. **CO4:** Analyse scientific evidence supporting Panchagavya, Panchakarma and fasting-based interventions. **CO5:** Appreciate the contributions of Indian scientists to microbiology, molecular biology and biotechnology. **CO6:** Explore opportunities for integrating indigenous knowledge with contemporary scientific research and innovation.

Mapping between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■						■	
CO2	■	■			■		■	
CO3	■	■			■	■	■	
CO4	■	■			■		■	■
CO5	■	■			■		■	■
CO6	■	■	■				■	

Course content

UNIT 1: HISTORICAL PERSPECTIVES & INDIGENOUS KNOWLEDGE IN MICROBIOLOGY

1.1	History of microbiology: from ancient traditional practices to modern science
1.2	Role of microorganisms in ancient civilizations: Vedic, Egyptian, Mesopotamian perspectives
1.3	Traditional Indian practices and their microbial connections (Ayurveda, Siddha, Unani)
1.4	Contributions of Indian scholars (Jagadish Chandra Bose, Birbal Sahni) to microbiology
1.5	Ethnomicrobiology: definition, scope, and significance and Documentation and preservation of traditional microbiological knowledge
UNIT 2: TRADITIONAL FERMENTATION PRACTICES	
2.1	Principles of fermentation: aerobic vs. anaerobic, homo- and hetero-fermentation
2.2	Traditional fermented foods of India: Idli, Dosa, Dhokla, Jalebi, Kanji, Ambali, and Fermented dairy products: Dahi (curd), Lassi, Shrikhand, Paneer, Buttermilk
2.3	Traditional beverages: Toddy, Rice beer (Handia), Mahua wine, Neera, and Traditional fermented foods of tribal communities in Gujarat and India
2.4	Vinegar production: traditional methods
2.5	Quality, safety, and nutritional aspects of traditionally fermented products and Comparison of traditional vs. industrial fermentation processes
UNIT 3: TRADITIONAL FOOD PRESERVATION, NATURAL ANTIMICROBIALS	
3.1	Ancient and traditional methods of food preservation: sun-drying, salting, pickling and smoking
3.2	Microbiological basis of food spoilage and preservation techniques; Traditional Indian pickles (Achaar), Murabba and Papad: microbiology and role of spices
3.3	Ethnomedicinal plants with antimicrobial properties: Aloe vera, Garlic, Neem and Tulsi
3.4	Traditional wound-healing practices and antimicrobial significance; Use of honey, ghee and herbal oils as traditional antimicrobial agents
3.5	Phytochemicals and their mode of antimicrobial action;
3.6	Modern scientific validation of traditional antimicrobial agents (evidence-based approach)
UNIT 4: TRADITIONAL AGRICULTURAL MICROBIOLOGY & MODERN RELEVANCE	
4.1	Traditional soil enrichment practices: green manuring, crop rotation, mixed cropping and Traditional composting: Nadep, Vermicomposting, Pit composting – microbiological basis
4.2	Indigenous biofertilizer knowledge: Rhizobium inoculation, Azolla-Anabaena, Blue-Green Algae, and Traditional biopesticide practices: Panchagavya, Dashparni Ark, Brahmastra
4.3	Cow-based microbiological practices (Panchagavya): scientific validation and applications
4.4	Role of traditional practices in sustainable agriculture and organic farming
4.5	Integration of traditional microbiological knowledge into modern biotechnology, Bioprospecting of traditional practices: IPR issues and ethical considerations, Future perspectives: blending ethnomicrobiology with modern microbiome research

References

- Tamang, J. P. (Ed.). Ethnic Fermented Foods and Beverages of India: Science, History and Culture. Springer.
- Tamang, J. P. & Kailasapathy, K. (Eds.). Fermented Foods and Beverages of the World. CRC Press.
- Ministry of AYUSH, Government of India. Ayurveda: The Science of Life.
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- National Institute of Agricultural Extension Management (MANAGE). Study Material on Natural Farming.
- National Centre for Organic and Natural Farming (NCOF). Comprehensive Training Manual on Natural Farming.
- Swaminathan, M. S. From Green Revolution to Evergreen Revolution.
- Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M. & Losick, R. Molecular Biology of the Gene.
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- Kaur, A. & Joshi, N. (2023). Panchagavya in Human Life and Health: A Review. International Journal of Research in Ayurveda and Pharmacy.
- Chandran, D. et al. (2023). Potential Benefits and Therapeutic Applications of Panchgavya Therapy (Cowpathy) for Human and Animal Health: Current Scientific Knowledge. Journal of Experimental Biology and Agricultural Sciences.
- Narwal, N. et al. Antimicrobial Properties of Panchgavya in Curing Plant Disease.
- Nobel Prize Outreach AB. Nobel Prize Educational Resources (Autophagy, Ribosome Structure, Genetic Code and CRISPR-related discoveries).
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- Indian Knowledge Systems (IKS) Division, Ministry of Education, Government of India.
- National Centre for Organic and Natural Farming (NCOF).
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- Indian Council of Agricultural Research (ICAR).
- National Centre for Biological Sciences (NCBS), Bengaluru.
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- https://swayam-plus.swayam2.ac.in/
- https://nptel.ac.in

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Evaluation scheme

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program

In

Microbiology

4 years (Honours without OJT/Research Project)

B. Sc. Sem 7 Syllabus

(Effective from Academic Year: 2026-27)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT PROGRAM TITLE	
Name of Program	Bachelor of Science (Honours with OJT/RP) In Microbiology
Program Abbreviation	B.Sc. MB
Duration	One Year
Eligibility Criteria	As per university norms
Pre-requisite	Basic concepts in the field of microbiology
Medium of Instruction	English
Objective of Program	Objective of this program is to provide Fundamental and applied knowledge of Microorganism to students. To develop Laboratory skills and to train the students in scientific thinking to prepare for carriers like health care, pharmaceutical, biotechnology, diagnostics, industry and academia and to promote awareness to students of microbial application in the field of diseases prevention, environmental sustainability and technological innovation.
Program Outcome (PO)	**PO-01: Scientific Knowledge & Conceptual Understanding:** Develop a strong foundation in scientific principles, theories and concepts across disciplines, fostering interdisciplinary learning, advance knowledge and problem-solving abilities. **PO-02: Analytical & Critical Thinking:** Apply critical thinking and analytical reasoning to evaluate scientific data, hypotheses and real-world problems, leading to evidence-based conclusions. **PO-03: Research & Inquiry-based Learning:** Develop investigative skills through experimentation, data analysis and scientific inquiry to contribute to research and innovation. **PO-04: Laboratory & Technical Skills:** Gain hands-on experience with laboratory techniques, instrumentation and computational tools relevant to scientific research and industry applications. **PO-05: Digital & Computational Literacy:** Utilize digital tools, computational techniques and emerging technologies such as AI, bioinformatics and statistical modelling to enhance scientific learning and problem-solving.

	PO-06: <u>Environmental & Societal Responsibility</u>: Understand the role of science in addressing environmental, health and societal challenges, promoting sustainability and ethical responsibility. **PO-07: <u>Effective Communication & Collaboration</u>:** Develop proficiency in scientific communication, both written and oral, for effective dissemination of knowledge while collaborating in multidisciplinary teams. **PO-08: <u>Innovation & Entrepreneurship</u>:** Foster an entrepreneurial mind-set by applying scientific knowledge for innovation, technology development, and industry-oriented applications. Develop sustainable solutions to address real-world challenges in research and environmental management. **PO-09: <u>Lifelong Learning & Professional Growth</u>:** Cultivate curiosity and adaptability for continuous learning, equipping students for higher education, research, and professional careers. **PO-10: <u>Ethical Leadership & Value-based Education</u>:** Develop leadership qualities, ethical values, and a sense of responsibility in applying science for societal progress, aligning with Indian knowledge systems and global perspectives.
Program Specific Outcomes (PSO)	**PSO1 : <u>Core Knowledge in Microbiology:-</u>** • Understand the fundamental concepts of microbiology, including microbial diversity, structure, function and classification. • Explain the role of microorganism in human health, industry, agriculture and the environment. **PSO2 : <u>Practical and Laboratory Skills:-</u>** • Perform basic microbiological techniques such as microbial staining, culturing, isolation and enumeration. • Utilize aseptic techniques and biosafety measures in handling microorganisms. • Operate laboratory instruments effectively. **PSO3 : <u>Applied and Industrial Microbiology:-</u>** • Understand the role of microorganisms and their application in food, pharmaceuticals, biotechnology and environmental science. • Demonstrate knowledge of fermentation processes,

	microbial biotechnology and their industrial significance. • Demonstrate the ability to work in teams and encourage innovation and entrepreneurship. **PSO4 : <u>Disease and Health-Related Microbiology:-</u>** • Identify pathogenic microorganisms and understand their role in infectious diseases. • Explain antimicrobial resistance, immunity and the role of microbes in public health. **PSO5 : <u>Critical Thinking and Problem-Solving:-</u>** • Analyze scientific data, interpret experimental results and troubleshoot laboratory issues. • Apply microbiological knowledge to solve real-world problems in healthcare, industry, environmental management and sustainability. **PSO6 : <u>Ethical and Professional Responsibilities:-</u>** • Follow ethical guidelines in microbiological research and laboratory work. • Adhere to safety protocols and regulatory standards in microbiology-related fields.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	■		■		■	
PO2		■			■	
PO3		■	■			
PO4				■		■
PO5		■		■	■	■
PO6			■		■	
PO7					■	■
PO8			■		■	
PO9	■	■	■	■	■	
PO10		■		■		■

STRUCTURE FOR ERP – MICROBIOLOGY – SEM – 7 Honours without OJT/RP - (UG)																	
Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit		Internal Marks		External Marks		Total	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
MAJOR 1	MB – MJ - 701	MICROBIAL GENETICS	MICROBIAL GENETICS	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 2	MB – MJ - 702	MICROBIAL METABOLISM & PHYSIO LOGICAL ADAPTATION	MICROBIAL METABOLISM & PHYSIOLOGICAL ADAPTATION	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 3	MB – MJ - 703	MICROBIAL BIOTECHNOLOGY	MICROBIAL BIOTECHNOLOG Y	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 4	MB – MJ - 704	TRADITIONAL PRACTICES IN MICROBIOLOGY	TRADITIONAL PRACTICES IN MICROBIOLOGY	400-499	04	00	02.00 h	00 h	04	00	50	-	50	-	100	-
ME	ME-701	FUNDAMENTALS OF CYBER SECURITY	FUNDAMENTALS OF CYBER SECURITY	400-499	04	00	02.00 h	00 h	04	00	50	-	50	-	100	-
MAJOR 5	MB-MJ-705	RESEARCH METHODOLOGY-I	RESEARCH METHODOLOGY-I	400-499	02	-	01	-	02		25		25		50	-

- Cyber security syllabus will be prepared by computer science faculty and of VNSGU, Surat.
- Research methodology-I syllabus will be prepared by Adhoc. Board of Research methodology, VNSGU, Surat.

