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VEER NARMAD SOUTH GUJARAT UNIVERSITY

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉદ્ધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ-૨૦૨૩-૨૪ થી અમલમાં આવનાર M.Sc. Microbiology Semester 3 & 4 ના અભ્યાસક્રમ માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૬/૦૫/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે કરેલ ભલામણ સ્વીકારી વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૬ અન્વયે કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૨૩/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૨૮ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૩/૦૪/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૨

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩-૨૪ થી અમલમાં આવનાર M.Sc. Microbiology Sem.- 3 & 4 નો વિદ્યાશાખા દ્વારા રીફર બેક કરેલ અભ્યાસક્રમમાં જરૂરી સુધારા સાથે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ ની સભાની ઠરાવ ક્રમાંક: ૬

:: આથી ઠરાવવામાં આવે છે કે, માઈક્રોબાયોલોજી વિષયની અભ્યાસ સમિતિની તા.૧૩/૦૪/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે કરેલ ભલામણ સ્વીકારી શૈક્ષણિક વર્ષ ૨૦૨૩-૨૪ થી અમલમાં આવનાર M.Sc. Microbiology Sem.-3 & 4 નો વિદ્યાશાખા દ્વારા રીફર બેક કરેલ અભ્યાસક્રમમાં જરૂરી સુધારા સાથે મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૨૩/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંક: ૨૮

:: આથી ઠરાવવામાં આવે છે કે, વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ ની સભાની ઠરાવ ક્રમાંક: ૬ અન્વયે કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

(બિડાણ: ઉપર મુજબ)

ક્રમાંક : એસ./સાયન્સ/પરિપત્ર/૧૬૦૮૨/૨૦૨૩
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પ્રતિ,

- ૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટના વડાશ્રીઓ.
..... આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારું.
- ૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારું.

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એકેડેમિક કાઉન્સિલ તા.23/06-2023

આબ.નં. ૨૪૮ બિડાણપરિશિષ્ટ. ૧૪



Veer Narmad South Gujarat University,
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M.Sc. (Microbiology) Syllabus
(Effective from JUNE, 2023)

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III
2023

Teaching & Evaluation Scheme Semester III

Theory Paper/ Practical	Teaching schedule Hrs/ week	Exam schedule			Total marks	Credit
		Duration (Hrs)	Internal marks	External marks		
Theory papers:						
1: Core I (CC-1) Fermentation technology	4	3	30	70	100	4
2: Core II (CC-2) Industrial microbiology	4	3	30	70	100	4
3: Core III (CE-1) Agricultural microbiology	4	3	30	70	100	4
Inter / multi-Disciplinary (AECC)	4	3	30	70	100	4
4: Elective Paper –I Research methodology & Biostatistics Elective Paper –2 Biostatistics, research methodology and communication skills						
Practicals:	12	10-15	50	100	150	6
5. Practical based on Core I, II, III & Elective paper I & II						
6. Skill Based elective paper / swayam/ other MOOC courses GE-1 Bioprocess engineering GE-2 Biosafety regulations, Bioethics and IPR GE-3 Advances in diagnostic microbiology GE-4 Mathematics and general aptitude skills	2	-	20	30	50	2

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III

MB 3001: FERMENTATION TECHNOLOGY

1. Course Code & Title

Course code: Core course 1 (MB 3001)
Course title: Fermentation technology
Course type: Core
Course credits: 04

2. Course overview and Course Objectives

The objective of this paper is to introduce students to fermentation process and impart knowledge required for fermentation. The paper also provides the information about the industrial applications and recent technological advances in fermentation technology.

Course Objectives

- To study the methods of screening and isolation of industrially important microorganisms and also the techniques of strain improvement and its preservation.
- To learn the constituents of media, available sources, media optimization and sterilization for industrial production.
- To gain an insight of the components of a bioreactor and its design as well as to learn types of fermentation process
- To prepare the students for downstream processing and effluent treatment essentials for fermentation process.

3. Course Content

UNIT 1	ISOLATION, SCREENING AND IMPROVEMENT OF INDUSTRIALLY IMPORTANT MICROORGANISMS
	Teaching Duration: Lectures 15
1.1	Isolation of industrially important microorganisms
1.2	Screening methods and high throughput screening: Enzymes from Extreme Environments, Cell-Based Screening Methods, Metabolomics for the Discovery of Novel Compounds, Methods to access Silent Biosynthetic Pathways
1.3	New approaches to microbial isolations and actinomycetes
1.4	Strain Improvement: Selection and Improvement of Industrial Organisms for Biotechnological Applications
1.5	Over production: Processes for Overproduction of Microbial Metabolites for Industrial Applications
1.6	Culture preservation: storage at reduced temperature, storage in a dehydrated form, quality control of preserved stock
1.7	Inoculum development: criteria for the transfer of inoculum, Development of inoculum for yeast and bacterial processes

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UNIT 2	MEDIA FOR INDUSTRIAL FERMENTATIONS
	Teaching Duration: Lectures 15
2.1	Introduction
2.2	Typical media
2.3	Medium formulation
2.4	Media components for cultivation of industrial microorganisms
2.5	Oxygen requirement and antifoams
2.6	Biosynthetic Pathways for Metabolic Products of Microorganisms
2.7	Media sterilization
2.8	Statistical optimization of media

UNIT 3	FERMENTORS: DESIGN, OPERATION, AND APPLICATIONS
	Teaching Duration: Lectures 15
3.1	Bioreactors & its components parts
3.2	Peripheral parts and accessories
3.3	Alternative vessel designs: The Aerated Stirred-Tank Batch fermenter and anaerobic batch fermenter
3.4	Design of New fermenters based on the Physiology of the Organisms: Air Lift fermenters
3.5	Methods of measuring process variables, On-line analysis of other chemical factors, Control systems
3.6	Fermenter configurations: Fed-batch cultivation, surface or solid state(substrate)
3.7	Microbial Experimentation in the Fermentation Industry The Place of the Pilot Plant
3.8	Current trends and future prospects in fermenter design and applications

UNIT 4	DOWNSTREAM PROCESSING AND EFFLUENT TREATMENT
	Teaching Duration: Lectures 15
4.1	Removal of microbial cells and other solid matters
4.2	Foam separation (floatation)
4.3	Filtration, centrifugation, cell disruption, chromatography, Membrane processes, liquid-liquid extraction, Drying, Crystallization and Whole broth processing
4.4	Solvent recovery
4.5	Effluent treatment: various disposal methods and treatment process: Aerobic processes and Anaerobic processes

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4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Students shall develop insights for the isolation, screening, cultivation, gain knowledge of strain improvements methods as well as preservation techniques.

