



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, ઉદ્ધના-મગદલા 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 :-

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 ક્રમાંક:૦૨ 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 ક્રમાંક:૨૨ થી સ્વીકારી મંજૂર કરેલ છે. જેની આથી જાણ કરવામાં આવે છે.

માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૪/૦૫/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંક:૦૨
:: 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.૧૫/૦૬/૨૦૨૪ની ઠરાવ ક્રમાંક: 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 ક્રમાંક:૦૨ 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.

(બિડાણ: ઉપર મુજબ)

ક્રમાંક : એસ./Microbiology/ સિલેબસ/પરિપત્ર/૧૨૭૯૬/૨૦૨૪

તા.૧૯-૦૬-૨૦૨૪

Wife
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.

એડમિટ કાર્ડનિલ તા. 15-06-2024
ખાખત.....22.....બિડાણ/પરિણે.....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
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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 ₂ S 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, Dehydrogenase, Oxidase
4. Study of pure culture (morphological, cultural and biochemical characteristics) of *Escherichia coli* and *Klebsiella mobilis* (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*, *Bacillus 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 from 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.