[Subject code for Theory-2603000507016001]
[Subject code for Peractical-2603000507016002]

<table>
<tr><th colspan="2">MB-MJ-701 MICROBIAL GENETICS</th></tr>
<tr><td>Program Name</td><td>B. Sc Honours (Microbiology)</td></tr>
<tr><td>Semester</td><td>VII</td></tr>
<tr><td>NCrF Credit Level</td><td>06</td></tr>
<tr><td>Course Type</td><td>MAJOR</td></tr>
<tr><td>Course Subtype</td><td>MAJOR 1</td></tr>
<tr><td>Subject Type</td><td>Discipline Specific</td></tr>
<tr><td>Course Code</td><td>MB-MJ-701</td></tr>
<tr><td>Course Level</td><td>400-499</td></tr>
<tr><td>Course Title</td><td>Microbial Genetics</td></tr>
<tr><td>Credit</td><td>02</td></tr>
<tr><td>Effective From</td><td>Academic year: 2026-27</td></tr>
<tr><td>Course Outcomes (COs)</td><td>After completing this course, students will be able to:
CO-1: Explain the principles of molecular genetics including DNA replication, transcription, translation, protein processing, and genetic information flow in microorganisms.
CO-2: Analyse mechanisms of microbial gene regulation including operon systems, transcriptional control, RNA-based regulation, and signal transduction pathways.
CO-3: Analyse the causes of mutations, DNA damage, and repair mechanisms involved in maintaining genetic stability in microorganisms.
CO-4: Interpret the structure, properties, and functions of plasmids, transposons, bacteriophages, and other mobile genetic elements in microbial systems.
CO-5: Apply concepts of microbial genetics and gene transfer mechanisms in biotechnology, industrial microbiology, environmental microbiology, and microbial research applications.</td></tr>
<tr><td>Mapping between COs and PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td colspan="2">Course Content</td></tr>
<tr><td colspan="2">UNIT 1: NUCLEIC ACID STRUCTURE AND SYNTHESIS</td></tr>
</table>

1.1	*Molecular Biology and Genetic Elements:* DNA and Genetic Information Flow, Genetic Elements: Chromosomes and Plasmids overview
1.2	*DNA Replication:* Templates, Enzymes, and Replication Fork, Bidirectional Replication, the Replisome, and Proofreading
1.3	*RNA Synthesis:* Transcription in Bacteria, in Archaea
1.4	*Protein Synthesis*: Translation, Amino Acids, Polypeptides, and Proteins, Transfer RNA, Genetic Code, Mechanism of Protein Synthesis
1.5	*Protein Processing, Secretion, and Targeting:* Assisted Protein Folding and Chaperones, Protein Secretion in Gram-Negative Systems
1.6	*DNA-Binding Proteins and Transcriptional Regulation*: DNA-Binding Proteins, Negative Control- Repression and Induction, Positive Control- Activation, Global Control and the *lac* Operon, Transcription Controls in Archaea
1.7	*RNA-Based Regulation*: Regulatory RNAs, Riboswitches, Attenuation
1.8	*Regulation of Enzymes and Other Proteins*: Feedback Inhibition, Post-Translational Regulation
UNIT 2: MUTATION, PLASMIDS, GENE TRANSFER AND GENOME REARRANGEMENT	
2.1	*Mutation and DNA repair:* The causes of mutations, Repair of mutations and other types of DNA damage
2.2	*Plasmid*: Functions Encoded, Structure, Properties of Plasmids
2.3	Transformation, Artificially Induced Competence- Chemical Induction, Electroporation and Protoplast Transformation
2.4	Transduction
2.5	Conjugation and Formation of Hfr Strains & Chromosome Mobilization, mapping genes by interrupted mating, Gene Transfer in Archaea,
2.6	*Recombination*: Homologous and site-specific recombination
2.7	*Transposition*: Transposition, Mechanisms of Transposition and General Properties of Transposons

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- Henkin, T. M., & Peters, J. E. (2020). *Snyder and Champness molecular genetics of bacteria* (5th ed.). ASM Press; John Wiley & Sons. ISBN 9781555819750
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- Willey, J. M., Sandman, K. M., & Wood, D. H. (2023). *Prescott's microbiology* (12th ed.). McGraw-Hill Education. ISBN 978-1-265-12303-1

Online references

- https://swayam.gov.in/
- https://swayam-plus.swayam2.ac.in/

Teaching Methodology The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.
Evaluation scheme 50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-701 MICROBIAL GENETICS

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 1**
Subject Type	**Discipline specific**
Course Code	**MBP-MJ-701**
Course Level	**400-499**
Course Title	**Microbial Genetics Practical**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	Upon successful completion of this practical course, the students will be able to: **CO1:** Perform the isolation, purification and quantitative estimation of genomic DNA, plasmid DNA and RNA from microbial cells using standard molecular biology techniques. **CO2:** Execute microbial genetic experiments involving mutation induction, mutant isolation and gene expression analysis to understand microbial genetics and gene regulation. **CO3:** Demonstrate bacterial transformation techniques and interpret the role of gene transfer mechanisms in microbial genetic exchange. **CO4:** To demonstrate execution of lac-operon.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO4						

Course Content

1. Extraction of bacterial genomic DNA from bacteria and Quantitative estimation of DNA.
2. Extraction of RNA from yeast and Quantitative estimation of RNA.
3. Isolation of Plasmid DNA.
4. Isolation of Auxotrophic Mutants by Replica Plating technique.
5. Study of UV-Induced Mutation in Bacteria.
6. Induction of β-Galactosidase Activity (lac Operon Demonstration).
7. Bacterial Transformation testing using agar plate methods.

References

- Patel, R. J., & Patel, R. K. Experimental Microbiology, Vol. 1, 10th Edition, Aditya, 2022
- Patel, R.J., & Patel, R. K. Experimental Microbiology, Vol. 2, 10th Edition, Aditya, 2022.
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- Tiwari, R. P., Hoondal, G. S., & Tewari, R. (2004). Laboratory techniques in microbiology & biotechnology (1st ed.). Abhishek Publications ISBN 81-8247-077-3

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive Discussion, seminars, assignments, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

[Subject code for Theory-2603000507026001]

[Subject code for Practical-2603000507026002]

MB-MJ-702: MICROBIAL METABOLISM AND PHYSIOLOGICAL ADAPTATION

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 2**
Subject Type	**Discipline Specific**
Course Code	**MB-MJ-702**
Course Level	**400-499**
Course Title	**Microbial Metabolism and Physiological Adaptation**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1**: Explain the fundamental principles of microbial metabolism, bioenergetics, ATP synthesis, redox reactions, and energy generation mechanisms in microorganisms. **CO-2**: Describe major catabolic pathways including aerobic respiration, anaerobic respiration, fermentation pathways, autotrophy, lithotrophy, methanogenesis, and phototrophy in microorganisms. **CO-3**: Explain anabolic processes including biosynthesis of amino acids, nucleotides, lipids, peptidoglycan, and inorganic metabolic pathways such as nitrogen and sulfur metabolism. **CO-4**: Demonstrate practical skills in microbial physiology techniques including growth curve analysis, fermentation tests, anaerobic cultivation, enzymatic assays, endospore staining, and biofilm studies. **CO-5**: Apply concepts of microbial metabolism and physiological adaptations in environmental microbiology, industrial microbiology, biotechnology, metabolic engineering, and sustainable microbial processes.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■					
CO2	■					
CO3	■	■	■		■	
CO4	■	■	■		■	
CO5	■	■	■		■	■

Course Content

UNIT 1: METABOLISM AND BIOENERGETICS

1.1	Introduction to Microbial Metabolism, Important Principles and Concepts, ATP- the Major Energy Currency

1.2	Redox Reactions, Sequential Redox Reactions, Biochemical Pathways- Sets of Linked Chemical Reactions, Enzymes and Ribozymes, Metabolism regulation to maintain Homeostasis
1.3	Cellular Mechanisms for ATP Synthesis, Chemiosmotic Theory, ATP Synthase, The Proton Motive Force (PMF) Quantifying PMF, Environmental impacts on PMF
1.4	Oxidative decarboxylation of pyruvate, TCA cycle, Glyoxylate cycle, anaplerotic reactions
1.5	Electron Transport and Oxidative Phosphorylation, Aerobic respiration, Anaerobic respiration, Energy yield comparison Fermentation Pathways:
1.6	Propionate, Acetate, Lactate, Mixed-Acid and Butanediol Fermentation, and Butyrate Fermentation, Syntrophy Autotrophic Pathways: Concept of autotrophy, Calvin cycle, Reverse TCA cycle
1.7	C1 Metabolism: Acetogenesis, Methanogenesis, Methanotrophy Phototrophy (Light Reactions in Oxygenic Photosynthesis and in Anoxygenic Photosynthesis, Rhodopsin-Based Phototrophy)
UNIT 2: MICROBIAL ANABOLISM AND PHYSIOLOGICAL ADAPTATION	
2.1	Lithotrophy: hydrogen-oxidizing bacteria, Ammonia-oxidizing bacteria, Nitrite-oxidizing bacteria, Sulfur-oxidizing prokaryotes, Iron-oxidizing bacteria
2.2	Inorganic metabolisms: Assimilation and Dissimilation of Nitrate and Sulfate, Nitrogen fixation: nitrogen-fixing systems and nitrogenase
2.3	Anabolism and Biosynthesis: concept of biosynthesis, Precursor Metabolites for Biosynthesis
2.4	Lipid Synthesis: Fatty Acids and Phospholipids, Sterols and Isoprenoid Lipids, Lipopolysaccharides, Synthesis of Peptidoglycan
2.5	Two component regulatory system
2.6	Microbial stress responses: oxidative stress, physiological response to oxidative stress in *E. coli*, heat shock response, sporulation, stages of sporulation, germination and regulation in *Bacillus subtilis*, resistance properties of endospores
2.7	Prevalence, Importance, Properties, and Regulation of Biofilm Formation, Quorum Sensing, Metabolic engineering of bacteria

References

- Kim, B. H., & Gadd, G. M. (2008). Bacterial physiology and metabolism (2nd ed.). Cambridge University Press. ISBN-13 978-0-511-39322-8
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- Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M.,; Stahl, D. A. (2018). Brock biology of microorganisms (15th ed.). Pearson.
- Moat, A. G., Foster, J. W., & amp; Spector, M. P. (2002). Microbial physiology (4th ed.). Wiley-Liss.

- Stevens, A. M., Ditty, J. L., Parales, R. E., & amp; Merkel, S. M. (2023). Microbial physiology: Unity and diversity. ASM Books / Wiley. ISBN: 978-1683673675
- Stevens, A. M., Ditty, J. L., Parales, R. E., & Merkel, S. M. (2023). Microbial physiology: Unity and diversity. ASM Books / Wiley. ISBN: 978-1683673675
- White, D., Drummond, J., & Fuqua, C. (2012). The physiology and biochemistry of prokaryotes (4th ed.). Oxford University Press.
- Willey, J. M., Sandman, K. M., & Wood, D. H. (2023). Prescott's microbiology (12th ed.). McGraw-Hill Education. ISBN 978-1-265-12303-1

Online reference

- https://swayam.gov.in/
- https://swayam-plus.swayam2.ac.in/

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Evaluation scheme

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-702 MICROBIAL METABOLISM AND PHYSIOLOGICAL ADAPTATION

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 2**
Subject Type	**Discipline Specific**
Course Code	**MBP-MJ-702**
Course Level	**400-499**
Course Title	**Microbial Metabolism and Physiological Adaptation Practical**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1**: Gain practical skills to determine the growth curve of bacterial culture and analyse the effect of stress on the growth curve pattern. **CO-2**: Develop skill to estimate the sugar utilized by yeast culture. **CO-3**: Perform the technique of endospore staining and determination of the biofilm formation. **CO-4**: Demonstrate the effect of bile salts on gram positive and gram-negative bacteria.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO4						

Course Content

1. Study of Bacterial Growth Curve under stress conditions of temperature.
2. Study of Bacterial Growth Curve under stress conditions of pH.
3. Estimation of sugar utilization by yeast by DNSA method.
4. Study of Sporulation by Endospore Staining.
5. Study of Biofilm formation by tube method using crystal violet staining.
6. Determination of sensitivity of gram positive and gram-negative bacteria to bile salts.
7. Enrichment and microscopic observation of Photosynthetic Bacteria.

References

- Patel, R. J., & Patel, R. K. Experimental Microbiology, Vol. 1, 10th Edition, Aditya, 2022
- Patel, R.J., & Patel, R. K. Experimental Microbiology, Vol. 2, 10th Edition, Aditya, 2022.
- Aneja, K. R., Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.