Unit 2: Students shall gain in-depth knowledge of media components, its optimization and sterilization.

Unit3: Students shall learn scientific design of fermentor vessel, its operation and fermentation processes.

Unit 4: Students shall get acquainted with the understanding of the downstream processing and effluent treatment process.

Recommended learning resources

- Creuger W, Crueger A. and Aneja K. R., (2000) Biotechnology: A textbook of industrial microbiology, 3rd Edition, Panima, New Delhi. (ISBN: 978-93-85998-63-8)
- E.M.T. El-Mansi, Bryce C.F.A., Demain A. L. and Allman A. R., (2012) Fermentation Microbiology and Biotechnology, 3rd Edition, Taylor & Francis, (ISBN: 978-1-4398-5581-2)
- Okafor N., (2017), Modern industrial microbiology and biotechnology, 2nd edition, Science publishers, USA.. (ISBN: 978-1-1385-5018-6)
- Stanbury P. F., Whitaker A. and Hall S. J., (2016), Principles of Fermentation Technology, 3rd Edition, Elsevier, (ISBN: 978-0-08-099953-1)
- Waites, M.J., (2001) Industrial microbiology: An Introduction, 1st Edition, Blackwell publishing, (ISBN: 0-632-05307-0)

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III

MB 3002: INDUSTRIAL MICROBIOLOGY

1. Course Code & Title

Course code: Core course 1 (MB 3002)
Course title: Industrial microbiology
Course type: Core
Course credits: 04

2. Course overview and Course Objectives

Industrial microbiology is a branch of applied microbiology in which microorganisms are used in industrial processes which includes production of high- value products such as drugs, chemicals, fuels and food product. This paper includes the production and processes of various microbial metabolites at industrial scale by use of microbes.

Course Objectives

- To study the technique to develop fermented food and dairy using microorganisms.
- To learn the process of microbial fermentations for industrial production of important metabolites.
- To gain an insight of the modern trends used for the production of microbial metabolites.
- To understand the algal products and microbial products of economic importance.

3. Course Content

FERMENTED FOOD AND DAIRY PRODUCTS	
UNIT 1	Teaching Duration: Lectures 15
1.1	Fungal biomass production: Bakers' , Food, Feed and alcohol yeast
1.2	Milk based fermented foods
1.3	Grain based fermented foods: Soy sauce
1.4	Alcohol based fermented products: Beer, Wine and spirits
1.5	Vegetable based fermented foods: Sauerkraut
1.6	Fermentations for production of stimulant beverages
1.7	Microbial flavours: Vanillin and terpenes

MICROBIAL PRODUCTS FOR HEALTH CARE	
UNIT 2	Teaching Duration: Lectures 15
2.1	Antibiotics: Cephalosporin and Bacteriocin
2.2	Anticancer agents: Anthracyclines and Antitumor Antibiotics
2.3	Monoclonal antibodies: Production and recovery
2.4	Hormones: Insulin
2.5	Vaccines production
2.6	Microbial Transformation and Steroids and Sterols
2.7	Production of Ergot Alkaloids
2.8	Production of fungal antibiotics and pharmacologically active products

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VALUABLE INDUSTRIAL PRODUCTS FROM MICROBES	
UNIT 3	Teaching Duration: Lectures 15
3.1	Microbial polysaccharides: Biosurfactants, Dextran and Xanthan
3.2	PHA: Separation, purification and manufacturing methods
3.3	Carotenoids: β carotene
3.5	Probiotics and pharmabiotics
3.6	Organic acids: Citric acid and Gluconic acid
3.7	Amino acids: L-Lysine
3.8	Enzymes: Protease and Cellulase

MODERN TRENDS IN MICROBIAL PRODUCTION	
UNIT 4	Teaching Duration: Lectures 15
4.1	Techniques and technologies to produce biomass of cyanobacteria and microalgae
4.2	Single Cell Protein (SCP)
4.3	Bio pesticides & Bio inoculants
4.4	Bacterial siderophores
4.5	Microbiologically induced calcium carbonate precipitation (MICP)
4.6	CRISPR-CAS system
4.7	Search for Microbial Products with Bioactive Properties: Conventional Processes and Newer Methods of Drug Discovery, Regulating Agency for Approval

4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Students shall learn skills to develop dairy and food products

Unit 2: Students shall gain knowledge of microbial fermentations

Unit 3: Students will gain an understanding of microbial products

Unit 4: Students shall develop an understanding of microbial products of economic importance.

Recommended learning resources

- Adam M. and Dick M., (2014), Food Microbiology: An introduction, 1st edition, Medtec Publication, (ISBN: 978-93-81714-61-4)
- Clarke W., (2016), Biotechnology: Industrial Microbiology, 1st edition, CBS Publishers, (ISBN: 978-81-239-2864-7)
- Flickinger M. C. and Drew S. W., (1999), Encyclopedia of Bioprocess Technology, Volumes 1-5, Wiley-Inter-science, (ISBN: 978-0471138228)
- Okafor N., (2017), Modern Industrial Microbiology and Biotechnology, 2nd edition, Science Publishers, (ISBN: 978-1-138-03614-7)
- Peppler H. J. and Perlman D., (2004), Microbial Biotechnology, Volume 1 and Volume 2, 2nd edition, Academic press, (ISBN: 978-81-8147-495-7/978-81-8147-496-1)
- Ratledge C. and Kristiansen B., (2006), Basic Biotechnology, 3rd edition, Cambridge University Press, (ISBN: 978-0-521-72947-5)

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- Reed G., (2004), Prescott & Dunn's Industrial Microbiology, 4th edition, CBS Publishers, (ISBN: 81-239-1001-0)
- Rehm H. J. and Reed G., (2010), Biotechnology, Vol. 10, Wiley India Pvt. Ltd., (ISBN: 978-3527283200)
- Kevin Kavanagh, Fungi Biology and Applications, ISBN 0-470-86701-9 (HB) 2005, John Wiley & Sons Ltd
- Ram Prasad, Sarvajeet S. Gill, Narendra Tuteja, New and Future Developments in Microbial Biotechnology and Bioengineering, 2018 Elsevier, ISBN: 978-0-444-63987-5
- A. H. Patel, Industrial microbiology, Macmillan, new edition

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M.Sc. MICROBIOLOGY SEM III

MB 3003: AGRICULTURAL MICROBIOLOGY

1. Course Code & Title

Course code: Core course 3 (MB 3003)
Course title: Agricultural microbiology
Course type: Core
Course credits: 04

2. Course overview and Course Objectives

The course includes the study of the impact of soil microbial community and its role in biogeochemical cycling. The course objective also includes study of plant pathogen interactions and the role of artificial intelligence in tracing the plant diseases. IT includes to understand the interactions between plant and microbe and its useful impact in soil fertility.

