

Course outcome {Subject wise}:

Semester I

Course subject code MB 1001
Course title Microbial diversity
Course outcome Students shall acquire knowledge of principles underlying classification, Students shall learn the rules of bacteria nomenclature and taxonomic framework for prokaryotic microorganisms. Student shall study major phyla of the domain bacteria and archaea. Student shall learn principles of virus structure, replication of viruses and newer forms of viruses. Students shall gain an insight regarding the emerging viral diseases. Students shall study fungal and algal cell biology.

Course subject code MB 1002
Course title Molecular biology and genetic engineering
Course outcome Student shall gain knowledge of genome organization and replication. Students shall understand the relevance and biochemistry of DNA structure. Students shall understand the processes involved in expression of genome. and the various tools and technology applied for the construction of rDNA. Students shall learn to apply tools and techniques to carry out transfection in plants and animals.

Course subject code MB 1003
Course title Biophysical techniques and instrumentation
Course outcome The course shall introduce the students to the principles of detection and measurement systems and principles of the major molecular techniques to study the prokaryotes. Students shall study the various separation techniques and the spectroscopic techniques for the detection of bio-molecules. Students shall gain insight of NMR and X-ray spectrometers and its applications.

Course subject code MB 1004
Course title Environmental microbiology and biofuels
Course outcome The course shall enrich the students with the principles of microbial ecology and the various microbial processes prevailing in the environment. Students shall understand the principles of environmental microbiology and its application for sustainable development. Student shall learn the aspects of waste water engineering and reuse of water, versatility of microbial ecology, bioremediation and biodegradation as well as intricacies of microbial fuels.

Semester II

Course subject code MB 2001
Course title Enzymology and Microbial Physiology

Course outcome Students shall gain an insight of the kinetics of enzymes and enzyme inhibition. Students shall learn about the general methodology of protein engineering applications of enzymes. Students shall know about the physiological adaptations of microorganisms, the biochemistry and genetic mechanisms to withstand adverse conditions. Students shall learn microbial metabolism and the diverse metabolic processes of microorganisms.

Course subject code MB 2002

Course title Bioinformatics & bio nanotechnology

Course outcome Students shall gain an understanding on genomics, proteomics, transcriptomics, metagenomics and the various tools and techniques in its study. Students shall be enabled to apply bioinformatics in real research problems. The course shall make them familiar with the various databases and online tools for predictive results used in formulation of research problems. Students shall understand bio-nanotechnology and its applications in microbiology.

Course subject code MB 2003

Course title Advances in immunology and pathogenesis

Course outcome Students shall understand the principles of immunology, molecular pathogenesis, immune-technology and immunotherapy. The course shall develop an understanding of the molecular mechanism of pathogen in causing infections and the response of the host against the pathogens. Students shall develop an insight in developing therapy, vaccine development and the control of transmission of infectious diseases.

Course subject code MB 2004

Course title Biostatistics and Research methodology

Course outcome Students shall be enriched with the basic principle of research methodology. Students shall learn the fundamentals of research methodology and shall learn essential steps involved in research. They shall be enabled to define and formulate a research problem and also form a research report. Students shall develop an understanding of importance of biostatistics and its applications in analysis and interpretation of data.

Semester III

Course subject code: MB 3001

Course title: Fermentation technology

Course outcome: Students shall learn the methods of isolation and screening of microorganisms for various microbial products. Students shall understand the relevance of strain improvements and the techniques of strain improvement. The course shall enable them to learn various media components and the role of media optimization for maximized product yield. Students shall understand the design, operations and applications of bioreactors used in industrial scale production. Students

shall gain knowledge of product recovery and the various methods in down streaming processing.

Course subject code: MB 3002

Course title: Microbial products

Course outcome: Students shall gain an insight regarding the applications of microorganisms for the industrial processes which includes production of high-value products such as drugs, chemicals, fuels and food product. Students shall acquire knowledge for the microbial fermentations of antibiotics, hormones, organic acid, amino acid, enzymes and vitamins using microbial strains. Students shall learn process for the production of microbial products like biosurfactants, PHA, carotenoids, dextrans, microbial flavors. SCP, bioinsecticides, biofertilizers and monoclonal antibodies. The course shall develop the capability in students for commercializing microorganisms.

Course subject code: MB 3003

Course title: Biochemical engineering

Course outcome: 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. Students shall understand the mechanisms of heat and mass transfer, oxygen transfer and its importance in designing a fermentor.

Course subject code: MB 3004

Course title: Pharmaceutical microbiology

Course outcome: The course gives insight of microbiological analysis and quality control in pharmaceutical industries. Students shall understand the relevance of good manufacturing practices and its monitoring in pharmaceutical companies. The students would also learn quality check and quality maintenance of pharmaceutical products and microbiological auditing.

Course subject code: MB 4001

Course title: Seminar Presentation

Course outcome: Students shall learn the skill of presenting scientific advancement through seminar presentation. The student shall be able to search, review, scrutinize and represent the scientific concept with suitable evidences regarding recent developments in the field of microbiology. It shall make student gain confidence in representation of scientific data at larger forums in future.

Course subject code: MB 4002

Course title: Dissertation

Course outcome: M.Sc. Microbiology students shall learn to design scientific experiment, analysing the scientific data obtained, validate hypothesis and communicating the outcome in form of thesis. Additionally, student shall

get opportunity to learn several tools used to transform data in to appropriate statistical-graphical format, grammar correction for scientific writeups, scientific research article management and similarity check through plagiarism finder. Student shall get exposure to microbial research of scientific community which shall increase their inclination towards research.