- Cappuccino, J. G., Microbiology: A Laboratory Manual, 6Ed., Singapore Pearson Education Pvt. Ltd., 2005.
- Tiwari, R. P., Hoondal, G. S.,; Tewari, R. (2004). Laboratory techniques in microbiology ; biotechnology (1st ed.). Abhishek Publications ISBN 81-8247-077-3

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive
Discussions, seminars, assignments, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

[Subject code for Theory-2603000507036001]
[Subject code for Practical-2603000507036002]

MB-MJ-703: MICROBIAL BIOTECHNOLOGY

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 3**
Subject Type	**Discipline specific**
Course Code	**MB-MJ-703**
Course Level	**400-499**
Course Title	**Microbial Biotechnology**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1**: Explain the role of industrial microorganisms and fermentation processes in the production of primary metabolites, industrial enzymes, and microbial products. **CO-2**: Describe the microbial production technologies of organic acids, solvents, amino acids, vitamins, antibiotics, and industrially important biomolecules. **CO-3**: Analyze the production and applications of secondary metabolites, biopolymers, biofuels, agricultural bioproducts, fermented beverages, and therapeutic microbial products. **CO-4**: Interpret advanced concepts of metabolic engineering, AI-driven enzyme design, gas fermentation, microbial electrosynthesis, and intelligent bioprocess technologies. **CO-5**: Apply principles of industrial microbiology and microbial biotechnology for sustainable production systems, environmental applications, industrial processes, and entrepreneurial opportunities.
Mapping between Cos and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■		■			
CO2	■		■			
CO3	■	■	■			
CO4	■	■	■		■	■
CO5	■	■	■		■	■

Course content

UNIT 1: INDUSTRIAL MICROBIAL PRODUCTS AND FERMENTATION TECHNOLOGIES

1.1	Important microbes used in industrial microbiology and biotechnology: High throughput screening
1.2	Range of fermentation processes
1.3	Organic acids: Citric acid and Lactic acid
1.4	Amino acid: L-lysine; Vitamin: B12 & Riboflavin
1.5	Solvents: Ethanol and Bio-butanol
1.6	Biopolymers: PHAs and Exopolysaccharides: Xanthan.
1.7	Agricultural bioproducts: Microbial biopesticides, Siderophores and mycorrhizal biofertilizer
1.8	Alcohol-based fermented beverages: Beer and Wine
1.9	Therapeutics: mAbs, Insulin, Interferons, Antibiotics: Cephalosporins
UNIT 2: METABOLIC ENGINEERING AND INTELLIGENT PRODUCTION TECHNOLOGIES	
2.1	Industrially important enzymes
2.2	Next generation biofuels from cyanobacteria and yeasts
2.3	AI-driven enzyme design: enzymes with tailored specificities
2.4	Glycoengineered microbes: humanized glycoproteins production
2.5	Gas fermentation by C1 pathway: industrial waste gases to bioplastics and SCPs
2.6	Microbial Electrosynthesis Systems: reduction of CO_2 into value-added chemicals
2.7	Process Analytical Technology: real-time monitoring of microbial product formation
2.8	Machine learning: reinforcement learning algorithms to maximize product yield

References

- Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of fermentation technology (3rd ed.). Elsevier.
- Okafor, Nduka, and Benedict C. Okeke. *Modern Industrial Microbiology and Biotechnology*. Boca Raton, CRC Press, 2017.
- Waites, M. J., N. L. Morgan, et al. *Industrial Microbiology: An Introduction*. Oxford, Blackwell Science, 2001.
- Aehle, Wolfgang, editor. *Enzymes in Industry: Production and Applications*. 3rd ed., Weinheim, Wiley-VCH, 2007.
- Stephanopoulos, Gregory, Aristos A. Aristidou, and Jens Nielsen. *Metabolic Engineering: Principles and Methodologies*. San Diego, Academic Press, 1998.
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Pharmaceutical Biotechnology: Fundamentals and Applications. 5th ed., Cham, Springer, 2019.

- Kaplan, David L., editor. Biopolymers from Renewable Resources. Berlin, Springer, 1998
- Pandey, Ashok, D. J. Lee, et al., editors. Biofuels from Algae. Amsterdam, Elsevier, 2014.
- White, Chris, and Jamil Zainasheff. Yeast: The Practical Guide to Beer Fermentation. Boulder, Brewers Publications, 2010.

- Michael C. Flickinger, Encyclopedia of Industrial Biotechnology, Wiley Publication, 2009.
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- Köpke, Michael, and Sean Simpson, editors. Gas Fermentation: Carbon Capture and Utilization. Cham, Springer, 2022.
- Raghavan, P., and S. Ghosh. Machine Learning and Data Science in the Power Generation and Process Industries. Amsterdam, Elsevier, 2022.
- Smolke, Christina D., editor. The Metabolic Pathway Engineering Handbook: Fundamentals and Applications. Boca Raton, CRC Press, 2010.

Online reference

- https://swayam.gov.in/
- https://swayam-plus.swayam2.ac.in/

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Evaluation scheme

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-703 MICROBIAL BIOTECHNOLOGY

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 3**
Subject Type	**Discipline specific**
Course Code	**MBP-MJ-703**
Course Level	**400-499**
Course Title	**Microbial Biotechnology Practical**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1**: Gain practical skills in isolation and screening the metabolite producing microorganisms**.**

	CO-2: Perform estimation of metabolites produced during fermentation. **CO-3**: Carry out fermentation of metabolites and enzyme production on large scale**.** **CO-4**: Demonstrate the industrial production of microbial products**.**

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 to CO4						

Course Content

1. Isolation and screening of citric acid & lactic acid producing fungi.
2. Isolation and screening of EPS producing bacteria.
3. Screening of amylase- and cellulase-producing microorganisms.
4. Production of amylase/ cellulase enzyme under solid & submerged fermentation.
5. Purification of amylase/ cellulase by ammonium sulphate and dialysis to determine specific activity and fold purification.
6. CAS assay for siderophore production.
7. Spectrophotometric estimation of Riboflavin /Vitamin B12.

References

- Patel, R. J., & Patel, R. K. Experimental Microbiology, Vol. 1, 10th Edition, Aditya, 2022
- Patel, R.J., & Patel, R. K. Experimental Microbiology, Vol. 2, 10th Edition, Aditya, 2022.
- Aneja, K. R., Experiments in Microbiology 4th ed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.
- Cappuccino, J. G., Microbiology: A Laboratory Manual, 6th Ed., Singapore Pearson Education Pvt. Ltd., 2005.
- Bartzatt, R., & Wol, T. (2014). Detection and assay of vitamin B-12 (riboflavin) in alkaline borate buffer with UV/visible spectrophotometry. International Scholarly Research Notices, 2014, Article 453085.

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive
Discussions, seminars, assignments, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

[Subject code-2603000507056001]

MB-MJ-704 (BKS): TRADITIONAL PRACTICES IN MICROBIOLOGY

Program Name	**B. Sc Honours In Microbiology**
Semester	**VII**
NCrF Credit Level	**06**
Course Type	**MAJOR (BKS)**
Course Subtype	**MAJOR 4**
Subject Type	**Discipline specific**
Course Code	**MB-MJ-704**
Course Level	**400-499**
Course Title	**Traditional Practices in Microbiology**
Credit	**04**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	Upon successful completion of the course, students will be able to: **CO1:** Explain the scientific basis of traditional Indian knowledge systems related to agriculture, health and biotechnology. **CO2:** Evaluate traditional fermented foods and indigenous practices from microbiological and biotechnological perspectives. **CO3:** Interpret Ayurvedic concepts in relation to microbiome science and modern biomedical research. **CO4:** Analyse scientific evidence supporting Panchagavya, Panchakarma and fasting-based interventions. **CO5:** Appreciate the contributions of Indian scientists to microbiology, molecular biology and biotechnology. **CO6:** Explore opportunities for integrating indigenous knowledge with contemporary scientific research and innovation.

Mapping between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■						■	
CO2	■	■			■		■	
CO3	■	■			■	■	■	
CO4	■	■			■		■	■
CO5	■	■			■		■	■
CO6	■	■	■				■	

Course content

UNIT 1: HISTORICAL PERSPECTIVES & INDIGENOUS KNOWLEDGE IN MICROBIOLOGY

1.1	History of microbiology: from ancient traditional practices to modern science
1.2	Role of microorganisms in ancient civilizations: Vedic, Egyptian, Mesopotamian perspectives
1.3	Traditional Indian practices and their microbial connections (Ayurveda, Siddha, Unani)
1.4	Contributions of Indian scholars (Jagadish Chandra Bose, Birbal Sahni) to microbiology
1.5	Ethnomicrobiology: definition, scope, and significance and Documentation and preservation of traditional microbiological knowledge
UNIT 2: TRADITIONAL FERMENTATION PRACTICES	
2.1	Principles of fermentation: aerobic vs. anaerobic, homo- and hetero-fermentation
2.2	Traditional fermented foods of India: Idli, Dosa, Dhokla, Jalebi, Kanji, Ambali, and Fermented dairy products: Dahi (curd), Lassi, Shrikhand, Paneer, Buttermilk
2.3	Traditional beverages: Toddy, Rice beer (Handia), Mahua wine, Neera, and Traditional fermented foods of tribal communities in Gujarat and India
2.4	Vinegar production: traditional methods
2.5	Quality, safety, and nutritional aspects of traditionally fermented products and Comparison of traditional vs. industrial fermentation processes
UNIT 3: TRADITIONAL FOOD PRESERVATION, NATURAL ANTIMICROBIALS	
3.1	Ancient and traditional methods of food preservation: sun-drying, salting, pickling and smoking
3.2	Microbiological basis of food spoilage and preservation techniques; Traditional Indian pickles (Achaar), Murabba and Papad: microbiology and role of spices
3.3	Ethnomedicinal plants with antimicrobial properties: Aloe vera, Garlic, Neem and Tulsi
3.4	Traditional wound-healing practices and antimicrobial significance; Use of honey, ghee and herbal oils as traditional antimicrobial agents
3.5	Phytochemicals and their mode of antimicrobial action;
3.6	Modern scientific validation of traditional antimicrobial agents (evidence-based approach)
UNIT 4: TRADITIONAL AGRICULTURAL MICROBIOLOGY & MODERN RELEVANCE	
4.1	Traditional soil enrichment practices: green manuring, crop rotation, mixed cropping and Traditional composting: Nadep, Vermicomposting, Pit composting – microbiological basis
4.2	Indigenous biofertilizer knowledge: Rhizobium inoculation, Azolla-Anabaena, Blue-Green Algae, and Traditional biopesticide practices: Panchagavya, Dashparni Ark, Brahmastra
4.3	Cow-based microbiological practices (Panchagavya): scientific validation and applications
4.4	Role of traditional practices in sustainable agriculture and organic farming
4.5	Integration of traditional microbiological knowledge into modern biotechnology, Bioprospecting of traditional practices: IPR issues and ethical considerations, Future perspectives: blending ethnomicrobiology with modern microbiome research

References

- Tamang, J. P. (Ed.). Ethnic Fermented Foods and Beverages of India: Science, History and Culture. Springer.
- Tamang, J. P. & Kailasapathy, K. (Eds.). Fermented Foods and Beverages of the World. CRC Press.
- Ministry of AYUSH, Government of India. Ayurveda: The Science of Life.
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- Swaminathan, M. S. From Green Revolution to Evergreen Revolution.
- Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M. & Losick, R. Molecular Biology of the Gene.
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- Kaur, A. & Joshi, N. (2023). Panchagavya in Human Life and Health: A Review. International Journal of Research in Ayurveda and Pharmacy.
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- Narwal, N. et al. Antimicrobial Properties of Panchgavya in Curing Plant Disease.
- Nobel Prize Outreach AB. Nobel Prize Educational Resources (Autophagy, Ribosome Structure, Genetic Code and CRISPR-related discoveries).
- Ministry of AYUSH, Government of India.
- Indian Knowledge Systems (IKS) Division, Ministry of Education, Government of India.
- National Centre for Organic and Natural Farming (NCOF).
- National Institute of Agricultural Extension Management (MANAGE).
- Indian Council of Agricultural Research (ICAR).
- National Centre for Biological Sciences (NCBS), Bengaluru.
- https://swayam.gov.in/
- https://swayam-plus.swayam2.ac.in/
- https://nptel.ac.in

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Evaluation scheme

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program

In

Microbiology

4 years (Honours with OJT/Research Project)

B. Sc. Sem 8 Syllabus

(Effective from Academic Year: 2026-27)

STRUCTURE FOR ERP – MICROBIOLOGY – SEM – 8 Honours with OJT (UG)															
Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit		Internal Marks		External Marks		Total	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
MAJOR 1	MB – MJ - 801	MOLECULAR BIOLOGY & GENOME ENGINEERING	MOLECULAR BIOLOGY & GENOME ENGINEERING	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 2	MB – MJ - 802	ENVIRONMENTAL MICROBIOLOGY	ENVIRONMENTAL MICROBIOLOGY	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 3	MB – MJ - 803	BIOPROCESS & FERMENTATION TECHNOLOGY	BIOPROCESS & FERMENTATION TECHNOLOGY	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR -4	MB-MJ-804	BIOPHYSICS, ANALYTICAL BIOCHEMISTRY AND INSTRUMENTATION	BIOPHYSICS, ANALYTICAL BIOCHEMISTRY AND INSTRUMENTATION	400-499	04	00	02.00 h	00 h	04	00	50	-	50	-	100	-
RP/OJT	MB-RP/OJT- 801	RESEARCH PROJECT / ON JOB TRAINING	RESEARCH PROJECT/ ON JOB TRAINING	400-499	12		-	-	06		75		75		150	

[Subject code for Theory-*2703000508016001*]

[Subject code for Practical-2703000508016002]