Course Objectives

- To study the factors affecting soil microbial population and its role in enhancing soil health
- To learn the beneficial role of plant microbial interactions
- To gain an insight of plant diseases and plant pathogens. It also includes the learning of artificial intelligence tools and techniques in plant disease management.
- To understand the methods to study microbial community

3. Course Content

SOIL ECOLOGY	
UNIT 1	Teaching Duration: Lectures 15
1.1	Soil and its properties
1.2	Factors influencing soil microbial population
1.3	Ecology of soil microorganisms
1.4	Biogeochemical cycling: Carbon, Nitrogen, Sulphur, Phosphorus cycling
1.5	Microorganisms in soil aggregation
1.6	Decomposition of organic matter in soil
1.7	Microbial Biodiversity: present and future of soil health

PLANT-MICROBE INTERACTION	
UNIT 2	Teaching Duration: Lectures 15
2.1	Microbial interactions among microbes: Neutralism, Commensalism, symbiosis, synergism, amensalism, parasitism, predation, competition
2.2	Microbial interaction with plants: Phyllosphere, rhizosphere, R:S ratio, rhizoplane, spermosphere, phyllosphere
2.3	Mycorrhizae: VAM- ecto, endo, ectoendomycorrhizae
2.4	Symbiotic and free living nitrogen fixers
2.5	Mass scale production and quality control of bio inoculants

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PLANT PATHOGENICITY	
UNIT 3	Teaching Duration: Lectures 15
3.1	Plant pathogens and infectious cycle
3.2	Plant disease resistance
3.3	Physiology of parasitism
3.4	Fungal, Bacterial, Viral, mycoplasmal plant diseases
3.5	Factors affecting disease incidence and control measures
3.6	Biocontrol agents for sustainable agriculture
3.7	AI in agricultural microbiology: prediction of microbial species, microbial communities to predict disease, interaction between microbes, microbiome-disease

IDENTIFICATION OF SOIL MICROBIAL COMMUNITIES	
UNIT 4	Teaching Duration: Lectures 15
4.1	Phenotypic, biochemical characterization, carbon utilization patterns, FAME
4.2	Molecular approaches
4.2.1	G+C content, PFGE, RFLP, RAPD, AFLP, MLVA, SSCP, DGGE, TGGE
4.2.2	Hybridization based methods: DNA microarray
4.2.3	Ribotyping, MLST
4.3	Protein based characterization: Serotyping, Mass spectrometry
4.4	Study of unculturable communities
4.4.1	FISH, Phylogenetic marker
4.5	Enrichment methods: BrdU method, Stable isotope probing
4.6	Bioinformatics resources for unculturable microbial communities analysis

4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Students shall understand role of microorganisms in soil ecology and soil health.

Unit 2: Students shall gain knowledge of the beneficial interactions of microorganisms in agriculture.

Unit 3: Students will gain an understanding of the plant pathogen interactions and the role of artificial intelligence in disease detection, control and management.

Unit 4: Students shall develop an understanding of the methods to study microbial community.

Recommended learning resources

- George. N. Agrios (2005). Plant pathology, Elsevier academic press, 5th edition, U.K.
- Mehrotra. R. S. and Ashok Aggrawal (2002), Plant pathology, Tata Mc Graw Hill publishers, 2nd edition, Delhi.
- Bagyaraj D. G. and Rangaswami, G. (2005), Agricultural Microbiology, Prentice-Hall of India, 2nd edition, New Delhi.
- Vidhyasekaran, P. (2007). Fungal Pathogenesis in Plants and Crops: Molecular Biology and Host Defense mechanisms, 2nd edition, APS press, U.S.A.
- Hermann H. Prell, Peter R. Day (2001). Plant-Fungal Pathogen interaction: A classical and molecular view, 1st edition, Springer-Verlag Berlin Heidelberg, Germany. sphete

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- Kosuge T and Nester E.W. (1985-1989) Plant-Microbe interactions: Molecular and Genetic perspectives. Vol I-IV, McGraw Hill.
- Van Elsas J.D., Trevors J. T. & Wellington E.M.H (2006). Modern soil microbiology. CRC Press.
- <https://apshournals.aps.net.org/doi/full/10.1094/PDIS-03-15-0340-FE>.
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6482238/>
- <https://journals.plos.org/plosone/article/id+10.1371/journal.pone.0215502>
- <https://www.frontiersin.org/artices/10.3389/fmicb.2019.00827/full>
- <https://www.softwebsolutions.com/resources/plant-diseases-detection-using-iot.html>

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III

ELECTIVE 1
MB 3004 A: RESEARCH METHODOLOGY AND BIOSTATISTICS

1. Course Code & Title

Course code: Core Elective 1 (MB 3004)
Course title: Research methodology and biostatistics
Course type: Core
Course credits: 04

2. Course overview and Course Objectives

The learning objective of the paper will enrich the students with the basic principle of research methodology which help the students to learn essential steps involved in research. It also increases the understanding in use of biostatistics in analysis and interpretation of data.

Course Objectives

- To study the research fundamentals
- To learn about formulating a research problem, research design, and preparation of research report.
- To gain an insight of collecting data and presentation of scientific data.
- To understand the bio statistical tools and techniques for conducting research

3. Course Content

UNIT 1	RESEARCH & ITS TYPES
	Teaching Duration: Lectures 15
1.1	Meaning and objective of Research.
1.2	Motivation in research.
1.3	Criteria of good research.
1.4	Problems encountered by researchers in India.
1.5	Types of research.
1.6	Reviewing the literature for research purpose.

UNIT 2	RESEARCH METHODOLOGY
	Teaching Duration: Lectures 15
2.1	Constructing hypothesis.
2.2	Research design.
2.3	Defining a research problem.
2.4	Contents of research proposal.
2.5	Research report.
	2.5.1 Research report- Tables.
	2.5.2 Research report- Figures.
	2.5.3 Research report- Formatting & Typing.

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UNIT 3		FUNDAMENTALS OF BIOSTATISTICS
		Teaching Duration: Lectures 15
3.1	Introduction to Biostatistics 3.1.1 Definition, development & application of Biostatistics 3.1.2 Role of Biostatistics 3.1.3 Data collection and treatment.	
3.2	Preliminary Concepts.	
3.3	Diagrammatic representation of data.	
3.4	Graphical representation of data.	
3.5	Frequency Distribution.	

