Re-Accredited 'B++' 2.86 CGPA by NAAC
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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.