MB-MJ-801 MOLECULAR BIOLOGY & GENOME ENGINEERING	
Program Name	**B.Sc Honors In Microbiology**
Semester	**VIII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 1**
Subject Type	**Discipline Specific**
Course Code	**MB-MJ-801**
Course Level	**400 - 499**
Course Title	**Molecular Biology & Genome Engineering**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes	Upon successful completion of this course, the students will be able to: **CO1:** Explain the principles of recombinant DNA technology, DNA manipulation, cloning vectors and gene transfer mechanisms used in genetic engineering. **CO2:** Apply the concepts of DNA cloning, recombinant selection and gene expression systems in microorganisms and other biological systems. **CO3:** Analyze the structure, function and applications of different cloning and expression vectors used in genetic engineering and biotechnology. **CO4:** Explain the principles and applications of protein engineering, directed evolution, mutagenesis and microarray technologies in biological research and industry. **CO5:**Evaluate the role of genome editing technologies, including CRISPR-Cas9 and computational approaches, in modern biotechnology and life sciences.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Course Content

UNIT 1: GENETIC ENGINEERING

1.1	Preparation of total cell DNA, plasmid and bacteriophage DNA
1.2	DNA manipulative enzymes and restriction endonucleases, Ligation - joining DNA molecules
1.3	Uptake of DNA by bacterial cells and Identification of recombinants
1.4	Introduction of phage DNA into bacterial cells and non-bacterial cells
1.5	Cloning vectors based on E. coli plasmids, λ bacteriophage, vectors for synthesis of single-stranded DNA
1.6	Vectors for yeast, fungi, higher plants and for animals
1.7	Cosmids, phasmids, other advanced vectors, Expression vectors
1.8	Screening and differential screening strategies available for library screening, Manipulation of Gene Expression in Prokaryotes

UNIT 2: PROTEIN ENGINEERING AND GENOME EDITING TECHNOLOGIES

2.1	Introduction of Protein Structure and function
2.2	Concepts for Protein Engineering
2.3	Computer Simulations: A Tool for Investigating the Function of Complex Biological Macromolecules
2.4	Evolutionary Methods for Protein Engineering (Methods for the directed evolution of proteins)
2.5	Directed Mutagenesis Procedures and Protein Engineering in various enzymes
2.6	DNA and Protein Microarray technology
2.7	CRISPR-Cas9 genome editing

References

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- Li, T., Yang, Y., Qi, H., Cui, W., Zhang, L., Fu, X., He, X., Liu, M., Li, P.-F., & Yu, T. (2023). CRISPR/Cas9 therapeutics: Progress and prospects. *Signal Transduction and Targeted Therapy*, *8*(1), Article 36. https://doi.org/10.1038/s41392-023-01309-7

Rastogi, S., & Pathak, N. (2009). *Genetic engineering*. Oxford University Press, ISBN: 978-0195696578

Online References

- NCBI – https://www.ncbi.nlm.nih.gov
- Addgene – https://www.addgene.org
- DNA Learning Center (CSHL) – https://dnalc.cshl.edu
- EMBL-EBI – https://www.ebi.ac.uk
- Protein Data Bank (PDB) – https://www.rcsb.org
- UniProt – https://www.uniprot.org
- AlphaFold Protein Structure Database – https://alphafold.ebi.ac.uk
- Broad Institute CRISPR Resources – https://www.broadinstitute.org/what-broad/areas-focus/project-spotlight/crispr
- NPTEL – https://nptel.ac.in
- SWAYAM – https://swayam.gov.in
- SWAYAM Plus- https://swayam-plus.swayam2.ac.in/

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-801 MOLECULAR BIOLOGY & GENOME ENGINEERING

Program Name	**B. Sc Honours In Microbiology**
Semester	**VIII**

NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 1**
Subject Type	**Discipline Specific**
Course Code	**MBP-MJ-801**
Course Level	**400-499**
Course Title	**Molecular Biology & Genome Engineering Practical**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	Upon successful completion of this practical course, the students will be able to: **CO1:** Perform fundamental molecular biology techniques including restriction digestion, ligation and PCR amplification for manipulation and analysis of nucleic acids. **CO2:** Demonstrate protein extraction, quantification and protein folding studies using standard biochemical and molecular biology techniques. **CO3:** Apply molecular techniques such as site-directed mutagenesis and primer design for genetic modification and experimental planning. **CO4:** Carryout protein extraction and protein folding related experiments.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 To CO4						

Course Content

1. Restriction digestion of DNA/ plasmid using restriction endonuclease.
2. Ligation of DNA molecules.
3. In vitro amplification of DNA by PCR.
4. PCR Mediated Site Directed mutagenesis.
5. Protein extraction from bacterial cells and estimation by Bradford/Lowry assay.
6. Protein folding- denaturation and renaturation by Urea method.

- **References**

- Sambrook, J., & Russell, D. W. (2001). *Molecular cloning: A laboratory manual* (3rd ed.). Cold Spring Harbor Laboratory Press.
- Green, M. R., & Sambrook, J. (2019). *Molecular Cloning: A Laboratory Manual* (4th ed.). Cold Spring Harbor Laboratory Press.
- Brown, T. A. (2020). *Gene Cloning and DNA Analysis: An Introduction* (8th ed.). Wiley-Blackwell.
- Walker, J. M. (Ed.). (2009). *The Protein Protocols Handbook* (3rd ed.). Humana Press.

- Cappuccino, J. G., & Welsh, C. (2018). Microbiology: A laboratory manual (11th global ed.). Pearson Education Limited.
- Bisen, P. S. (2014). *Laboratory protocols in applied life sciences*. CRC Press.
- Alexander, S. K., Strete, D., & Niles, M. J. (2003). *Laboratory exercises in organismal and molecular microbiology*. McGraw-Hill Higher Education
- Aneja, K. R., Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.
- Saxena, J., Baunthiyal, M., & Ravi, I. (2015). *Laboratory manual of microbiology, biochemistry and molecular biology,* Scientific Publishers.
- Bossi, Camilli, Grundl, Experiments in Bacterial Genetics: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 2023, ISBN 978-1621824497
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- Baxevanis, A. D., & Ouellette, B. F. F. (Eds.). (2005). Bioinformatics: A practical guide to the analysis of genes and proteins (3rd ed.). Wiley-Interscience.
- Mount, D. W. (2021). *Bioinformatics: Sequence and Genome Analysis* (5th ed.). Cold Spring Harbor Laboratory Press.
- Lesk, A. M. (2019). *Introduction to Bioinformatics* (5th ed.). Oxford University Press.

Online References

- Addgene Protocols – https://www.addgene.org/protocols/
- New England Biolabs (NEB) Protocols and Tools – https://www.neb.com
- Benchling Molecular Biology Platform – https://www.benchling.com
- SnapGene Molecular Biology Resources – https://www.snapgene.com
- NCBI BLAST and ORF Finder – https://www.ncbi.nlm.nih.gov
- Primer3 for Primer Design – https://primer3.ut.ee
- ExPASy Bioinformatics Resource Portal – https://www.expasy.org
- SWISS-MODEL Homology Modelling Server – https://swissmodel.expasy.org
- RCSB Protein Data Bank (PDB) – https://www.rcsb.org
- AlphaFold Protein Structure Database – https://alphafold.ebi.ac.uk
- CHOPCHOP CRISPR Design Tool – https://chopchop.cbu.uib.no
- EMBL-EBI Training Portal – https://www.ebi.ac.uk/training

Teaching Methodology

The teaching methodology will involve laboratory experiments, and practical demonstrations to facilitate comprehensive experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on internal examination 50% SEE: External assessment based on semester-end university examination.

[Subject code for Theory-2703000508026001]

[Subject code for Practical-2703000508026002]

MB-MJ-802 ENVIRONMENTAL MICROBIOLOGY

Program Name	**B.Sc Honors In Microbiology**
Semester	**VIII**
NCrF Credit Level	**6.0**
Course Type	**MAJOR**
Course Subtype	**MAJOR 2**
Subject Type	**Discipline Specific**
Course Code	**MB-MJ-802**
Course Level	**400 - 499**
Course Title	**Environmental Microbiology**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1:** Explain the principles and mechanisms involved in microbial degradation of organic and inorganic pollutants, waste treatment processes and environmental bioremediation technologies for sustainable environmental management. **CO-2:** Analyze microbial processes involved in biofuel production, waste valorization, renewable bioenergy generation and circular bioeconomy applications. **CO-3:** Evaluate environmental risks associated with GMOs, biosafety issues, environmental regulations and microbial threats in relation to environmental protection and public health. **CO-4:** Assess the role of microorganisms in climate change mitigation, antimicrobial resistance dissemination, One Health approaches and ecosystem sustainability. **CO-5:** Apply microbiological and biotechnological approaches for resource recovery, environmental restoration, sustainable agriculture and innovative environmental solutions.

Mapping between COs and PSOs

	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO-1		■	■		■	
CO-2	■	■	■	■	■	
CO-3		■		■	■	■
CO-4	■			■	■	■
CO-5		■	■	■	■	

Course Content

UNIT 1: BIOREMEDIATION AND ENVIRONMENTAL WASTE MANAGEMENT TECHNOLOGIES

1.1	Degradation of hydrocarbons, Chlorinated Hydrocarbons and Aromatics, and Dioxins

1.2	Degradation of Xenobiotics Pesticides, Polymer and dye
1.3	Bioremediation with Inorganic Pollutants
1.4	Treatment of Waste from Organic Chemical Industries
1.5	Treatment of Waste from Food and Dairy Industries, Sugar and Distillery Waste, Paper and Pulp industries
1.6	Pharmaceuticals and Hospital Waste Treatment
1.7	Treatment and management of Solid Waste, Treatment of Municipal Waste
1.8	Insight of biofuel prospects From microalgae as Renewable energy source for Environmental sustainability
UNIT 2: BIOENERGY, ONE HEALTH AND SUSTAINABLE ENVIRONMENTAL BIOTECHNOLOGY	
2.1	Biodiesel, Transesterification for biodiesel, Biomethane and Biohydrogen
2.2	Conversion of Waste to Biofuels, Bioproducts, and Bioenergy
2.3	Cellulosic Ethanol Technology
2.4	Microbial Solutions for Climate Change Toward an Economically
2.5	Resilient Future, An Introduction to Sustainable Circular Bioeconomy,
2.6	Environmental risk assessment, biosafety, GMO release and environmental regulations. Microorganisms and Bioterrorism
2.7	A One-Health Perspective of Antimicrobial Resistance: Human, Animals and Environmental Health, The One Health resistome Microbially Induced Calcium Carbonate Precipitation (MICP) and Its Potential in Bioconcrete: Microbiological and Molecular Concepts

References

- Barton, L. L., & Northup, D. E. (2011). Microbial ecology. John Wiley & Sons.
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Online Resources

- SWAYAM https://swayam.gov.in
- NPTEL https://nptel.ac.in
- World Health Organization (WHO) https://www.who.int
- Food and Agriculture Organization (FAO) https://www.fao.org
- United Nations Environment Programme (UNEP) https://www.unep.org
- Bioremediation and biodegradation [https://youtu.be/OskyBh4MDy4?si=i-mD149KV2FdpOw0]
- Biodegradation of pesticides [https://youtu.be/tffTDCnuvwY?si=rqeiVGzYOIhKo5wB]
- Biodegradation of heavy metals [https://youtu.be/nO21I-UvA9I?si=Po7mWIuCxOZPj5Js]
- Biodegradation[https://youtu.be/qhqlLZKhsYQ?si=UKsVtqnvCwnFtzZD]
- https://frtr.gov/matrix/documents/Monitored-Natural-Attenuation/2006-In-Situ-and-Ex-Situ-Biodegradation-Technologies-for-Remediation-of-Contaminated-Sites.PDF

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-802 ENVIRONMENTAL MICROBIOLOGY

Program Name	**B. Sc Honours in Microbiology**
Semester	**VIII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 2**
Subject Type	**Discipline specific**
Course Code	**MBP-MJ-802**
Course Level	**400-499**
Course Title	**Environmental Microbiology**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1:** Perform laboratory techniques for assessment of microbial tolerance to environmental pollutants, biodegradation of xenobiotics and evaluation of microbial remediation potential. **CO-2:** Analyze environmental quality parameters and microbial indicators using BOD, COD and antimicrobial susceptibility testing for environmental monitoring and public health assessment. **CO-3:** Isolate, characterize and evaluate environmentally significant microorganisms including microalgae and pollutant-degrading microbial communities. **CO-4:** Apply computational tools for community metagenomic analysis to assess microbial diversity, community structure and ecological functions in environmental samples. **CO-5:** Interpret functional metagenomic datasets to identify metabolic pathways, biodegradation potential and environmental applications of microbial communities.
Mapping between COs and PSOs	

	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO-1 to CO 5						

Course Content

1. Study of heavy metal tolerance by environmental microorganisms.
2. Pesticide tolerance assay of environmental microorganisms.
3. Biodegradation of pesticide by microbial isolates.
4. Microbial degradation of synthetic dyes (methylene blue/crystal violet) and evaluation of decolourization efficiency.
5. Estimation of Biochemical Oxygen Demand (BOD).
6. Estimation of Chemical Oxygen Demand (COD).