UNIT 4		METHODS OF DATA ANALYSIS
		Teaching Duration: Lectures 15
4.1	Measures of Central Tendency. 4.1.1 Arithmetic mean. 4.1.2 Median. 4.1.3 Mode. 4.1.4 Geometric mean. 4.1.5 Harmonic mean. 4.1.6 Illustrative problems.	
4.2	Student t-test Student t-test. 4.2.1 Introduction. 4.2.2 Student's t-Distribution. 4.2.3 Application of t-Distribution.	
4.3	Analysis of Variance (ANOVA). 4.3.1. Principle of Anova.	

4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Students shall understand fundamentals of research and its types

Unit 2: Students shall gain knowledge of research methodology

Unit 3: Students will gain an understanding the presentation of statistical data and its analysis.

Unit 4: Students shall develop an understanding of the bio statistical tools for data analysis.

Recommended learning resources

- Arora P. N. (2017) Biostatistics, Himalaya Publishing House. (ISBN: 978-93-5142-823-7)
- Gurumani N. (2011) Research Methodology for Biological Sciences, MJP Publishers, Chennai. (ISBN: 978-81-8094-016-0)
- Gurumani N. (2010) An Introduction to Biostatistics, MJP Publishers, Chennai. Revised 2nd Edition. (ISBN: 978-81-8094-006-4)
- Khan I.A. and Khanum A. (2009) Fundamentals of Biostatistics, Ukaaz Publications, Hyderabad. Revised 5th Edition. (ISBN: 978-81-9004-410-3)
- Ranjit Kumar. (2011) Research Methodology-A step by step Guide for Beginners. Sage Publications. 3rd Edition. (ISBN: 978-1-84920-301-2)

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- C. R. Kothari and Gaurav Garg (2004) Research Methodology Methods and Techniques, Newage International Publication, 2nd Revised Edition (ISBN: 978-81-224-2488-1).

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III

ELECTIVE 2
MB 3004 B: BIostatistics, RESEARCH METHODOLOGY AND COMMUNICATION SKILLS

1. Course Code & Title

Course code: Core elective 2 (MB 3004)
Course Research aptitude, Research technique tools and communication skills
Course type: Core
Course credits: 04

2. Course overview and Course Objectives

Course is designed with the blending of statistics, research methodology and communication skill to acquitted the learner with the essential's methods of the mentioned area. The course includes the methods and techniques required for the analysis of data, resource of data and ICT related details

Course Objectives

- To understand various statistical methods used for research and data presentation
- To develop research aptitude for scientific writing, communication skill and use of ICT in microbiology and life science
- To gain an insight on effective communication
- To develop deeper insights into statistics, research methodology, mathematical and logical reasoning.

3. Course Content

UNIT 1	STATISTICAL METHODS
	Teaching Duration: Lectures 15
1.1	Measures of central tendency and dispersal
1.2	Probability distributions (Binomial, Poisson and normal) and Sampling
1.3	distribution
1.4	Difference between parametric and non-parametric statistics
1.5	Confidence Interval, Errors and Levels of significance
1.6	Regression and Correlation
1.7	t-test and Analysis of variance and X ² test
1.8	Basic introduction to Multi-variant statistics
1.9	

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UNIT 2	STATISTICAL METHODS
	Teaching Duration: Lectures 15
1.1	Research: Meaning, Types, and Characteristics, Positivism and Post positivistic approach to research
1.2	Methods of Research: Experimental, Descriptive, Historical, Qualitative and Quantitative methods.
1.3	Steps of Research.
1.4	Thesis and Article writing: Format and styles of referencing.
1.5	Application of ICT in research.
1.6	Research ethics.

UNIT 3	COMMUNICATION AND ICT
	Teaching Duration: Lectures 15
3.1	Communication: Meaning, types and characteristics of communication.
3.2	Effective communication: Verbal and Non-verbal, Inter-Cultural and group communications, Classroom communication.
3.3	Barriers to effective communication.
3.4	Mass-Media and Society,
3.5	ICT: General abbreviations and terminology,
3.6	Basics of Internet, Intranet, E-mail, Audio and Video-conferencing.
3.7	Digital initiatives in higher education,
3.8	ICT and Governance.

UNIT 4	MATHEMATICAL AND LOGICAL REASONING AND APTITUDE
	Teaching Duration: Lectures 15
4.1	Types of reasoning.
4.2	Number series, Letter series, Codes and Relationships.
4.3	Mathematical Aptitude (Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc.).
4.4	Understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies, Uses of language, Connotations and denotations of terms, Classical Square of opposition.
4.6	Evaluating and distinguishing deductive and inductive reasoning.
4.7	Analogies and Venn diagram: Simple and multiple use for establishing validity of arguments.

4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit1: Student will learn the essential Statistical Methods useful for the data analysis

Unit 2: Student will learn scientific design of experiments, research methods and

Unit 3: Student will be acquainted with Communication skill and ICT related resources for the research

Unit 4: Student will develop the mathematical and logical reasoning and aptitude

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Recommended learning resources

- Biostatistics: Basic Concepts and Methodology for the Health Sciences Wayne W. Daniel and Chad L. Cross, ISBN-10 : 8126551895, Wiley; 10th Ed.
- Biostatistics by Veer Bala Rastogi, Medtech 3rd Ed., ISBN-10: 9384007595.
- Fundamentals of Biostatistics, 8th Ed., Bernard Rosner, Cengage Learning, ISBN: 978-1-305-26892-0.
- Fundamentals of Biostatistics, 1994, by Khan and Khanum , Ukaaz Publications, ISBN-10 : 8190044109.
- Statistical analysis in microbiology: statnotes, Richard A. Armstrong and Anthony C. Hilton, 2011 by John Wiley & Sons, ISBN 978-0-470-55930-7.
- Statistical analysis, MicroSoft® Excel 2010, 2011 by Pearson Education, Editor in Chief Greg Wiegand, ISBN-10: 0-7897-4720-0.
- UGC NET Life Science, 2018, Ashish Nagesh, Quaiser J. Hossain, ISBN-10: 9312146513.
- Biostatistics and Microbiology- A Survival Manual, Daryl S. Paulson, ISBN: 978-0387772813, Springer; 2009.
- The Basic Practice of Statistics, 6th edition, David S. Moore, William I. Notz, Michael A. Fligner, W. H. Freeman and Company, ISBN: : 978-1-4641-0254-7
- Fundamental of research methodology and statistics, Yogesh kumar singh, New age international publishers, ISBN : 978-81-224-2418-8
- Research methodology methods and techniques, C. R. Kothari, New age international publishers, ISBN: 9788122415223,
- Teaching and Research Aptitude, Third Edition, KVS Madaan, 2020 Pearson India Education Services Pvt. Ltd, ISBN 978-93-534-3953-8
- Statistical analysis, MicroSoft® Excel 2010, 2011 by Pearson Education, Editor in Chief Greg Wiegand, ISBN-10: 0-7897-4720-0.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III
LIST OF PRACTICALS