-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા લેઠળની સંલગ્ન માર્ઠક્રોબાયોલોજી વિષય ચલાવતી સ્નાતક અને અનસ્નાતક કોલેજોનાં આચાર્યશ્રીઓને તથા ડિપાર્ટમેન્ટનાં વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૦-૨૧ અમલમાં આવનાર બી.એસસી. એન્ડ એમ.એસસી. (માર્ઠક્રોબાયોલોજી) સેમેસ્ટર-૧ અને ૨ નાં અભ્યાસક્રમ અંગે માર્ઠક્રોબાયોલોજી વિષયની અભ્યાસસમિતિની તા.૦૬/૦૩/૨૦૨૦ ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે નીચે મુજબ કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલએ તેની તા.૩૦/૦૬/૨૦૨૦ ની સભાના ઠરાવ ક્રમાંક:૨૭ અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્દઉપરાંત તેનો અમલ કરવો.

માર્ઠક્રોબાયોલોજી વિષયની અભ્યાસસમિતિની તા.૦૬/૦૩/૨૦૨૦ ની સભાનાં ઠરાવ ક્રમાંક: ૨

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૦-૨૧ અમલમાં આવનાર બી.એસસી. એન્ડ એમ.એસસી. (માર્ઠક્રોબાયોલોજી) સેમેસ્ટર-૧ અને ૨ નાં અભ્યાસક્રમ માટે તા.૧૬/૧૨/૨૦૧૯ ની સભામાં નીમ્લ પેટાસમિતિએ તૈયાર કરેલ અભ્યાસક્રમમાં પેપર નંબર અને પેપરના શિર્ષક (Title) માં જરૂરી ફેરફારો કરી સર્વાનુમતે મંજૂર કરી તે મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૩૦/૦૬/૨૦૨૦ ની સભાનાં ઠરાવ ક્રમાંક: ૨૭

:: આથી ઠરાવવામાં આવે છે કે, માર્ઠક્રોબાયોલોજી વિષયની અભ્યાસસમિતિએ તેની તા.૦૬/૦૩/૨૦૨૦ ની સભાના ઠરાવ ક્રમાંક : ૨ અન્વયે ભલામણ કરેલ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ મંજૂર કરેલ શૈક્ષણિક વર્ષ ૨૦૨૦-૨૧ થી અમલમાં આવનાર બી.એસસી. એન્ડ એમ.એસસી. (માર્ઠક્રોબાયોલોજી) સેમેસ્ટર-૧ અને ૨ નાં અભ્યાસક્રમ મંજૂર કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક: એકે./પરિપત્ર/૫૮૦૫/૨૦૨૦

તા. ૧૫-૦૭-૨૦૨૦

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ઈ.ચા. કલસચિવ

પ્રતિ,

- ૧) વિજ્ઞાન વિદ્યાશાખા લેઠળની સંલગ્ન માર્ઠક્રોબાયોલોજી વિષય ચલાવતી સ્નાતક અને અનસ્નાતક કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રી.
- ૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારું.

Circular

No. : A.C./Circular/5805/2020

Date: 15/07/2020

The Principals of affiliated colleges and the Head of the graduate and post-graduate department offering Microbiology subject under the Faculty of Science are hereby informed that the new syllabus of B.Sc. and M.Sc. Microbiology Sem -I and Sem- II has been recommended as below according to the Resolution No.: 2 in Academic Council of Microbiology dated 06/03/2020. This recommendation has been forwarded by the Dean of the Science Faculty to the Academic Council with the view of approval according to the Resolution no.: 27 of the Academic Council dated 30/06/2020 has been accepted and approved. Report it to the concerned teachers and students, and implement it.

Resolution No.: 2, Academic Council of Microbiology dated 06/03/2020:

Therefore, it is resolved that the recommendation to the Faculty of Science for the approval of the syllabus of B.Sc. and M.Sc. Microbiology Sem -I and Sem- II with appropriate changes according to the paper number and paper title prepared by the elected sub-committee to accept and allow unanimously to be implemented from the academic year 2020-21

Resolution No.: 27, Academic Council dated 30/06/2020:

Therefore, it is resolved that syllabus of B.Sc. and M.Sc. (Microbiology) Sem-I and Sem-II to be implemented from the academic year 2020-21 has been approved as per the recommendation under the Resolution No.:2 of Academic Council of Microbiology dated 06/03/2020.

Attachment: As above

No. : A.C./Circular/5805/2020

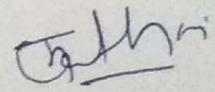
Date: 15/07/2020

I/C Registrar


To,

1. The Principals of affiliated colleges and the Head of post-graduate department offering Microbiology subject under the Faculty of Science
2. The dean, Faculty of Science
3. Exam Superintendent, Examination Department, V.N.S.G. University, Surat

....For information and implementation



Registrar
Veer Narmad South Gujarat University


Head
Department of Biosciences
Veer Narmad South Gujarat University,
Surat-395 007.