7. Isolation and characterization of microalgae from environmental samples.
8. Antibiotic susceptibility testing of environmental isolates

References

- Ian L. Pepper, Charles P. Gerba, Terry J. Gentry, Environmental Microbiology: A Laboratory Manual, 2nd Ed. Academic Press
- Glazer Alexander N., Nikaido Hiroshi, Microbial Biotechnology: Fundamentals of Applied Microbiology, 2nd Edition, Cambridge University Press
- Agathos Spiros and Reineke Walter, Biotechnology for the Environment: Strategy and Fundamentals, Series: Advances in Biochemical Engineering/Biotechnology, Vol. 81, Springer.
- Cappuccino, J. G., & Welsh, C. (2018). Microbiology: A laboratory manual (11th global ed.). Pearson Education Limited.
- Bisen, P. S. (2014). *Laboratory protocols in applied life sciences*. CRC Press.
- Alexander, S. K., Strete, D., & Niles, M. J. (2003). *Laboratory exercises in organismal and molecular microbiology*. McGraw-Hill Higher Education
- Aneja, K. R., Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.
- Saxena, J., Baunthiyal, M., & Ravi, I. (2015). *Laboratory manual of microbiology, biochemistry and molecular biology,* Scientific Publishers.
- Bossi, Camilli, Grundl, Experiments in Bacterial Genetics: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 2023, ISBN 978-1621824497
- Tiwari, R. P., Hoondal, G. S., & Tewari, R. (2004). *Laboratory techniques in microbiology & biotechnology* (1st ed.). Abhishek Publications ISBN 81-8247-077-3

Online references

- National Center for Biotechnology Information (NCBI) https://www.ncbi.nlm.nih.gov
- PubMed https://pubmed.ncbi.nlm.nih.gov
- United Nations Environment Programme (UNEP) https://www.unep.org
- World Health Organization (WHO) – One Health & Antimicrobial Resistance Resources https://www.who.int
- Food and Agriculture Organization (FAO) https://www.fao.org
- Intergovernmental Panel on Climate Change (IPCC) https://www.ipcc.ch
- Department of Biotechnology (DBT), Government of India https://dbtindia.gov.in
- Genetic Engineering Appraisal Committee (GEAC), Government of India https://geacindia.gov.in

Teaching Methodology The teaching methodology will involve laboratory experiments, and practical demonstrations to facilitate comprehensive experimental understanding of the subject.
Distribution of Marks 50% CCE: Internal assessment based on internal examination 50% SEE: External assessment based on semester-end university examination.

[Subject code for Theory-2703000508036001]

[Subject code for Practical-2703000508036002]

MB-MJ-803 BIOPROCESS & FERMENTATION TECHNOLOGY

Program Name	**B.Sc Honors In Microbiology**
Semester	**VIII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 3**
Subject Type	**Discipline Specific**
Course Code	**MB-MJ-803**
Course Level	**400 - 499**
Course Title	**Bioprocess & Fermentation Technology**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes	Upon successful completion of this course, the students will be able to: **CO1:** Explain the principles of upstream bioprocessing, including microbial strain selection, strain improvement, culture preservation, fermentation media formulation and inoculum development for industrial fermentation processes **CO2:** Apply the concepts of microbial growth kinetics, fermentation strategies, solid-state fermentation and process optimization for efficient bioprocess developmen **CO3:** Analyze the roles of aeration, agitation, oxygen transfer, scale-up and scale-down strategies in industrial fermentation and bioreactor performance. **CO4:** Evaluate downstream processing techniques including cell separation, cell disruption, extraction, purification and product recovery used in industrial biotechnology **CO5:** Assess modern advances in bioprocess engineering, including heterologous protein production, synthetic biology, Bioprocessing 4.0 and integrated industrial biomanufacturing systems.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1		■	■			
CO2	■	■	■		■	
CO3			■			
CO4			■			■
CO5			■			■

Course Content	
UNIT 1: UPSTREAM PROCESSING AND FERMENTATION TECHNOLOGY	
1.1	Isolation of suitable microorganisms from the environment, Culture collections, Improvement of industrial microorganisms, Strain stability,
1.2	Culture preservation: Storage at reduced temperature, storage in a dehydrated form and quality control of preserved stock cultures
1.3	Fermentation media, formulation, Carbon sources Nitrogen source Minerals & others growth factor, precursors, inducers inhibitors, Oxygen requirement, Antifoam and Statistical media Optimization
1.4	Microbial growth kinetics: Batch culture, Continuous culture, Fed-batch culture
1.5	Inoculum development, inoculum transfer, Development of inocula for yeast processes and bacteria
1.6	Introduction to Solid-state fermentation, Suitability of Microorganisms for SSF Processes Biomass Measurement, Factors Affecting SSF, Scale-Up, Modeling in SSF, Types of SSF Bioreactors
1.7	Sterilization and Contamination Control: Sterilization of media, air and equipment; filtration systems; contamination sources; aseptic operation; biosafety and GMP considerations.
1.8	Process Monitoring and Control**:** Measurement and control of temperature, pH, dissolved oxygen, foam, pressure and biomass; sensors, biosensors and process automation
UNIT 2: DOWNSTREAM PROCESSING AND MODERN BIOPROCESS ENGINEERING	
2.1	Aeration and agitation: Introduction, Oxygen requirements of industrial fermentations, Oxygen supply, Determination of KLa values, Fluid rheology, Factors affecting KLa values in fermentation vessels,
2.2	Scale-Up and Scale-Down
2.3	Downstream Processing: Cell harvesting, filtration, centrifugation, cell disruption, extraction, precipitation, membrane separation, chromatography and product formulation.
2.4	Cell disruption by Physico-mechanical methods, Chemical and biological methods
2.5	Products purification: Liquid–liquid extraction, Solvent recovery, Two-phase aqueous extraction, Reversed micelle extraction, Supercritical fluid extraction, Adsorption, Removal of volatile products, Drying, Crystallization
2.6	Recent Advances and Impacts of Microtiter Plate-Based Fermentations in Synthetic Biology and Bioprocess Development
2.7	Emerging trends in bioprocess technology: microbiome microbiome-based biotechnology, omics-guided bioprocessing, AI-assisted fermentation, continuous biomanufacturing and Industry applications.

References

- Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). *Principles of fermentation technology* (3rd ed.). Elsevier Science & Technology.
- Waites, M. J., Morgan, N. L., Rockey, J. S., & Higton, G. (2001). *Industrial microbiology: An introduction*. Blackwell Science.
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- El-Mansi, E. M. T., Nielsen, J., Mousdale, D., Allman, T., & Carlson, R. (Eds.). (2019). *Fermentation microbiology and biotechnology* (4th ed.). CRC Press.
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Online References

- Addgene – https://www.addgene.org
- New England Biolabs (NEB) Protocols and Technical Resources – https://www.neb.com/tools-and-resources
- Thermo Fisher Scientific Learning Center – https://www.thermofisher.com
- Cytiva Bioprocess Resource Center – https://www.cytivalifesciences.com
- BioProcess International – https://www.bioprocessintl.com
- EMBL-EBI Training Portal – https://www.ebi.ac.uk/training
- NPTEL – https://nptel.ac.in
- SWAYAM – https://swayam.gov.in

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning and demonstrations to facilitate comprehensive theoretical understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination

PRACTICALS

MBP-MJ-803 BIOPROCESS & FERMENTATION TECHNOLOGY

<table>
<tr><td>Program Name</td><td>B. Sc Honours In Microbiology</td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td>NCrF Credit Level</td><td>06</td></tr>
<tr><td>Course Type</td><td>MAJOR</td></tr>
<tr><td>Course Subtype</td><td>MAJOR 3</td></tr>
<tr><td>Subject Type</td><td>Discipline specific</td></tr>
<tr><td>Course Code</td><td>MBP-MJ-803</td></tr>
<tr><td>Course Level</td><td>400-499</td></tr>
<tr><td>Course Title</td><td>Bioprocess & Fermentation Technology</td></tr>
<tr><td>Credit</td><td>02</td></tr>
<tr><td>Effective From</td><td>Academic year: 2026-27</td></tr>
<tr><td>Course Outcomes (COs)</td><td>Upon successful completion of this practical course, the students will be able to:
CO1: Prepare and optimize fermentation media, cultivate industrial microorganisms and evaluate microbial growth and biomass production using standard bioprocess techniques.
CO2: Perform fermentation processes for the production of industrially important metabolites and enzymes under submerged and solid-state fermentation conditions.
CO3: Apply cell harvesting, product recovery and partial purification techniques used in downstream processing of microbial products.
CO4: Operate and analyze laboratory-scale bioreactors, oxygen transfer parameters and fermentation performance using appropriate analytical methods.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1 To CO 4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td colspan="2">Course content
1. Preparation and optimization of fermentation media for microbial growth and product formation.
2. Cell harvesting by centrifugation and filtration techniques and Estimation of biomass concentration by spectrophotometric and dry cell weight methods.
3. Production and quantification of citric acid by Aspergillus niger fermentation.
4. Production and assay of industrially important enzymes (protease/cellulase) under submerged fermentation.</td></tr>
</table>

5. Production of microbial enzymes under solid-state fermentation using agro-industrial substrates.
6. Determination of oxygen transfer characteristics and estimation of volumetric oxygen transfer coefficient (kLa).
7. Recovery and partial purification of fermentation products by precipitation and membrane filtration methods.
8. Analysis of fermentation products using chromatographic or spectrophotometric methods.

References

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- Addgene Protocols – https://www.addgene.org/protocols
- New England Biolabs (NEB) Protocols – https://www.neb.com/protocols
- Thermo Fisher Scientific Learning Center – https://www.thermofisher.com
- Cytiva Bioprocess Resource Center – https://www.cytivalifesciences.com
- EMBL-EBI Training Portal – https://www.ebi.ac.uk/training
- BioProcess International – https://www.bioprocessintl.com
- NPTEL Biotechnology Courses – https://nptel.ac.in
- SWAYAM – https://swayam.gov.in
- JMP Learning Library – https://www.jmp.com/en_us/learning-library.html

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, Laboratory exercises and practical, demonstrations to facilitate comprehensive theoretical understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, practical test, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination

[Subject code-2703000508056001]

MB-MJ-804: BIOPHYSICS, ANALYTICAL BIOCHEMISTRY AND INSTRUMENTATION

Program Name	**B. Sc Honours (Microbiology)**
Semester	**VIII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 3**
Subject Type	**Discipline specific**
Course Code	**MB-MJ-804**
Course Level	**400-499**
Course Title	**Biophysics, Analytical Biochemistry and Instrumentation**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	Upon successful completion of this practical course, the students will be able to: **CO-1:** Explain the principles of biophysical chemistry, chromatography, electrophoresis and their applications in biological and biochemical investigations. **CO-2:** Apply the principles of spectroscopic, microscopic and centrifugation techniques for analysis and characterization of biomolecules and biological systems. **CO-3:** Analyze molecular structure determination methods, advanced analytical techniques and nucleic acid quantification approaches used in modern biological research. **CO-4:** Evaluate the applications of mass spectrometry, PCR variants, flow cytometry, biosensors and imaging technologies in microbiology, biotechnology and biomedical sciences. **CO-5:** Assess immunological, radiolabeling and electrophysiological techniques and their significance in diagnostics, research and healthcare applications.