MBP-3005

1. Screening of citric acid and lactic acid producing microorganisms.
2. Screening of cellulase, amylase and protease producing microorganisms.
3. Production of fungal amylase by solid state fermentation.
4. Production of fungal amylase by submerged fermentation
5. Partial purification of amylase by ammonium sulphate precipitation and dialysis/column chromatography and calculation of specific activity & fold purification.
6. Cell disruption by sonication and estimation of intracellular protein.
7. Production of ethanol using pure carbohydrate.
 - (a) Determination of pH, TSS (°Brix)
 - (b) Determination of alcohol (ethanol) percentage.
 - (c) Determination of phenol content
 - (d) Estimation of reducing & total sugar.
8. Production of ethanol using agro-industrial waste.
 - (a) Determination of pH, TSS (°Brix)
 - (b) Determination of alcohol (ethanol) percentage
 - (c) Determination of phenol content
 - (d) Estimation of reducing & total sugar
9. Microbial production of dextran/xanthan by *Leuconostoc mesenteroides*/*Xanthomonas campestris*.
10. CAS assay for microbial siderophore production
11. Study of VAM fungi

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III

SKILL BASED ELECTIV PAPER -1
GE-1: BIOPROCESS ENGINEERING

1. Course Code & Title

Course code: GE-1
Course title: Bioprocess engineering
Course type: Core
Course credits: 02

2. Course overview and Course Objectives

This course is designed to impart the knowledge of principle of fermenters and its configuration. Students shall gain knowledge to design, develop, and operate industrial level fermentation process and would learn rheological behaviour of fluids and mass transfer and population dynamics in a fermentor.

Course Objectives

- To study the various aspects of bioreactor design and function of parts
- To learn the concept of fluid flow and mixing
- To gain an insight in mass transfer
- To understand the fundamentals of bioprocess monitoring and its control

3. Course Content

UNIT 1	BIOREACTOR DESIGN AND IT'S COMPONENTS
1.1	Bioreactor design
1.2	Components of bioprocess reactor
1.3	Bioreactor vessels
1.4	Gassing devices

UNIT 2	FLUID FLOWS AND MIXING
2.1	Classification of fluids
2.2	Viscosity and viscosity measurement
2.3	Non-newtonian fluids
2.4	Rheological properties of fermentation broth
2.5	Scale-up of mixing systems

UNIT 3	MASS TRANSFER
3.1	Convection mass transfer
3.2	Oxygen uptake in cell culture
3.3	Mass transfer correlation
3.4	Measurement of $K_L a$

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UNIT 4	BIOPROCESS MONITORING AND CONTROL
4.1	Methods of measuring process variables
4.2	On-line analysis of other chemical factors
4.3	Control systems

Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Student will learn functioning of bioreactor

Unit 2: Student will learn fluid dynamics and its relationship with large scale fermentation mediums

Unit 3: Student will be acquainted with mass transfer during ongoing fermentation

Unit 4: Student will develop understanding about bioprocess and its control

Recommended learning resources

- Shuler M. L. and Kargi F. (2003) *Bioprocess engineering Basic concepts*, 2nd ED, Pearson education Pvt Ltd, India.
- Stanbury P.F., Whitaker A., Hall S.J., (1997) *Principles of fermentation technology*, 2nd ED, Aditya books(P) Ltd, New Delhi.
- El-mansi E.M.T and Bryce C.F.A. (2004) *Fermentation microbiology and biotechnology*, Taylor & Francis Inc, USA.
- Martin K. (2007) *Ullmann's biotechnology and biochemical engineering*, Vol-1&2, Wiley – VCH verlag gmbh and Co, Weinheim.
- Bailey J. S. and Bhatia S.C. (2009) *Biochemical engineering*, CBS publishers & distributors, India.
- Doran P.M. (2008) *Bioprocess engineering principles*, Academic press, California.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III

SKILL BASED ELECTIV PAPER -2
GE-2: BIOSAFETY, BIOETHICS AND IPR

1. Course Code & Title

Course code: General Elective 2

Course title: **Biosafety, Bioethics and IPR**

Course type: Skill based elective paper

Course credits: 02

2. Course overview and Course Objectives

This course design to add knowledge regarding biosafety in arena of microbiology related field. The fundamentals of bioethics and IPR will provide students understanding about ideal practices in life sciences research and development.

Course objectives:

- To Impart knowledge of biosafety issues on microbes and genetically modified organisms
- To create awareness about regulatory bodies
- To learn various aspects of commercialization of patents
- To introduce the concept of intellectual property rights, patenting.

UNIT 1	BIOSAFETY AND ITS REGULATION
1.1	Primary containment for biohazards; biosafety levels; PPE, GRAS organisms
1.2	Biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs
1.3	Principles of safety assessment of transgenic plants - Regulations: International regulations-Cartagena protocol
1.4	Indian regulations-EPA act and rules, guidance documents, regulatory framework: RCGM, GEAC, IBSC and other regulatory bodies

UNIT 2	BIOETHICS
2.1	Bioethics: Introduction, ethical conflicts in biological sciences-interference with nature
2.2	Bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation
2.3	Bioethics in research - cloning and stem cell research, Human and animal experimentation, animal rights/welfare
2.4	Protection of environment and biodiversity – biopiracy

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UNIT 3	PATENT AND REGULATORY BODIES
3.1	Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments
3.2	WIPO Treaties: Budapest Treaty; Patent Cooperation Treaty (PCT) and implications
3.3	Procedure for filing a PCT application
3.4	Patent application forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies

UNIT 4	COMMERCIALIZATION OF PATENT AND ROYALTY
4.1	Patent infringement- meaning, scope, litigation, case studies and examples
4.2	Commercialization of patented innovations
4.3	Licensing-outright sale
4.4	Licensing, royalty
4.5	Patenting by research students and scientists-university/organizational rules in India and abroad

4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Students shall understand importance of Personnel Protective Equipment (PPE), general biosafety rules and different biosafety levels

Unit 2: Students shall gain knowledge of the regulatory agencies for working products derived from biotechnology

Unit 3: Students will gain an understanding on ethical issues involving biological material

Unit 4: Students shall develop an understanding intellectual property right and their implications in biological research and product development