-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની માર્છક્રોબાયોલોજી વિષય ચલાવતી સંલગ્ન સ્નાતક તથા અનુસ્નાતક કોલેજોના આચાર્યશ્રીઓને તથા ડિપાર્ટમેન્ટના વડાશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ અમલમાં આવનાર બી.એસસી.સેમે. -૩ અને ૪ તથા એમ.એસસી. સેમેસ્ટર-૩ અને ૪ (માર્છક્રોબાયોલોજી) વિષયનાં અભ્યાસક્રમ અંગે ચર્ચા કરતા માર્છક્રોબાયોલોજી વિષયની અભ્યાસસમિતિની તા.૧૫/૦૩/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે નીચે મુજબ કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૧૭/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક: ૬ અન્વયે મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ એકેડેમિક કાઉન્સિલએ તેની તા.૨૫-૨૬/૦૬/૨૦૨૧ ની સભાના ઠરાવ ક્રમાંક: ૨૫ અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્દઉપરાંત તેનો અમલ કરવો.

માર્છક્રોબાયોલોજી વિષયની અભ્યાસસમિતિની તા.૧૫/૦૩/૨૦૨૧ ની સભાનાં ભલામણ ક્રમાંક:૨

- :: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ અમલમાં આવનાર બી.એસસી. એન્ડ એમ.એસસી. (માર્છક્રોબાયોલોજી) સેમેસ્ટર-૩ અને ૪ નાં અભ્યાસક્રમ સર્વાનુમતે મંજૂર કરી તે મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા.૧૭/૦૬/૨૦૨૧ની સભાનાં ઠરાવ ક્રમાંક: ૬

- :: આથી ઠરાવવામાં આવે છે કે, માર્છક્રોબાયોલોજી વિષયની અભ્યાસસમિતિની તા.૧૫/૦૩/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક:૨ અન્વયે મંજૂર કરેલ શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ અમલમાં આવનાર બી.એસસી. & એમ.એસસી.માર્છક્રોબાયોલોજી સેમેસ્ટર-૩ અને ૪ નાં અભ્યાસક્રમ મંજૂર કરી એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

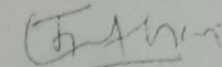
એકેડેમિક કાઉન્સિલની તા.૨૫-૨૬/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક: ૨૫

- :: આથી ઠરાવવામાં આવે છે કે, માર્છક્રોબાયોલોજી વિષયની અભ્યાસસમિતિએ તેની તા.૧૫/૩/૨૦૨૧ની સભાના ઠરાવ ક્રમાંક : ૨ અન્વયે ભલામણ કરેલ અને વિજ્ઞાન વિદ્યાશાખાએ તેની તા.૧૭/૦૬/૨૦૨૧ ની સભાનાં ઠરાવ ક્રમાંક : ૬ અન્વયે સ્વીકારેલ શૈક્ષણિક વર્ષ ૨૦૨૧-૨૨ થી અમલમાં આવનાર બી.એસસી. & એમ.એસસી. માર્છક્રોબાયોલોજી સેમેસ્ટર-૩ અને ૪ નાં અભ્યાસક્રમ મંજૂર કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક : એકે./પરિપત્ર/૮૦૦૪/૨૧

તા.૨૮-૦૬-૨૦૨૧



ઈ.ચા. કુલસચિવ

પ્રતિ,

- ૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની માર્છક્રોબાયોલોજી વિષય ચલાવતી સંલગ્ન કોલેજોના આચાર્યશ્રીઓ.
- ૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

Translated from Gujarati from English for the purpose of NAAC Only

Circular

No. : A.C./Circular/9004/21

Date: 28/06/2021

The Principals of affiliated colleges and the Head of the graduate and post-graduate department offering Microbiology subject under the Faculty of Science are hereby informed that the new syllabus of B.Sc. Sem- III and Sem- IV and M.Sc. Sem -III and Sem- VI (Microbiology) to be implemented from the academic year 2021-22 has been recommended as below according to the Resolution No.: 2 in Academic Council of Microbiology dated 15/03/2021. This recommendation has been forwarded to the Faculty of Science dated 17/06/2021 according to the Resolution No.: 6 which is forwarded to the Academic Council with the view of approval according to the Resolution no.: 25 dated 25-26/06/2021 has been accepted and approved. Report it to the concerned teachers and students, and implement it.

Resolution No.: 2, Academic Council of Microbiology dated 15/03/2021:

Therefore, it is resolved that the recommendation to the Faculty of Science for the approval of the syllabus of B.Sc. and M.Sc. (Microbiology) Sem -III and Sem- IV to accept and allow unanimously to be implemented from the academic year 2021-22

Resolution No.: 6, Faculty of science dated 30/06/2021:

Therefore, it is resolved that the syllabus of B.Sc. and M.Sc. (Microbiology) Sem -III and Sem- IV to be implemented from the academic year 2021-22 approved by the Academic Council of Microbiology dated 15/03/21 according to the Resolution No.: 2 has been recommended to accept and allow unanimously by the Academic Council

Resolution No.: 25, Academic Council dated 26/06/2021:

Therefore, it is resolved that the syllabus of B.Sc. and M.Sc. (Microbiology) Sem -III and Sem- IV to be implemented from the academic year 2021-22 approved by the Academic Council of Microbiology dated 15/03/21 according to the Resolution No.: 2 and accepted by the Faculty of Science dated 17/06/21 according to the Resolution No.: 6 in response to the recommendation by the Academic Council of Microbiology has been approved

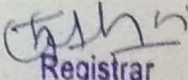
Attachment: As above

No. : A.C./Circular/9004/21

Date: 28/06/2021

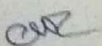
I/C Registrar

To,


Registrar

Veer Narmad South Gujarat University
Surat.

o/c



Head

Department of Biosciences
Veer Narmad South Gujarat University,
Surat-395 007.