Mapping between Cos and PSOs

	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO-1	■			■		
CO-2	■			■		
CO-3	■			■		
CO-4		■		■		■
CO-5		■		■		■

Course content

UNIT 1: BIOPHYSICAL CHEMISTRY, CHROMATOGRAPHIC AND ELECTROPHORETIC TECHNIQUES

1.1	Principles of biophysical chemistry: pH, buffer, reaction kinetics, thermodynamics, colligative properties
1.2	An Introduction to Chromatographic Separations, Principle, instrumentation and applications of Paper chromatography, Thin Layer
1.3	Chromatography (TLC), Principle, instrumentation and applications of Adsorption chromatography, Partition chromatography, Ion Exchange
1.4	Chromatography, Size Exclusion (Gel Filtration) Chromatography, Affinity Chromatography,
1.5	Principle, instrumentation and applications of Gas Chromatography (GC) and High-Performance Liquid Chromatography (HPLC) Electrophoresis: General principles, support media and buffers, electrophoresis of proteins, electrophoresis of nucleic acids, capillary electrophoresis and microchip electrophoresis.
UNIT 2: SPECTROSCOPY, STRUCTURAL BIOLOGY AND ADVANCED ANALYTICAL TECHNIQUES	
2.1	Spectroscopic Techniques for Biomolecular Analysis**:** UV–Visible Spectroscopy, Fluorescence Spectroscopy, Circular Dichroism (CD) Spectroscopy, Electron Spin Resonance (ESR/EPR) Spectroscopy
2.2	Structural Biology and Molecular Structure Determination: X-ray Diffraction (X-ray Crystallography), Cryo-Electron Microscopy (Cryo-EM), Nuclear Magnetic Resonance (NMR) Spectroscopy in
2.3	Structure Determination Advanced Molecular Characterization and Interaction Analysis: Light Scattering Techniques, Mass Spectrometry and its Types,
2.4	Surface Plasmon Resonance (SPR) Advanced Analytical Techniques: MALDI-TOF Mass Spectrometry, Liquid Chromatography–Mass Spectrometry (LC-
2.5	MS) and Liquid Chromatography–Tandem Mass Spectrometry (LC-MS/MS) Principle of Centrifugation, Differential centrifugation, density-gradient centrifugation, ultracentrifugation
UNIT 3: MOLECULAR ANALYSIS, QUANTIFICATION AND IMAGING TECHNOLOGIES	
3.1	Infrared and Raman Spectroscopy and Atomic Spectroscopy, Fluorescence Spectroscopy
3.2	PCR, Q-PCR, ddPCR and other variants of PCR,
3.3	Spectrophotometric and fluorometric nucleic acid quantification (Nanodrop and Qubit), Nucleic acid hybridization,
3.4	Protein Sequencing: Significance, Methods, and Applications
3.5	Confocal microscopy, fluorescence imaging, transmission electron microscopy (TEM), scanning electron microscopy (SEM), cryo-electron microscopy (Cryo-EM), Atomic Force Microscopy (AFM)

UNIT 4: CELLULAR ANALYSIS, IMMUNOTECHNIQUES AND BIOMEDICAL INSTRUMENTATION	
4.1	Principles, instrumentation and application of flow cytometry
4.2	Radiolabeling techniques: Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines
4.3	Histochemical and Immunotechniques: ELISA, RIA, blotting techniques, immunofluorescence, immunoprecipitation, FISH and GISH techniques
4.4	Concept, types and application biosensors
4.5	Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT

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- Hofmann, A., & Clokie, S. J. (Eds.). (2018). *Wilson and Walker's principles and techniques of biochemistry and molecular biology* (8th ed.). Cambridge University Press.
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- Chatwal, G. R., & Anand, S. K. (2019). *Instrumental methods of chemical analysis* (5th ed.). Himalaya Publishing House.
- https://www.metwarebio.com/what-is-protein-sequencing/

sOnline References

- https://www.metwarebio.com/what-is-protein-sequencing/
- National Center for Biotechnology Information (NCBI) – https://www.ncbi.nlm.nih.gov
- EMBL-European Bioinformatics Institute (EMBL-EBI) – https://www.ebi.ac.uk
- ExPASy Bioinformatics Resource Portal – https://www.expasy.org
- Protein Data Bank (PDB) – https://www.rcsb.org
- UniProt Protein Knowledgebase – https://www.uniprot.org
- PubChem Chemical Database – https://pubchem.ncbi.nlm.nih.gov

- NIST Chemistry WebBook – https://webbook.nist.gov
- MicroscopyU (Nikon Microscopy Education) – https://www.microscopyu.com
- Thermo Fisher Learning Center – https://www.thermofisher.com/in/en/home/global/forms/life-science/learning-center.html
- NPTEL Courses – https://nptel.ac.in
- SWAYAM – https://swayam.gov.in

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning and demonstrations to facilitate comprehensive theoretical understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program

In

Microbiology

4 years (Honours without OJT/Research Project)

B. Sc. Sem 8 Syllabus

(Effective from Academic Year: 2026-27)

STRUCTURE FOR ERP – MICROBIOLOGY – SEM – 8 Honours without OJT (UG)																	
Course Category	Course Code	Course Title	Mark sheet Title in English	Level of Course	Teaching Hours/Week		Exam Duration		Credit		Internal Marks		External Marks		Total	
					TH	PR	TH	PR	TH	PR	TH	PR	TH	PR	TH	PR
MAJOR 1	MB – MJ - 801	MOLECULAR BIOLOGY & GENOME ENGINEERING	MOLECULAR BIOLOGY & GENOME ENGINEERING	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 2	MB – MJ - 802	ENVIRONMENTAL MICROBIOLOGY	ENVIRONMENTAL MICROBIOLOGY	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR 3	MB – MJ - 803	BIOPROCESS & FERMENTATION TECHNOLOGY	BIOPROCESS & FERMENTATION TECHNOLOGY	400-499	02	04	01.00 h	06.00 h	02	02	25	25	25	25	50	50
MAJOR -4	MB-MJ 804	BIOPHYSICS, ANALYTICAL BIOCHEMISTRY AND INSTRUMENTATION	BIOPHYSICS, ANALYTICAL BIOCHEMISTRY AND INSTRUMENTATION	400-499	04	00	02.00 h	00 h	04	00	50	-	50	-	100	-
ME	ME-801	ENTREPRENEURSHIP	ENTREPRENEURSHIP	400-499	04	00	02.00 h	00 h	04	00	50	-	50	-	100	-
MAJOR 5	MB-MJ-705	RESEARCH METHODOLOGY-II	RESEARCH METHODOLOGY-II	400-499	02	-	01	-	02		25		25		50	-

[Subject code for Theory-2703000508016001]

[Subject code for Practical-2703000508016002]

MB-MJ-801 MOLECULAR BIOLOGY & GENOME ENGINEERING	
Program Name	**B.Sc Honors In Microbiology**
Semester	**VIII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 1**
Subject Type	**Discipline Specific**
Course Code	**MB-MJ-801**
Course Level	**400 - 499**
Course Title	**Molecular Biology & Genome Engineering**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes	Upon successful completion of this course, the students will be able to: **CO1:** Explain the principles of recombinant DNA technology, DNA manipulation, cloning vectors and gene transfer mechanisms used in genetic engineering. **CO2:** Apply the concepts of DNA cloning, recombinant selection and gene expression systems in microorganisms and other biological systems. **CO3:** Analyze the structure, function and applications of different cloning and expression vectors used in genetic engineering and biotechnology. **CO4:** Explain the principles and applications of protein engineering, directed evolution, mutagenesis and microarray technologies in biological research and industry. **CO5:**Evaluate the role of genome editing technologies, including CRISPR-Cas9 and computational approaches, in modern biotechnology and life sciences.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Course Content

UNIT 1: GENETIC ENGINEERING

1.1	Preparation of total cell DNA, plasmid and bacteriophage DNA
1.2	DNA manipulative enzymes and restriction endonucleases, Ligation - joining DNA molecules
1.3	Uptake of DNA by bacterial cells and Identification of recombinants
1.4	Introduction of phage DNA into bacterial cells and non-bacterial cells
1.5	Cloning vectors based on E. coli plasmids, λ bacteriophage, vectors for synthesis of single-stranded DNA
1.6	Vectors for yeast, fungi, higher plants and for animals
1.7	Cosmids, phasmids, other advanced vectors, Expression vectors
1.8	Screening and differential screening strategies available for library screening, Manipulation of Gene Expression in Prokaryotes

UNIT 2: PROTEIN ENGINEERING AND GENOME EDITING TECHNOLOGIES

2.1	Introduction of Protein Structure and function
2.2	Concepts for Protein Engineering
2.3	Computer Simulations: A Tool for Investigating the Function of Complex Biological Macromolecules
2.4	Evolutionary Methods for Protein Engineering (Methods for the directed evolution of proteins)
2.5	Directed Mutagenesis Procedures and Protein Engineering in various enzymes
2.6	DNA and Protein Microarray technology
2.7	CRISPR-Cas9 genome editing

References

- Brown, T. A. (2021). *Gene cloning and DNA analysis: An introduction* (8th ed.). Wiley-Blackwell. ISBN 9781119640783
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- Primrose, S. B., & Twyman, R. M. (2006). *Principles of gene manipulation and genomics* (7th ed.). Blackwell Publishing.
- Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). *Molecular biotechnology: Principles and applications of recombinant DNA* (4th ed.). ASM Press.
- Allan Svendsen. (Ed.). (2004). *Enzyme functionality: Design, engineering, and screening*. Marcel Dekker. ISBN: 0-8247-4709-7.

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- Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). *Molecular biotechnology: Principles and applications of recombinant DNA* (4th ed.). ASM Press.
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- Pacesa, M., Pelea, O., & Jinek, M. (2024). Past, present, and future of CRISPR genome editing technologies. Cell, 187(5), 1076–1100. https://doi.org/10.1016/j.cell.2024.01.042
- Li, T., Yang, Y., Qi, H., Cui, W., Zhang, L., Fu, X., He, X., Liu, M., Li, P.-F., & Yu, T. (2023). CRISPR/Cas9 therapeutics: Progress and prospects. *Signal Transduction and Targeted Therapy*, *8*(1), Article 36. https://doi.org/10.1038/s41392-023-01309-7

Rastogi, S., & Pathak, N. (2009). *Genetic engineering*. Oxford University Press, ISBN: 978-0195696578

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- NCBI – https://www.ncbi.nlm.nih.gov
- Addgene – https://www.addgene.org
- DNA Learning Center (CSHL) – https://dnalc.cshl.edu
- EMBL-EBI – https://www.ebi.ac.uk
- Protein Data Bank (PDB) – https://www.rcsb.org
- UniProt – https://www.uniprot.org
- AlphaFold Protein Structure Database – https://alphafold.ebi.ac.uk
- Broad Institute CRISPR Resources – https://www.broadinstitute.org/what-broad/areas-focus/project-spotlight/crispr
- NPTEL – https://nptel.ac.in
- SWAYAM – https://swayam.gov.in
- SWAYAM Plus- https://swayam-plus.swayam2.ac.in/

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, laboratory experiments, and practical demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-801 MOLECULAR BIOLOGY & GENOME ENGINEERING

Program Name	**B. Sc Honours In Microbiology**
Semester	**VIII**

NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 1**
Subject Type	**Discipline Specific**
Course Code	**MBP-MJ-801**
Course Level	**400-499**
Course Title	**Molecular Biology & Genome Engineering Practical**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	Upon successful completion of this practical course, the students will be able to: **CO1:** Perform fundamental molecular biology techniques including restriction digestion, ligation and PCR amplification for manipulation and analysis of nucleic acids. **CO2:** Demonstrate protein extraction, quantification and protein folding studies using standard biochemical and molecular biology techniques. **CO3:** Apply molecular techniques such as site-directed mutagenesis and primer design for genetic modification and experimental planning. **CO4:** Carryout protein extraction and protein folding related experiments.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1 To CO4						

Course Content

1. Restriction digestion of DNA/ plasmid using restriction endonuclease.
2. Ligation of DNA molecules.
3. In vitro amplification of DNA by PCR.
4. PCR Mediated Site Directed mutagenesis.
5. Protein extraction from bacterial cells and estimation by Bradford/Lowry assay.
6. Protein folding- denaturation and renaturation by Urea method.

- **References**

- Sambrook, J., & Russell, D. W. (2001). *Molecular cloning: A laboratory manual* (3rd ed.). Cold Spring Harbor Laboratory Press.
- Green, M. R., & Sambrook, J. (2019). *Molecular Cloning: A Laboratory Manual* (4th ed.). Cold Spring Harbor Laboratory Press.
- Brown, T. A. (2020). *Gene Cloning and DNA Analysis: An Introduction* (8th ed.). Wiley-Blackwell.
- Walker, J. M. (Ed.). (2009). *The Protein Protocols Handbook* (3rd ed.). Humana Press.