Recommended learning resources

1. International Union for the Protection of New Varieties of Plants. <http://www.upov.int>
2. National Portal of India. <http://www.archive.india.gov.in>
3. Parashar S, Goel D (2013) IPR, Biosafety and Bioethics Pearson Publishing India, ISBN: 9788131774700.
4. Nambisan P (2017) An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology. Academic Press, ISBN: 9780128092316.
5. <http://dbtindia.gov.in/guidelines-biosafety>
6. Office of the Controller General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. <http://www.ipindia.nic.in/>
7. World Trade Organisation. <http://www.wto.org>
8. World Intellectual Property Organisation. <http://www.wipo.int>

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III

SKILL BASED ELECTIVE PAPER-3
GE-3: ADVANCES IN DIAGNOSTIC MICROBIOLOGY

1. Course Code & Title

Course code: GE-3 (MB 3005)
Course title: Advances in diagnostic microbiology
Course type: Skill based elective paper
Course credits: 02

2. Course overview and Course Objectives

Diagnostic microbiology field continues to undergo a quiet revolution that already has resulted in many benefits for microbiologists, clinicians, and most importantly patients. This revolution was made possible by the use of advanced technologies. The objective of this paper is to introduce students a comprehensive, well-referenced, and up-to-date description of these rapidly evolving advanced methods for the diagnosis of infectious diseases in the routine clinical as well as research microbiology laboratory.

Course Objectives

- To study the methods for the cultivation and identification of antimicrobial activity.
- To learn the methods for the identification of parasitic, mycological and viral pathogens
- To gain an insight of molecular techniques used in identification of microbial agents
- To understand the advancement in clinical diagnosis of diseases.

3. Course Content

UNIT 1	DIAGNOSIS OF INFECTIOUS DISEASES AND EVALUATION OF ANTIMICROBIAL ACTIVITY
1.1	Traditional cultivation and identification
1.2	Nucleic acid based analytic methods for microbial identification and characterization
1.3	Immunochemical methods used for organism detection
1.4	Serologic diagnosis of infectious diseases
1.5	Laboratory methods and strategies for antimicrobial susceptibility testing

UNIT 2	LABORATORY METHODS FOR INFECTIOUS MICROBES
2.1	Overview of bacterial identification methods and strategies
2.2	Laboratory methods for diagnosis of parasitic infections
2.3	Laboratory methods in basic Mycology
2.4	Laboratory methods in basic Virology

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UNIT 3	ADVANCED LABORATORY DIAGNOSTIC TECHNIQUES - 1
3.1	Molecular Typing Techniques
3.2	PCR and Its Variations
3.3	Gel Electrophoresis, Southern Blot, and Colorimetric Microwell Plate-Based System
3.4	Direct Nucleotide Sequencing for Amplification Product Identification
3.5	Microarray-Based Amplification Product Detection and Identification

UNIT 4	ADVANCED LABORATORY DIAGNOSTIC TECHNIQUES - 2
4.1	Cellular Fatty Acid-Based Microbial Identification and Antimicrobial Susceptibility Testing
4.2	MALDI-TOF Mass Spectrometry-Based Microbial Identification
4.3	Nonamplified Probe-Based Microbial Detection and Identification
4.4	Microbial Identification by PCR/Electrospray Ionization-Mass Spectrometry
4.5	Bacterial Identification Based on Universal Gene Amplification and Sequencing

STUDENTS LEARNING OUTCOMES:

After successful completion of the course student will be able to

- Develop the skills for the application of basic and advanced techniques employed in Diagnostic Microbiology
- Use selected diagnostic techniques
- Familiar with working, principles, tools and techniques of Diagnostic Microbiology and creative use of advanced techniques in diagnosis of microbial diseases.

4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Students shall understand the application of basic techniques in

Unit 2: Students shall gain knowledge of usage of diagnostic techniques

Unit 3: Students will gain an understanding working, principles, tools and techniques of diagnostic Microbiology and creative use of advanced techniques in diagnosis of microbial diseases.

Unit 4: Students shall develop an understanding of advanced techniques of microbial diagnosis

Recommended learning resources

- Betty A Forbes, Daniel F Sahn and Alice S Weissfeld (2007), *Bailey & Scott's Diagnostic Microbiology*, 12th ed., Elsevier, ISBN: 9780070604605.
- Yi-Wei Tang and Charles W Stratton (2013), *Advanced Techniques in Diagnostic Microbiology*, 2nd ed., Springer, ISBN: 978-1-4614-3970-7 (eBook).

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM III

SKILL BASED ELECTIVE PAPER-3
GE-4: MATHEMATICS AND GENERAL APTITUDE SKILLS

1. Course Code & Title

Course code: GE-3 (MB 3005)
Course title: Mathematics and General Aptitude Skills
Course type: Skill based elective paper
Course credits: 02

2. Course overview and Course Objectives

Course is designed with the all aptitude skills which included in the UGC-NET and CSIR-NET along with the GSET examination syllabus. Students will get the details methods and techniques to solve sixteen different mathematical and general aptitude skills.

Course Objectives

- To study the essential mathematical problems and Numerical Ability.
- To develop an understanding various daily life and geometrical life problems
- To offer the deep perceptions into the mathematical problems, numerical ability, daily life and geometrical life problems.

3. Course Content

UNIT 1	TYPICAL PROBLEMS
1.1	Calendar problems
1.2	Clock problems
1.3	Moving locomotive problems
1.4	Series formation

UNIT 2	NUMERICAL ABILITY
2.1	Numbers
2.2	Probability and arrangement
2.3	Coding -decoding
2.4	Distance and direction

UNIT 3	DAILY LIFE PROBLEMS
3.1	Finding the x
3.2	Average and percentage
3.3	Monetary problems

UNIT 4	GEOMETRICAL LIFE PROBLEMS
4.1	Geometry

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4.2	Mensuration and quantitative comparison
4.3	Puzzles

After successful completion of the course student will be able to

4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Students shall acquire the essential knowledge useful to solve the problems of mathematics understand the application

Unit 2: Students shall gain an understanding of basic arithmetical operations such as additions, reduction, multiply, and divisions constitute basic numeracy abilities

Unit 3: Students shall get acquainted with daily life problems

Unit 4: Students shall develop logical reasoning and aptitude skill to solve the real geometrical life problems.