1. The Principals of affiliated colleges and the Head of post-graduate department offering Microbiology subject under the Faculty of Science
2. The dean, Faculty of Science
3. Exam Superintendent, Examination Department, V.N.S.G. University, Surat

....For information and implementation

Handwritten mark

Head
Department of Biosciences
Veer Narmad South Gujarat University,
Surat-395 007.

Handwritten signature
Registrar
Veer Narmad South Gujarat University
Surat.



Veer Narmad South Gujarat University,
Surat

M.Sc. (Microbiology) Syllabus

(Effective from June, 2020)

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

Teaching & Evaluation Scheme
Semester I

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB-1001	Microbial diversity	4	-	70	30	100	4
MB-1002	Molecular biology and genetic engineering	4	-	70	30	100	4
MB-1003	Biophysical techniques and instrumentation	4	-	70	30	100	4
MB-1004	Environmental microbiology and biofuels	4	-	70	30	100	4
MBP-1005	Practicals	-	16	140	60	200	8
Total		16	16	420	180	600	24

M.Sc. Semester I
MB 1001: MICROBIAL DIVERSITY

Student Learning Objective: The main aspect of this paper is to study the diverse forms of microorganisms and principles underlying its classification, study of major phyla of the domain bacteria and archaea. The paper also includes the study of viruses, fungi and algae.

UNIT 1	PROKARYOTIC TAXONOMY
	Teaching Duration: Lectures 15
1.1	Prokaryotic domain
1.2	Classification of prokaryotic organisms
1.3	Identification of prokaryotes
1.4	Numerical and polyphasic taxonomy
1.5	Prokaryotic systematic
1.6	Bacterial nomenclature
1.7	Taxonomic framework for prokaryotic systematic
1.8	Intellectual property of prokaryotes

UNIT 2	ARCHAEA AND PROTEOBACTERIA
	Teaching Duration: Lectures 15
2.1	The <i>Archaea</i>
	2.1.1 Overview of <i>Archaea</i>
	2.1.2 Phylum <i>Creanarchaeota</i> ,
	2.1.3 Phylum <i>Euarcheaeota</i>
2.2	The Proteobacteria
	2.2.1 <i>Alphaproteobacteria</i>
	2.2.2 <i>Betaproteobacteria</i>
	2.2.3 <i>Gammaproteobacteria</i>
	2.2.4 <i>Deltaproteobacteria</i>
	2.2.5 <i>Epsilonproteobacteria</i>

UNIT 3	VIROLOGY
	Teaching Duration: Lectures 15
3.1	Principles of virus structure
3.2	virus replication strategies
3.3	Viral conquest of the host cell
3.4	Emerging viral diseases
3.5	Viroids and prions
3.6	Plant phages: TMV
3.7	Protists viruses: Chlorella viruses
3.8	Animal viruses: HIVs and their replication
3.9	Bacteriophages: phage λ , phage Mu-1

UNIT 4	MYCOLOGY AND PHYCOLOGY
	Teaching Duration: Lectures 15
4.1	Natural classification of fungi 4.1.1 Members of kingdom Fungi 4.1.2 The species concept in fungi 4.1.3 The untrue fungi 4.1.4 Ecosystem mycology
4.2	Hyphal cell biology: Mycelium: the hyphal mode of growth, Spore germination and dormancy, The fungal lifestyle: colony formation, Mycelium growth kinetics
4.3	Fungal cell and tissue differentiation: Mycelial differentiation, Making spores
4.4	Arbuscular (AM) endomycorrhizas
4.5	Characteristics of algae 4.5.1 Structure of algal cell 4.5.2 Nutrition of algae 4.5.3 Classification of algae
4.6	Cyanobacteria 4.6.1 Ecology of Cyanobacteria 4.6.2 Classification

REFERENCES:

- Bergey's manual of systematic bacteriology, (2009) 2nd edition, vol 1 Springer. (ISBN; 978-0-387-95041-9).
- Wiley J., Sherwood I., (2011), Prescott, Harley and Kleins Microbiology, 9th edition., Mc Graw Hill. (ISBN; 978-0073402406)
- David M. Knipe, Peter M. Howley, (2007). 5th edition., vol. 1, Fields Virology. (ISBN; 978-0-7817-6060-7)
- David Moore, Geoffrey Robson, Anthony Trinci, (2011) 21st century guidebook to fungi, Cambridge University Press. (ISBN; 978-0-521-18695-7)
- Robert Edward Lee, (2008) Phycology, Cambridge University Press. (ISBN; 978-0-521-14144-4).

MB 1002: MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Student Learning Objectives: The student will be able to gain knowledge on the structure of genetic material and molecular mechanisms in bacteria. It shall include the various tools and technology applied for the construction of rDNA and the applications of tools and techniques to carry out transfection in plants and animals.