- Cappuccino, J. G., & Welsh, C. (2018). Microbiology: A laboratory manual (11th global ed.). Pearson Education Limited.
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- Alexander, S. K., Strete, D., & Niles, M. J. (2003). *Laboratory exercises in organismal and molecular microbiology*. McGraw-Hill Higher Education
- Aneja, K. R., Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.
- Saxena, J., Baunthiyal, M., & Ravi, I. (2015). *Laboratory manual of microbiology, biochemistry and molecular biology,* Scientific Publishers.
- Bossi, Camilli, Grundl, Experiments in Bacterial Genetics: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 2023, ISBN 978-1621824497
- Tiwari, R. P., Hoondal, G. S., & Tewari, R. (2004). *Laboratory techniques in microbiology & biotechnology* (1st ed.). Abhishek Publications ISBN 81-8247-077-3
- Baxevanis, A. D., & Ouellette, B. F. F. (Eds.). (2005). Bioinformatics: A practical guide to the analysis of genes and proteins (3rd ed.). Wiley-Interscience.
- Mount, D. W. (2021). *Bioinformatics: Sequence and Genome Analysis* (5th ed.). Cold Spring Harbor Laboratory Press.
- Lesk, A. M. (2019). *Introduction to Bioinformatics* (5th ed.). Oxford University Press.

Online References

- Addgene Protocols – https://www.addgene.org/protocols/
- New England Biolabs (NEB) Protocols and Tools – https://www.neb.com
- Benchling Molecular Biology Platform – https://www.benchling.com
- SnapGene Molecular Biology Resources – https://www.snapgene.com
- NCBI BLAST and ORF Finder – https://www.ncbi.nlm.nih.gov
- Primer3 for Primer Design – https://primer3.ut.ee
- ExPASy Bioinformatics Resource Portal – https://www.expasy.org
- SWISS-MODEL Homology Modelling Server – https://swissmodel.expasy.org
- RCSB Protein Data Bank (PDB) – https://www.rcsb.org
- AlphaFold Protein Structure Database – https://alphafold.ebi.ac.uk
- CHOPCHOP CRISPR Design Tool – https://chopchop.cbu.uib.no
- EMBL-EBI Training Portal – https://www.ebi.ac.uk/training

Teaching Methodology

The teaching methodology will involve laboratory experiments, and practical demonstrations to facilitate comprehensive experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on internal examination 50% SEE: External assessment based on semester-end university examination.

[Subject code for Theory-2703000508026001]

[Subject code for Practical-2703000508026002]

MB-MJ-802 ENVIRONMENTAL MICROBIOLOGY

Program Name	**B.Sc Honors In Microbiology**
Semester	**VIII**
NCrF Credit Level	**6.0**
Course Type	**MAJOR**
Course Subtype	**MAJOR 2**
Subject Type	**Discipline Specific**
Course Code	**MB-MJ-802**
Course Level	**400 - 499**
Course Title	**Environmental Microbiology**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1:** Explain the principles and mechanisms involved in microbial degradation of organic and inorganic pollutants, waste treatment processes and environmental bioremediation technologies for sustainable environmental management. **CO-2:** Analyze microbial processes involved in biofuel production, waste valorization, renewable bioenergy generation and circular bioeconomy applications. **CO-3:** Evaluate environmental risks associated with GMOs, biosafety issues, environmental regulations and microbial threats in relation to environmental protection and public health. **CO-4:** Assess the role of microorganisms in climate change mitigation, antimicrobial resistance dissemination, One Health approaches and ecosystem sustainability. **CO-5:** Apply microbiological and biotechnological approaches for resource recovery, environmental restoration, sustainable agriculture and innovative environmental solutions.

Mapping between COs and PSOs

	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO-1		■	■		■	
CO-2	■	■	■	■	■	
CO-3		■		■	■	■
CO-4	■			■	■	■
CO-5		■	■	■	■	

Course Content

UNIT 1: BIOREMEDIATION AND ENVIRONMENTAL WASTE MANAGEMENT TECHNOLOGIES

1.1	Degradation of hydrocarbons, Chlorinated Hydrocarbons and Aromatics, and Dioxins

1.2	Degradation of Xenobiotics Pesticides, Polymer and dye
1.3	Bioremediation with Inorganic Pollutants
1.4	Treatment of Waste from Organic Chemical Industries
1.5	Treatment of Waste from Food and Dairy Industries, Sugar and Distillery Waste, Paper and Pulp industries
1.6	Pharmaceuticals and Hospital Waste Treatment
1.7	Treatment and management of Solid Waste, Treatment of Municipal Waste
1.8	Insight of biofuel prospects From microalgae as Renewable energy source for Environmental sustainability
UNIT 2: BIOENERGY, ONE HEALTH AND SUSTAINABLE ENVIRONMENTAL BIOTECHNOLOGY	
2.1	Biodiesel, Transesterification for biodiesel, Biomethane and Biohydrogen
2.2	Conversion of Waste to Biofuels, Bioproducts, and Bioenergy
2.3	Cellulosic Ethanol Technology
2.4	Microbial Solutions for Climate Change Toward an Economically
2.5	Resilient Future, An Introduction to Sustainable Circular Bioeconomy,
2.6	Environmental risk assessment, biosafety, GMO release and environmental regulations. Microorganisms and Bioterrorism
2.7	A One-Health Perspective of Antimicrobial Resistance: Human, Animals and Environmental Health, The One Health resistome Microbially Induced Calcium Carbonate Precipitation (MICP) and Its Potential in Bioconcrete: Microbiological and Molecular Concepts

References

- Barton, L. L., & Northup, D. E. (2011). Microbial ecology. John Wiley & Sons.
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- Sukla, L. B., Pradhan, N., Panda, S., & Mishra, B. K. (Eds.). (2015). Environmental Microbial Biotechnology. Springer.
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Online Resources

- SWAYAM https://swayam.gov.in
- NPTEL https://nptel.ac.in
- World Health Organization (WHO) https://www.who.int
- Food and Agriculture Organization (FAO) https://www.fao.org
- United Nations Environment Programme (UNEP) https://www.unep.org
- Bioremediation and biodegradation [https://youtu.be/OskyBh4MDy4?si=i-mD149KV2FdpOw0]
- Biodegradation of pesticides [https://youtu.be/tffTDCnuvwY?si=rqeiVGzYOIhKo5wB]
- Biodegradation of heavy metals [https://youtu.be/nO21I-UvA9I?si=Po7mWIuCxOZPj5Js]
- Biodegradation[https://youtu.be/qhqlLZKhsYQ?si=UKsVtqnvCwnFtzZD]
- https://frtr.gov/matrix/documents/Monitored-Natural-Attenuation/2006-In-Situ-and-Ex-Situ-Biodegradation-Technologies-for-Remediation-of-Contaminated-Sites.PDF

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, demonstrations to facilitate comprehensive theoretical and experimental understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination.

PRACTICALS

MBP-MJ-802 ENVIRONMENTAL MICROBIOLOGY

Program Name	**B. Sc Honours in Microbiology**
Semester	**VIII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 2**
Subject Type	**Discipline specific**
Course Code	**MBP-MJ-802**
Course Level	**400-499**
Course Title	**Environmental Microbiology**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	After completing this course, students will be able to: **CO-1:** Perform laboratory techniques for assessment of microbial tolerance to environmental pollutants, biodegradation of xenobiotics and evaluation of microbial remediation potential. **CO-2:** Analyze environmental quality parameters and microbial indicators using BOD, COD and antimicrobial susceptibility testing for environmental monitoring and public health assessment. **CO-3:** Isolate, characterize and evaluate environmentally significant microorganisms including microalgae and pollutant-degrading microbial communities. **CO-4:** Apply computational tools for community metagenomic analysis to assess microbial diversity, community structure and ecological functions in environmental samples. **CO-5:** Interpret functional metagenomic datasets to identify metabolic pathways, biodegradation potential and environmental applications of microbial communities.
Mapping between COs and PSOs	

	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO-1 to CO 5						

Course Content

1. Study of heavy metal tolerance by environmental microorganisms.
2. Pesticide tolerance assay of environmental microorganisms.
3. Biodegradation of pesticide by microbial isolates.
4. Microbial degradation of synthetic dyes (methylene blue/crystal violet) and evaluation of decolourization efficiency.
5. Estimation of Biochemical Oxygen Demand (BOD).
6. Estimation of Chemical Oxygen Demand (COD).

7. Isolation and characterization of microalgae from environmental samples.
8. Antibiotic susceptibility testing of environmental isolates

References

- Ian L. Pepper, Charles P. Gerba, Terry J. Gentry, Environmental Microbiology: A Laboratory Manual, 2nd Ed. Academic Press
- Glazer Alexander N., Nikaido Hiroshi, Microbial Biotechnology: Fundamentals of Applied Microbiology, 2nd Edition, Cambridge University Press
- Agathos Spiros and Reineke Walter, Biotechnology for the Environment: Strategy and Fundamentals, Series: Advances in Biochemical Engineering/Biotechnology, Vol. 81, Springer.
- Cappuccino, J. G., & Welsh, C. (2018). Microbiology: A laboratory manual (11th global ed.). Pearson Education Limited.
- Bisen, P. S. (2014). *Laboratory protocols in applied life sciences*. CRC Press.
- Alexander, S. K., Strete, D., & Niles, M. J. (2003). *Laboratory exercises in organismal and molecular microbiology*. McGraw-Hill Higher Education
- Aneja, K. R., Experiments in Microbiology 4thed., Experiments in microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, New Age International Publishers, 2003.
- Saxena, J., Baunthiyal, M., & Ravi, I. (2015). *Laboratory manual of microbiology, biochemistry and molecular biology,* Scientific Publishers.
- Bossi, Camilli, Grundl, Experiments in Bacterial Genetics: A Laboratory Manual, Cold Spring Harbor Laboratory Press, 2023, ISBN 978-1621824497
- Tiwari, R. P., Hoondal, G. S., & Tewari, R. (2004). *Laboratory techniques in microbiology & biotechnology* (1st ed.). Abhishek Publications ISBN 81-8247-077-3

Online references

- National Center for Biotechnology Information (NCBI) https://www.ncbi.nlm.nih.gov
- PubMed https://pubmed.ncbi.nlm.nih.gov
- United Nations Environment Programme (UNEP) https://www.unep.org
- World Health Organization (WHO) – One Health & Antimicrobial Resistance Resources https://www.who.int
- Food and Agriculture Organization (FAO) https://www.fao.org
- Intergovernmental Panel on Climate Change (IPCC) https://www.ipcc.ch
- Department of Biotechnology (DBT), Government of India https://dbtindia.gov.in
- Genetic Engineering Appraisal Committee (GEAC), Government of India https://geacindia.gov.in

Teaching Methodology The teaching methodology will involve laboratory experiments, and practical demonstrations to facilitate comprehensive experimental understanding of the subject.
Distribution of Marks 50% CCE: Internal assessment based on internal examination 50% SEE: External assessment based on semester-end university examination.

[Subject code for Theory-2703000508036001]

[Subject code foe Practical-2703000508036002]

MB-MJ-803 BIOPROCESS & FERMENTATION TECHNOLOGY

Program Name	**B.Sc Honors In Microbiology**
Semester	**VIII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 3**
Subject Type	**Discipline Specific**
Course Code	**MB-MJ-803**
Course Level	**400 - 499**
Course Title	**Bioprocess & Fermentation Technology**
Credit	**02**
Effective From	**Academic year: 2026-27**
Course Outcomes	Upon successful completion of this course, the students will be able to: **CO1:** Explain the principles of upstream bioprocessing, including microbial strain selection, strain improvement, culture preservation, fermentation media formulation and inoculum development for industrial fermentation processes **CO2:** Apply the concepts of microbial growth kinetics, fermentation strategies, solid-state fermentation and process optimization for efficient bioprocess developmen **CO3:** Analyze the roles of aeration, agitation, oxygen transfer, scale-up and scale-down strategies in industrial fermentation and bioreactor performance. **CO4:** Evaluate downstream processing techniques including cell separation, cell disruption, extraction, purification and product recovery used in industrial biotechnology **CO5:** Assess modern advances in bioprocess engineering, including heterologous protein production, synthetic biology, Bioprocessing 4.0 and integrated industrial biomanufacturing systems.