Recommended learning resources

- CSIR-NET General Aptitude - A New Outlook, by Christy Varghese, 2018, ISBN: 9788192291109, Lilly Publishing; Sixth edition
- CSIR NET General Aptitude (Part-A) 2023 - Comprehensive Theory & Practice Book, by Kailash Choudhary, ISBN: 8194843731, IFAS Publications; 4th edition, 2021
- CSIR-UGC-NET General Aptitude, Ram Mohan Pandey, 2022, Pathfinder Publication, ISBN: 978-93-80473-05-5

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**Veer Narmad South Gujarat University,
Surat**

**M.Sc. (Microbiology) Syllabus
(Effective from JUNE, 2023)**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM IV
2023 - 2024

Teaching & Evaluation Scheme

M. Sc. Semester IV

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB 4001 A	Seminar Presentation	4	-	70	30	100	4
MB 4001 B	Review Presentation	4	-	70	30	100	4
MB 4002 A	Dissertation	12	16	350	150	500	20
MB 4002 B	Industrial training / Internship project	12	16	350	150	500	20
MB 4002 C	Start- up prototype development project	12	16	350	150	500	20
TOTAL		16	16	420	180	600	24

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM IV

MB 4001 A: SEMINAR PRESENTATION

1. Course code & Title

Course code:	Core course 1 (MB 4001 A)
Course title:	Seminar Presentation
Course type:	Core
Course credits:	04

2. Course overview and Course Objectives

Every field of study and professional endeavour requires excellent listening and speaking skills. Good speaking skills are also essential for maintaining a healthy civic discourse and a democratic society. Student will select the seminar presentation topic from any microbiology and related area and prepare the presentation for 10-15 minutes maximum followed by 5 minutes for the questioning to know the student understanding. The ultimate goal of the seminar presentation is to develop the presentation skills, discussion skills and enhance their abilities to counter the questions. Students will be able to demonstrate competence in working with a methodology, structuring their oral work, and synthesizing information in terms of content, organization and delivery.

Course Objectives

- Developed presentation skill in terms of the content, organization and delivery
- Improvement of oral work
- Academically developed of stage performance and interaction
- Advanced the teaching and delivering proficiency related to microbiology topic

3. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Student shall learn to:

- To prepare the presentation using suitable software with scientific aptitude
- Prepare and effective oral presentation
- Improvement in the delivery and interaction with the audience
- Improve the various skill related to oral presentation including argumentative and critical thinking
- Prepare good orator in the field of microbiology

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Recommended learning resources

- Seals, D. R. (2022). Talking the talk: tips for effective oral presentations in biomedical research. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 323(4), R496-R511.
- Bulska, E. (2006). Good oral presentation of scientific work. *Analytical and bioanalytical chemistry*, 385(3), 403-405.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M.Sc. MICROBIOLOGY SEM IV

MB 4001 B: REVIEW PRESENTATION

1. Course code & Title

Course code:	Core course 1 (MB 4001 B)
Course title:	Review Presentation
Course type:	Core
Course credits:	04

2. Course overview and Course Objectives

Student will read the previously published review article (last five years) and prepare the presentation to get the in-depth knowledge and understanding on the centre-specified selected review paper from Scopus/ WoS and UGC-CARE listed journals. The students will develop the understanding about the selected literature reviews, systematic reviews, and meta-analyses topic related to microbiology and other allied area. The students can also present their own published or publishable review article in the field of microbiology under their supervised teacher in the said journals. The aim and goal of the course is to develop the skill to prepare, communicate, understand published review or published the review articles in the scientific journals. Student will select the review paper related to microbiology and related area and give a presentation for 10-15minutes maximum followed by 5 minutes for the questioning to know the student understanding

Course Objectives

- Prepare the student to understand the previously published literature review
- Know the quality of review paper published in the Scopus/WoS/ UGC-CARE listed Journals and understanding of the latest development in the microbiology
- Aware the student about the quality of publication, plagiarisms and ethical practice
- Acquainted the student with peer-review process, communication and publication process
- Create scientific writing skills in the students if possible for the publication of the review.

3. Course Learning Outcomes/Student's Learning Outcomes (SLO)

- Provide the comprehensive and exhaustive knowledge of selected review
- Developed the discipline specific scientific writing and reading skill
- Provide the new research directions to strengthen support for existing theories
- Identify patterns and gap among existing research studies
- Improve the skill to develop the content, aware with submission and communication and acquainted with the reviewer suggestions
- Improve the scientific critical thinking and writing skill

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Recommended learning resources

- Callcut, R. A., & Branson, R. D. (2009). How to read a review paper. *Respiratory Care*, 54(10), 1379-1385.
- Keshav, S. (2007). How to read a paper. *ACM SIGCOMM Computer Communication Review*, 37(3), 83-84.
- Cargill, M., & O'Connor, P. (2021). *Writing scientific research articles: Strategy and steps*. John Wiley & Sons. ISBN: 9781119717270
- Paul, J., & Criado, A. R. (2020). The art of writing literature review: What do we know and what do we need to know?. *International Business Review*, 29(4), 101717.

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M.Sc. MICROBIOLOGY SEM IV

MB 4002: Select any one from the given list

Sr. No.	Works under paper 4002	Credit	Organization types for works	Participation numbers	Tenure of works
1	4002 A: Dissertation	20	Any Academic and Research Institute	individual or in pair	15 weeks minimum
2	4002 B: Industrial Training/Internship Project	20	Any Pharma./Biotech./diagnostic /food and other related Industries	Individual	15 weeks minimum
3	4002 C: Start-up or prototype development project Related to Microbial product or microbial process	20	Any institute under SSIP grant or institutional start-up and entrepreneur grant at regional, state and national level agencies or angel investor	individual or in pair	15 weeks minimum

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M.Sc. MICROBIOLOGY SEM IV

MB 4002 A: DISSERTATION

1. Course Code & Title

Course code:	Core course 1 (MB 4002 A)
Course title:	Dissertation
Course type:	Core
Course credits:	20

2. Course overview and Course Objectives

The dissertation is a major guided independent research project on a topic chosen by the student and supervisor in the field of microbiology and life sciences. It usually involves a literature review, critical analysis of primary and secondary data, and field or lab work. The dissertation demonstrates critical analysis, broad reading, and advanced research methods. Course will help to execute the research work independently. On successful completion of this course, students must prepare and present the thesis during the evaluation. Thesis includes the introduction, literature review, objectives, methodology, result and discussion and conclusion with suitable references.

Course Objectives

- To learn research skills that is necessary for getting a master's degree.
- Identify the gap and solution using development of methodology
- Address the contemporary regional to global level problems and solved the problems using field or laboratory work
- To display the knowledge and capability required for independent work.

3. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Learning outcomes: Student will learn to:

- Plan and conduct an independent, sustained critical investigation and evaluation of a scientific research topic.
- Systematic identification of relevant theory, concepts, methodologies, evidence, techniques, and conclusions
- Find and evaluate relevant information sources
- Evaluate original data using qualitative and quantitative methods
- Ethically collect and evaluate data and other resources
- Write and speak clearly about research concepts and contexts

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M.Sc. MICROBIOLOGY SEM IV

MB 4002 B: Industrial Training/Internship Project

1. Course Code & Title

Course code: Core course 1 (MB 4002 B)
Course title: Industrial Training/Internship Project
Course type: Core
Course credits: 20

2. Course overview and Course Objectives

The industrial training or internship in the industries inculcates the students about the industrial problems and industrial research useful for pharmaceutical, diagnosis, biotechnological, bioinformatics, food and nutraceuticals, cosmetic and other life science sectors. The overall goal of the industrial project is to display the knowledge and capability required for industrial workplace and solves industrial problems with teamwork and multidisciplinary approach. Student can work in any UGC recognized academic organization/ state or national level research institute/ ISO or FDA/USFDA/NABL/ICMR/FSSAI/GLP industry or research centre having R & D and Q.C. facilities with the due permission of supervised teacher and institutional head. On successful completion of this industrial project, students must prepare and present the project report or thesis during the evaluation. Report or thesis includes the introduction, literature review, objectives, methodology, result and output and conclusion with suitable references

Course Objectives

- Develop professional skills during their study tenure.
- Get the exposure with the industrial project and developed research skills to complete a project.
- Acquitted with workplace setting and opportunity to future employment
- Developed the communication skill, capacity, cooperation, economic analysis, planning, and scheduling at industrial level

3. Student's Learning Outcomes (SLO)

Student will learn to:

- Identify skills and capabilities to effectively meet the demands of industries.
- Enhance communication within the workplace.
- Assess job-related experiences.
- Write and speak about research findings at industrials and field level.

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- Complete a project utilizing industrial-oriented research.
- Use multidisciplinary teamwork to solve industrial problems with theoretical .

Recommended learning resources

https://btm.gujarat.gov.in/images/Directory_01.pdf

https://ic.gujarat.gov.in/?page_id=147

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M.Sc. MICROBIOLOGY SEM IV

MB 4002 C: Startup or prototype development project

1. Course Code & Title

Course code:	Core course (MB 4002 C)
Course title:	Startup or prototype development project
Course type:	Core
Course credits:	20

2. Course overview and Course Objectives

Students will use the innovative minds to address the real-life problems. Gain the understanding of the steps involved in taking an idea from conception to marketability. Gain insight into the process of developing and implementing strategies for commercializing innovations. Create a business model canvas and a portfolio showcasing the company's innovations. Students lay the groundwork for analyzing the innovation process and then move on to discussing how to commercialize new ideas. Student can work in any institute under SSIP grant or institutional startup and entrepreneur grant at regional, state and national level agencies. The ultimate goal of startup and prototype project is to improve the skill of students to developed prototype by translating the scientific knowledge from lab to land. On successful completion of this project, students must prepare and present the report or thesis during the evaluation. The report or thesis includes the introduction, literature review, objectives, methodology, result, output, marketability and commercialization status and summary with suitable references.

Course Objectives

- This course gives students a taste of the innovative and entrepreneurial world.
- Students are daring to venture beyond academic research into commercialized forms.
- Provide opportunity to commercialized the laboratory developed products or process.

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- Start-ups can benefit from innovation strategies to gain and maintain a competitive advantage.
- Students will apply the innovative minds and works in a team to developed products and process
- Ignite the student for mind to market concept

3.Course Learning Outcomes/Student's Learning Outcomes (SLO)

Student will learn to:

- Students become an entrepreneurs or innovators
- Prototype development to conversion into a commercial start up through this practical example
- Students gained extensive knowledge in the areas of entrepreneurship development and project management.
- Creativity and business idea generation and exploiting new entry opportunities.
- Initiate the translational research

Recommended learning resources

- Davis M, Davis K. and Dunagan M., (2012), Scientific papers and presentations: Effective scientific communication, 3rd edition, Elsevier and Academic press, (ISBN: 978-0-12-384727-0)
- Wallwork A., (2011), English: for writing research papers, Springer science plus Business media, LLC, (ISBN: 978-1-4419-7921-6)
- <https://ihubgujarat.in/>
- <http://www.ssipgujarat.in/>
- <https://mic.gov.in/innovation-council/iic>
- <https://stbi.gujarat.gov.in/>

Guidelines for MB 4001 & MB 4002

MB
4001

- Faculty has to mentor the allotted students for selected topics of seminar.
- With the given reference the teacher can orientate the student by conducting lecture to create awareness regarding reading, preparation and publication of review paper
- Students have to individually deliver a seminar on the advance or novel topic in the subject of microbiology, other than that mentioned in the curriculum.
- Teacher has to evaluate seminar of individual student and prepare for the final presentation of the allotted students
- Topic should not be related to his/ her dissertation.
- A seminar should be delivered within **15 minutes**.
- Students have to submit one copy of colour printed hand outs (**02 slides/ page**) of his/her presentation to the examiner.

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MB
4002

- Faculty has to mentor the allotted students for the dissertation.
- Work can be done individually or in a pair on any topic related to **microbiology**.
- Student have to select any one from the given three subjects, faculty has to mentor the allotted students for the dissertation, Industrial Training/Internship Project or Start-up or prototype development project
- Dissertation and Start-up or prototype development project can be done individually or in a pair on any topic related to microbiology. But **Industrial Training/Internship has to be completed individually only**
- Dissertation and Industrial Training/Internship Project may be carried in house or outside the college/university campus after due permission granted by the supervising teacher and institute head at the following recognized institutions or industries including
 - Any UGC recognized academic organization
 - Any agricultural university
 - State or national level research institute
 - ISO or FDA/USFDA/NABL/ICMR/FSSAI/GLP industry
 - Any research Centre having R & D and Q.C facilities
- Faculty will mentor the students for **Scientific writing & communication which includes** Communication skill in science, searching of scientific journals & resources, reviewing scientific literature, Preparation of graphs and tables to present the scientific data, Online grammar checking in scientific writing, References management by online tools, delivering effective oral presentation, Preparing and presenting research poster, writing a research paper and compiling a dissertation thesis, Plagiarisms checking, Publishing in scientific journal
- The thesis of dissertation work, report of the industrial training/ internship project as well as the report of start-up or prototype development project will be evaluated by examiner(s) which includes evaluation and presentation. The presentation shall be done by the students in audio-visual mode by the candidate within 15 minutes.
- The candidate has to submit their thesis / report in a standard hard-bound or spiral-bound thesis and soft copy in PDF format.

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