UNIT 1	GENOME ORGANIZATION AND REPLICATION
	Teaching Duration: Lectures 15
1.1	Nucleosomes
1.2	DNA Structure
1.3	DNA topology
1.4	RNA Structure
1.5	The replication fork
1.6	The specialization of DNA polymerases
1.7	DNA replication in prokaryotes
	1.7.1 Synthesis at the replication fork
	1.7.2 Initiation
	1.7.3 Binding and unwinding
	1.7.4 Finishing replication

UNIT 2	EXPRESSION OF THE GENOME
	Teaching Duration: Lectures 15
2.1	Transcription
	2.1.1 RNA polymerase
	2.1.2 Features of prokaryotic promoters
	2.1.3 The transcription cycle in Bacteria
2.2	Translation
	2.2.1 Messenger RNA
	2.2.2 Structure and role of tRNA
	2.2.3 Ribosome structure
	2.2.4 Genetic code
	2.2.5 Initiation, elongation and termination of protein synthesis in prokaryotes

UNIT 3	TOOLS AND TECHNIQUES OF RECOMBINANT DNA TECHNOLOGY
	Teaching Duration: Lectures 15
3.1	Enzymes
	3.1.1 Enzymes used in Genetic Engineering
	3.1.2 Restriction Endonucleases
	3.1.3 Ligation of DNA fragments using DNA Ligases
3.2	Vectors: plasmids as vectors in Genetic engineering, λ and M13 bacteriophages as cloning vehicle, phagemids, cosmids, YAC, BAC, HAC, MAC
3.3	Polymerase Chain Reaction
3.4	Construction of Genomic and cDNA libraries

UNIT 4	APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY
	Teaching Duration: Lectures 15
4.1	Nucleic acid as therapeutic agents 4.1.1 Anti-sense RNA 4.1.2 Interference RNA 4.1.3 Nucleic acid delivery
4.2.	Transfection of Plants 4.2.1 Plant Transformation with Ti plasmid 4.2.2 Ti plasmid derived vector systems 4.2.3 Plants as Bioreactors
4.3	Methods of Transgenesis in Animals 4.3.1 Retroviral Vector Method for mice 4.3.2 DNA microinjection method 4.3.3 Cre-loxP Recombination System

REFERENCES:

- Watson, J. D. et al (2017). Molecular Biology of the Gene. 7th edition., Pearson India Education Services Pvt. Ltd. (ISBN; 9780321762436)
- Glick B.R. and Patten C.L. (2017, 2018 Indian reprint). Molecular Biotechnology Principles and Applications of Recombinant DNA. 5th edition, ASM Press Washington DC, USA. (ISBN; 978-1-555-81936-1)
- Rastogi S. and Pathak N. (2016). Genetic engineering. 7th impression, Oxford University Press. (ISBN; 978-0195696578)
- Primrose S.B. and Twyman R.M. (2007), Principles of gene manipulation and Genomics. 7th edition. Blackwell Publishing, USA. (ISBN; 978-1-405-13544-3)

MB 1003: BIOPHYSICAL TECHNIQUES AND INSTRUMENTATION

Student Learning Objective: The objective of this course is to introduce the students to the principles of detection and measurement systems and principles of the major molecular techniques to study the prokaryotes. The study also emphasis the study of the various separation techniques and the spectroscopic techniques for the detection of bio-analytes.

UNIT 1	MOLECULAR TECHNIQUES
	Teaching Duration: Lectures 15
1.1	Non-amplified nucleic acid probes
1.2	Amplified nucleic acid technique
	1.2.1 Signal Amplification technique
	1.2.2 Target amplification technique
	1.2.3 Probe Amplification technique
1.3	Genetic fingerprinting methods
	1.3.1 RFLP to analyse lower eukaryotic pathogens and prokaryotes.
	1.3.2 RFEL
	1.3.3 RAPD
	1.3.4 Other PCR-Based method for DNA fingerprinting.

UNIT 2	SEPARATION TECHNIQUES
	Teaching Duration: Lectures 15
2.1	Chromatographic techniques
	2.1.1 Principles of chromatography
	2.1.2 Chromatographic performance parameters
	2.1.3 Partition chromatography
	2.1.4 Adsorption chromatography
	2.1.5 Thin layer chromatography
	2.1.6 Gel permeation chromatography
	2.1.7 Ion exchange chromatography
	2.1.8 Affinity chromatography
	2.1.9 High-Performance Liquid chromatography
	2.1.10 Gas chromatography
2.2	Electrophoresis
	2.2.1 Principle
	2.2.2 Modes of electrophoresis
	2.2.3 Support media
	2.2.4 Different types of electrophoresis
	2.2.5 Electrophoresis of DNA
	2.2.6 Immuno-electrophoresis

UNIT 3	SPECTROSCOPIC TECHNIQUES
	Teaching Duration: Lectures 15
3.1	3.1.1 General properties of electromagnetic radiation 3.1.2 The electromagnetic spectrum 3.1.3 Interactions of radiation and matter 3.1.4 Transmittance, Absorbance & Beer's law 3.1.5 Measurement of Transmittance and Absorbance
3.2	UV/Vis Spectrometry 3.2.1 Instrument component 3.2.2 Types of instruments 3.2.3 Some typical instruments: Photometers & Spectrophotometers 3.2.4 Qualitative Applications of UV/Vis Spectroscopy
3.3	IR Spectrometry 3.3.1 Theory of IR absorption spectrometry 3.3.2 IR instrumentation 3.3.3 IR sources and transducers 3.3.4 Sample handling for IR spectrometry 3.3.5 Application of IR spectrometry
3.4	Mass spectrometer 3.4.1 Molecular mass spectra 3.4.2 Ion Sources 3.4.3 Mass Spectrometers: Instrument components 3.4.4 Mass Analyzers 3.4.5 Tandem Mass Spectrometry 3.4.6 Application of Mass spectrometry