Mapping between Cos and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						

Course Content	
UNIT 1: UPSTREAM PROCESSING AND FERMENTATION TECHNOLOGY	
1.1	Isolation of suitable microorganisms from the environment, Culture collections, Improvement of industrial microorganisms, Strain stability,
1.2	Culture preservation: Storage at reduced temperature, storage in a dehydrated form and quality control of preserved stock cultures
1.3	Fermentation media, formulation, Carbon sources Nitrogen source Minerals & others growth factor, precursors, inducers inhibitors, Oxygen requirement, Antifoam and Statistical media Optimization
1.4	Microbial growth kinetics: Batch culture, Continuous culture, Fed-batch culture
1.5	Inoculum development, inoculum transfer, Development of inocula for yeast processes and bacteria
1.6	Introduction to Solid-state fermentation, Suitability of Microorganisms for SSF Processes Biomass Measurement, Factors Affecting SSF, Scale-Up, Modeling in SSF, Types of SSF Bioreactors
1.7	Sterilization and Contamination Control: Sterilization of media, air and equipment; filtration systems; contamination sources; aseptic operation; biosafety and GMP considerations.
1.8	Process Monitoring and Control**:** Measurement and control of temperature, pH, dissolved oxygen, foam, pressure and biomass; sensors, biosensors and process automation
UNIT 2: DOWNSTREAM PROCESSING AND MODERN BIOPROCESS ENGINEERING	
2.1	Aeration and agitation: Introduction, Oxygen requirements of industrial fermentations, Oxygen supply, Determination of KLa values, Fluid rheology, Factors affecting KLa values in fermentation vessels,
2.2	Scale-Up and Scale-Down
2.3	Downstream Processing: Cell harvesting, filtration, centrifugation, cell disruption, extraction, precipitation, membrane separation, chromatography and product formulation.
2.4	Cell disruption by Physico-mechanical methods, Chemical and biological methods
2.5	Products purification: Liquid–liquid extraction, Solvent recovery, Two-phase aqueous extraction, Reversed micelle extraction, Supercritical fluid extraction, Adsorption, Removal of volatile products, Drying, Crystallization
2.6	Recent Advances and Impacts of Microtiter Plate-Based Fermentations in Synthetic Biology and Bioprocess Development
2.7	Emerging trends in bioprocess technology: microbiome microbiome-based biotechnology, omics-guided bioprocessing, AI-assisted fermentation, continuous biomanufacturing and Industry applications.

References

- Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). *Principles of fermentation technology* (3rd ed.). Elsevier Science & Technology.
- Waites, M. J., Morgan, N. L., Rockey, J. S., & Higton, G. (2001). *Industrial microbiology: An introduction*. Blackwell Science.
- Okafor, N., & Okeke, B. C. (2017). *Modern industrial microbiology and biotechnology* (2nd ed.). CRC Press.
- El-Mansi, E. M. T., Nielsen, J., Mousdale, D., Allman, T., & Carlson, R. (Eds.). (2019). *Fermentation microbiology and biotechnology* (4th ed.). CRC Press.
- Isoko, K., Cordiner, J. L., Kis, Z., & Moghadam, P. Z. (2024). Bioprocessing 4.0: A pragmatic review and future perspectives. *Digital Discovery*, *3*(9), 1662–1681. https://doi.org/10.1039/d4dd00127c

Online References

- Addgene – https://www.addgene.org
- New England Biolabs (NEB) Protocols and Technical Resources – https://www.neb.com/tools-and-resources
- Thermo Fisher Scientific Learning Center – https://www.thermofisher.com
- Cytiva Bioprocess Resource Center – https://www.cytivalifesciences.com
- BioProcess International – https://www.bioprocessintl.com
- EMBL-EBI Training Portal – https://www.ebi.ac.uk/training
- NPTEL – https://nptel.ac.in
- SWAYAM – https://swayam.gov.in

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning and demonstrations to facilitate comprehensive theoretical understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination

PRACTICALS

MBP-MJ-803 BIOPROCESS & FERMENTATION TECHNOLOGY

<table>
<tr><td>Program Name</td><td>B. Sc Honours In Microbiology</td></tr>
<tr><td>Semester</td><td>VIII</td></tr>
<tr><td>NCrF Credit Level</td><td>06</td></tr>
<tr><td>Course Type</td><td>MAJOR</td></tr>
<tr><td>Course Subtype</td><td>MAJOR 3</td></tr>
<tr><td>Subject Type</td><td>Discipline specific</td></tr>
<tr><td>Course Code</td><td>MBP-MJ-803</td></tr>
<tr><td>Course Level</td><td>400-499</td></tr>
<tr><td>Course Title</td><td>Bioprocess & Fermentation Technology</td></tr>
<tr><td>Credit</td><td>02</td></tr>
<tr><td>Effective From</td><td>Academic year: 2026-27</td></tr>
<tr><td>Course Outcomes (COs)</td><td>Upon successful completion of this practical course, the students will be able to:
CO1: Prepare and optimize fermentation media, cultivate industrial microorganisms and evaluate microbial growth and biomass production using standard bioprocess techniques.
CO2: Perform fermentation processes for the production of industrially important metabolites and enzymes under submerged and solid-state fermentation conditions.
CO3: Apply cell harvesting, product recovery and partial purification techniques used in downstream processing of microbial products.
CO4: Operate and analyze laboratory-scale bioreactors, oxygen transfer parameters and fermentation performance using appropriate analytical methods.</td></tr>
<tr><td>Mapping between Cos and PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1 To CO 4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td colspan="2">Course content
1. Preparation and optimization of fermentation media for microbial growth and product formation.
2. Cell harvesting by centrifugation and filtration techniques and Estimation of biomass concentration by spectrophotometric and dry cell weight methods.
3. Production and quantification of citric acid by Aspergillus niger fermentation.
4. Production and assay of industrially important enzymes (protease/cellulase) under submerged fermentation.</td></tr>
</table>

5. Production of microbial enzymes under solid-state fermentation using agro-industrial substrates.
6. Determination of oxygen transfer characteristics and estimation of volumetric oxygen transfer coefficient (kLa).
7. Recovery and partial purification of fermentation products by precipitation and membrane filtration methods.
8. Analysis of fermentation products using chromatographic or spectrophotometric methods.

References

- Walker, J. M. (Ed.). (2009). *The Protein Protocols Handbook* (3rd ed.). Humana Press.
- Cappuccino, J. G., & Welsh, C. (2018). Microbiology: A laboratory manual (11th global ed.). Pearson Education Limited.
- Bisen, P. S. (2014). *Laboratory protocols in applied life sciences*. CRC Press.
- Alexander, S. K., Strete, D., & Niles, M. J. (2003). *Laboratory exercises in organismal and molecular microbiology*. McGraw-Hill Higher Education
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- Thermo Fisher Scientific Learning Center – https://www.thermofisher.com
- Cytiva Bioprocess Resource Center – https://www.cytivalifesciences.com
- EMBL-EBI Training Portal – https://www.ebi.ac.uk/training
- BioProcess International – https://www.bioprocessintl.com
- NPTEL Biotechnology Courses – https://nptel.ac.in
- SWAYAM – https://swayam.gov.in
- JMP Learning Library – https://www.jmp.com/en_us/learning-library.html

Teaching Methodology

The teaching methodology will involve classroom lectures, interactive discussions, self-study, seminars, assignments, project-based learning, Laboratory exercises and practical, demonstrations to facilitate comprehensive theoretical understanding of the subject.

Distribution of Marks

50% CCE: Internal assessment based on class attendance, participation, practical test, assignment, seminar, internal examination etc. 50% SEE: External assessment based on semester-end university examination

[Subject code-2703000508056001]

MB-MJ-804: BIOPHYSICS, ANALYTICAL BIOCHEMISTRY AND INSTRUMENTATION

Program Name	**B. Sc Honours (Microbiology)**
Semester	**VIII**
NCrF Credit Level	**06**
Course Type	**MAJOR**
Course Subtype	**MAJOR 4**
Subject Type	**Discipline specific**
Course Code	**MB-MJ-804**
Course Level	**400-499**
Course Title	**Biophysics, Analytical Biochemistry and Instrumentation**
Credit	**04**
Effective From	**Academic year: 2026-27**
Course Outcomes (COs)	Upon successful completion of this practical course, the students will be able to: **CO-1:** Explain the principles of biophysical chemistry, chromatography, electrophoresis and their applications in biological and biochemical investigations. **CO-2:** Apply the principles of spectroscopic, microscopic and centrifugation techniques for analysis and characterization of biomolecules and biological systems. **CO-3:** Analyze molecular structure determination methods, advanced analytical techniques and nucleic acid quantification approaches used in modern biological research. **CO-4:** Evaluate the applications of mass spectrometry, PCR variants, flow cytometry, biosensors and imaging technologies in microbiology, biotechnology and biomedical sciences. **CO-5:** Assess immunological, radiolabeling and electrophysiological techniques and their significance in diagnostics, research and healthcare applications.
Mapping between Cos and PSOs	

	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO-1	■			■		
CO-2	■			■		
CO-3	■			■		
CO-4		■		■		■
CO-5		■		■		■

Course content

UNIT 1: BIOPHYSICAL CHEMISTRY, CHROMATOGRAPHIC AND ELECTROPHORETIC TECHNIQUES

1.1	Principles of biophysical chemistry: pH, buffer, reaction kinetics, thermodynamics, colligative properties
1.2	An Introduction to Chromatographic Separations, Principle, instrumentation and applications of Paper chromatography, Thin Layer
1.3	Chromatography (TLC), Principle, instrumentation and applications of Adsorption chromatography, Partition chromatography, Ion Exchange
1.4	Chromatography, Size Exclusion (Gel Filtration) Chromatography, Affinity Chromatography,
1.5	Principle, instrumentation and applications of Gas Chromatography (GC) and High-Performance Liquid Chromatography (HPLC) Electrophoresis: General principles, support media and buffers, electrophoresis of proteins, electrophoresis of nucleic acids, capillary electrophoresis and microchip electrophoresis.
UNIT 2: SPECTROSCOPY, STRUCTURAL BIOLOGY AND ADVANCED ANALYTICAL TECHNIQUES	
2.1	Spectroscopic Techniques for Biomolecular Analysis**:** UV–Visible Spectroscopy, Fluorescence Spectroscopy, Circular Dichroism (CD) Spectroscopy, Electron Spin Resonance (ESR/EPR) Spectroscopy
2.2	Structural Biology and Molecular Structure Determination: X-ray Diffraction (X-ray Crystallography), Cryo-Electron Microscopy (Cryo-EM), Nuclear Magnetic Resonance (NMR) Spectroscopy in
2.3	Structure Determination Advanced Molecular Characterization and Interaction Analysis: Light Scattering Techniques, Mass Spectrometry and its Types,
2.4	Surface Plasmon Resonance (SPR) Advanced Analytical Techniques: MALDI-TOF Mass Spectrometry, Liquid Chromatography–Mass Spectrometry (LC-
2.5	MS) and Liquid Chromatography–Tandem Mass Spectrometry (LC-MS/MS) Principle of Centrifugation, Differential centrifugation, density-gradient centrifugation, ultracentrifugation
UNIT 3: MOLECULAR ANALYSIS, QUANTIFICATION AND IMAGING TECHNOLOGIES	
3.1	Infrared and Raman Spectroscopy and Atomic Spectroscopy, Fluorescence Spectroscopy
3.2	PCR, Q-PCR, ddPCR and other variants of PCR,
3.3	Spectrophotometric and fluorometric nucleic acid quantification (Nanodrop and Qubit), Nucleic acid hybridization,
3.4	Protein Sequencing: Significance, Methods, and Applications
3.5	Confocal microscopy, fluorescence imaging, transmission electron microscopy (TEM), scanning electron microscopy (SEM), cryo-electron microscopy (Cryo-EM), Atomic Force Microscopy (AFM)

UNIT 4: CELLULAR ANALYSIS, IMMUNOTECHNIQUES AND BIOMEDICAL INSTRUMENTATION	
4.1	Principles, instrumentation and application of flow cytometry
4.2	Radiolabeling techniques: Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines
4.3	Histochemical and Immunotechniques: ELISA, RIA, blotting techniques, immunofluorescence, immunoprecipitation, FISH and GISH techniques
4.4	Concept, types and application biosensors
4.5	Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT

References

- Nelson, D. L., Cox, M. M., Hoskins, A. A., & Lehninger, A. L. (2021). *Lehninger principles of biochemistry* (8th ed.). W. H. Freeman and Company
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- https://www.metwarebio.com/what-is-protein-sequencing/

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- https://www.metwarebio.com/what-is-protein-sequencing/
- National Center for Biotechnology Information (NCBI) – https://www.ncbi.nlm.nih.gov
- EMBL-European Bioinformatics Institute (EMBL-EBI) – https://www.ebi.ac.uk
- ExPASy Bioinformatics Resource Portal – https://www.expasy.org
- Protein Data Bank (PDB) – https://www.rcsb.org
- UniProt Protein Knowledgebase – https://www.uniprot.org
- PubChem Chemical Database – https://pubchem.ncbi.nlm.nih.gov

- NIST Chemistry WebBook – https://webbook.nist.gov
- MicroscopyU (Nikon Microscopy Education) – https://www.microscopyu.com
- Thermo Fisher Learning Center – https://www.thermofisher.com/in/en/home/global/forms/life-science/learning-center.html
- NPTEL Courses – https://nptel.ac.in
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Distribution of Marks

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