UNIT 4	BIOPHYSICAL TECHNIQUES
	Teaching Duration: Lectures 15
4.1	Nuclear Magnetic Resonance spectrometers 4.1.1 Theory of NMR: Quantum & Classical Description 4.1.2 Types of NMR Spectrometers 4.1.3 Theory of chemical shift 4.1.4 NMR Spectrometers: Instrumentation 4.1.5 Application of NMR
4.2	X-Ray Spectrometers 4.2.1 X-Ray Spectrum 4.2.2 Instrumentation for X-Ray Spectrometry 4.2.3 X-Ray Diffractometers 4.2.4 X-Ray Absorption meter 4.2.5 X-Ray Fluorescent spectrometer 4.2.6 Electron probe microanalyzer

REFERENCES:

- Murray, P. R., Baron, E. J., Pfaller, M. A., Tenover, F. C., & Tenover, R. H. (2005). Manual of clinical microbiology. 9th edition, Vol.2, American Society of Microbiology Press, Washington DC, (ISBN; 1-55581-255-4)
- Wilson, K. and Walker, J., (2010). Principles and Techniques of Biochemistry and Molecular Biology, 7th edition, Cambridge University Press (Low price edition), New York. (ISBN; 978-0521731676)
- Ghosal, S., & AVASTHI, A. S. (2018). Fundamentals of bioanalytical techniques and instrumentation. PHI Learning Pvt. Ltd. (ISBN; 978-8120338555)
- Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). Instrumental analysis. Cengage learning. (ISBN; 978-8131505427)
- Khandpur, R. S., (2008). Handbook of analytical instruments. 2nd edition, Tata McGraw-Hill Publishing Company Limited (New Delhi). (ISBN; 978-0070604605)

MB 1004: ENVIRONMENTAL MICROBIOLOGY AND BIOFUELS

Student Learning Objective: The objective of the course is to enrich the students with the current problems and research being focused to address environmental problems. The understanding of principles of environmental microbiology and its application for sustainable development. The course focuses on aspects of waste water engineering and reuse of water, versatility of microbial ecology, bioremediation and biodegradation as well as intricacies of microbial fuels.

UNIT 1	MICROBIAL ECOLOGY
	Teaching Duration: Lectures 15
1.1	Principles of microbial ecology
1.2	Strategic approach to study microbial ecology
1.3	Microbial mats
1.4	Biofilms
1.5	Algal blooms
1.6	Endophytic microbes
1.7	Quorum sensing

UNIT 2	WASTEWATER TREATMENT AND REUSE
	Teaching Duration: Lectures 15
2.1	Constituents in wastewater treatment, sampling, analysis methods
2.2	Aggregate organic constituents
2.3	Types of biological processes for wastewater treatment
2.4	Biological nitrification, denitrification and phosphorus removal
2.5	Guidelines for planning and designing treatment plants and CETPs

UNIT 3	BIODEGRADATION AND BIOREMEDIATION
	Teaching Duration: Lectures 15
3.1	Biodegradation and Bioremediation
3.2	Bioremediation technologies
3.3	Biodesulfurization
3.4	Biotreatment of pharmaceuticals and nuclear wastes
3.5	Biotreatment of textile effluent, food and dairy industry
3.6	Biodegradation of dyes
3.7	Biodegradation of polymers
3.8	Microbial transformation of pesticides
3.9	Microbial transformation of heavy metals

UNIT 4	BIOFUELS AND BIOENERGY
	Teaching Duration: Lectures 15
4.1	Cellulosic ethanol technology
	4.1.1 Enzymatic processes
	4.1.2 Cellulosic hydrolysis and fermentation
	4.1.3 Ethanol extraction
	4.1.4 Process economics

4.2	Algal fuels
	4.2.1 Microalgae: growth and harvesting
	4.2.2 Algae oil extraction
	4.2.3 Transesterification for biodiesel
	4.2.4 Prospects and economics

REFERENCES:

- T. M. Schmidt and M. Schaechter, (2012). Topics in ecological and environmental microbiology. edited by Academic press. (ISBN; 978-0-12-383878-0)
- Metcalf & Eddy Inc, (2002). Wastewater engineering: Treatment and Reuse, 4th edition, McGraw Hill higher education. (ISBN; 9780070495395)
- Doble, M. & Anil kumar. (2005). Biotreatment of industrial effluents. Butterworth Heinemann-an imprint of Elsevier. (ISBN; 9780080456218)
- Mohapatra P.K. (2010). Environmental Biotechnology, I.K. International. (ISBN 978-8188237548)
- Sungyu Lee and Shah Y.T., (2013). Biofuels and Bioenergy Processes and Technologies, CRC Press. (ISBN 978-1-4200-8955-4)

M.Sc. Microbiology Semester-I

LIST OF PRACTICALS MBP-1005

1. Determination of burst size of coliphage lysate by One-step growth curve.
2. Extraction and detection (Electrophoretic & spectrophotometric) of bacterial genomic DNA.
3. Ligation of DNA fragments.
4. Amplification of gene by PCR.
5. Study of RFLP
6. Study of bacterial transformation
7. Extraction of total RNA from yeast.
8. Demonstration of HPLC and GC
9. Thin layer chromatography of sugars and amino acids.
10. Analysis of physico-chemical analysis of domestic water and wastewater.
 - Acidity
 - Alkalinity
 - Hardness –EDTA titrimetric method
 - Solids: TDS and TSS
 - Chlorine demand
 - Chloride
11. Analysis of aggregate organic constituents
 - Biochemical oxygen demand
 - Chemical oxygen demand
12. Enzyme substrate coliform test for drinking water.
13. Isolation and cultivation of cyanobacteria.
14. Study of bacterial growth curve.
15. Study of fungal growth by slide culture technique.

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

Teaching & Evaluation Scheme
Semester II

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB-2001	Enzymology and Microbial Physiology	4	-	70	30	100	4
MB-2002	Bioinformatics & bio-nanotechnology	4	-	70	30	100	4
MB-2003	Advances in immunology and pathogenesis	4	-	70	30	100	4
MB-2004	Biostatistics and Research methodology	4	-	70	30	100	4
MBP -2005	Practicals	-	16	140	60	200	8
Total		16	16	420	180	600	24

M. Sc. Semester II
MB 2001: ENZYMOLOGY AND MICROBIAL PHYSIOLOGY

Student Learning Objective: This subject will give insights into the kinetics of enzymes and enzyme inhibition. Students will learn about the general methodology of protein engineering applications of enzymes. Also, this paper will focus on the diverse metabolic processes of microorganisms along with concepts of physiological adaptations in microorganisms.

UNIT 1	ENZYME KINETICS
	Teaching Duration: Lectures 15
1.1	Kinetics of uncatalyzed chemical reaction
1.2	Kinetics of Enzyme catalyzed reactions
1.3	Kinetics of single substrate enzyme catalyzed reaction 1.3.1 Michaelis-Menten equation, its modification and its significance 1.3.2 Vmax and Km 1.3.2 Lineweaver-Burk plot, Eadie-Hofstee plot, Hanes plot.
1.4	Enzyme inhibition kinetics: 1.4.1 Reversible inhibition: 1.4.2 Competitive inhibition 1.4.3 Non-Competitive inhibition 1.4.4 Un Competitive inhibition 1.4.5 Allosteric inhibition 1.4.6 Substrate inhibition 1.4.7 Partial inhibition 1.4.8 Irreversible inhibition.
1.5	Kinetics of multi-substrate enzyme catalyzed reaction: 1.5.1 Ping-pong reaction 1.5.2 Random-order reactions 1.5.3 Compulsory order reactions

UNIT 2	PROTEIN ENGINEERING AND APPLICATIONS OF ENZYMES
	Teaching Duration: Lectures 15
2.1	Enzyme Engineering of industrial enzymes. 2.1.1 Rational design methods 2.1.2 Site directed mutagenesis
2.3	Chemical modifications and unnatural amino acids 2.3.1 Random methods 2.3.2 Sequence space 2.3.3 Methods for mutagenesis 2.3.4 Methods for recombination 2.3.5 Sequence homology independent recombination 2.3.6 Screening and selection
2.4	Application of enzymes in Industry. 2.4.1 Milling and Baking: Enzyme in Flour. 2.4.2 Enzymes in Starch production, Sweetner and syrup production, Starch liquefaction and dextrose. 2.4.3 Pectic enzymes in fruit and juice manufacture: Food processing related properties of pectic enzymes.

	2.4.4 Textiles and laundry detergents: Enzymes in laundry detergents 2.4.5 Pulp and paper: Enzyme application in pulp and paper processes. 2.4.6 Enzymes and Bioremediation: Enzymology of n-alkane oxidation
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UNIT 3	PHYSIOLOGICAL ADAPTATION
	Teaching Duration: Lectures 15
3.1	Two component regulation 3.1.1 Prototypical Two Component regulatory system
3.2	Spectrum of Functions: 3.2.1 Osmolarity Changes and Porin Regulation 3.2.2 Quorum sensing and staphylococcal virulence 3.2.3 The Phosphorelay and Sporulation Initiation in <i>Bacillus subtilis</i> 3.2.4 Chemotaxis and Atypical Output Response
3.3	Physiology, Biochemistry & Genetic Aspects of: 3.3.1 Oxidative Stress Response and Regulation 3.3.2 Heat Shock Response 3.3.3 Nutritional Stress and Starvation Stress Response 3.3.4 pH Stress and Acid Tolerance
3.4	Biochemistry and Physiology of Radiation Resistant Microorganisms

UNIT 4	MICROBIAL METABOLISM
	Teaching Duration: Lectures 15
4.1	Assimilation and Dissimilation of Nitrate and Sulphate
4.2	Nitrogen Fixation
4.3	Phototrophic Prokaryotes.
4.4	Purple Photosynthetic Bacteria
4.5	Green Sulphur Bacteria.
4.6	The Structure of Photosynthetic Membranes in Bacteria.
4.7	Cell wall and Capsule Biosynthesis. 4.7.1 Peptidoglycan Structure and Synthesis. 4.7.2 Lipopolysaccharide Structure and Synthesis.

REFERENCES:

- Pandey A., Webb, C., Fernandes, M. and Larroche, C. (2006). Enzyme Technology. Springer-Verlag., New York. (ISBN; 978-0-387-29294-6)
- Price N. and Stevens L. (1999). Fundamentals of Enzymology. 3rd Edition Oxford University Press., London. (ISBN; 9780198502296)
- Streips U.N. and Yasbin R.E. (2002). Modern Microbial Genetics. 2nd Edition. Wiley-Liss, A John Wiley and sons Inc., publication, New York. (ISBN; 978-0-471-38665-0)
- Moat A., Foster J. and Spector M. (2009). Microbial Physiology, 4th Edition, Wiley. (ISBN; 978-81-265-2106-7)
- Schaechter M. (2004). The Desk Encyclopedia of Microbiology. Elsevier Academic Press, California USA. (ISBN; 9780080961286)
- Gray N., Calvin M., and Bhatia SC. (2012). Enzymes Biotechnology. 1st Edition. CBS Publishers, New Delhi. (ISBN; 9788123918297)
- White D. (2003). The Physiology and Biochemistry of Prokaryotes, 2nd Edition, Oxford University Press. (ISBN: 0-19-512579-7)

MB 2002: BIOINFORMATICS & BIO-NANOTECHNOLOGY

Student learning Objectives: The basic objective is to introduce the basic techniques of bioinformatics. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems. The students will become familiar with the online tools for predictive results for the formulation of research problems. This paper also describes rapidly growing branch of bio-nanotechnology and its applications.

UNIT 1	GENOMICS, PROTEOMICS & OTHER “OMICS”
	Teaching duration: Lectures 15
1.1	Next generation sequencing method
1.2	Genome assembling
1.3	Genome Annotation
1.4	Genome Mapping: RFLPs, SNPs, AFLPs
1.5	Interaction Proteomics: Methods of Protein-Protein Interaction
1.6	Expression proteomics: 2-D Differential gel electrophoresis
1.7	Functional Proteomics: Protein chips, Antibody array
1.8	Application of Proteomics: In the field of Medical, Pharmaceutical and Plant Biotechnology
1.9	Transcriptomics: RNA level Gene Expression: DNA Micro array Technology
2.0	Metagenomics
	2.0.1 Metagenomics offer a way forward and Contribution in various fields.
	2.0.2 Designing a Metagenomics Project: Sequence based and Function based analysis.

UNIT 2	DATABASES: IN SILICO RESOURCE FOR THE INFORMATION
	Teaching duration: Lectures 15
2.1	Biological Databases
2.2	Nucleotide sequence database: EMBL, gene bank, DDBJ
2.3	Protein Database: Protein sequence database: PIR, Swiss-Prot Structure database: PDB, MMDB
2.4	Classification database: CATH, SCOPE
2.5	Sequence-based Database Searches: BLAST, PSI-BLAST, RPS-BLAST
2.6	Metabolic pathway Database: KEGG

UNIT 3	SEQUENCE ALIGNMENTS AND PHYLOGENY
	Teaching duration: Lectures 15
3.1	Pairwise Sequence Alignment
3.2	3.2.1 Sequence Homology versus Sequence Similarity 3.2.2 Sequence Similarity versus Sequence Identity 3.2.3 Methods: Global and Local
3.3	Multiple Sequence Alignment

3.4	3.3.1 Exhaustive Algorithms 3.3.2 Heuristic Algorithms Phylogeny: 3.4.1 Methods of Phylogeny: Maximum likelihood, UPGMA, N-J method 3.4.2 Statistical evaluation of obtained phylogenetic tree 3.4.3 Software for phylogenetic analysis: Phylip
3.5	Secondary structure prediction: 3.5.1 Computation methods for secondary structure prediction: Chou Fasman and GOR.
3.6	Protein Modeling: methods of Protein Modeling, Homology Modeling; fold recognition and threading approaches, and Ab-initio structure prediction methods.

UNIT 4	BIO-NANOTECHNOLOGY
	Teaching duration: Lectures 15
4.1	An Introduction to Nano World: Nano, The Unit Nanometer, Nanoscience, Nanotechnology
4.2	Types and properties of Nanomaterials
4.3	Introduction to Bio-Nanotechnology, In the dominion of Biological machines
4.4	Nano motors of biological Systems, ATP Synthase: A Nano-turbine
4.6	Physical and Chemical methods for synthesis of nanoparticles.
4.7	Self-assembly techniques for synthesizing nanoparticles
4.8	Applications of nanotechnology
	4.8.1 Application of DNA and protein nanostructures in molecular nanotechnology and nanoelectronics
	4.8.2 Application of carbon nanotubes in Biological systems: Biosensors, Surgical supplements, Gene delivery using CNT instead of vector, Pollution control by CNT
	4.8.3 Nano particles and its amalgamation with drugs for drug delivery: Liposomes

REFERENCES:

- Primrose S. and Twyman R. (2006). Principles of Gene Manipulation & Genomics, 7th edition. Black well Publishing, Malden. (ISBN: 978-1405135443)
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- Twyman, R. (2004). Principles of proteomics. Taylor & Francis. (ISBN: 978-1859962732)
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MB 2003: ADVANCES IN IMMUNOLOGY AND PATHOGENESIS

Student learning Objectives: This paper focuses on principles of immunology, molecular pathogenesis, immune-technology and immunotherapy. It also provides understanding and studying the molecular mechanism of pathogen in causing infections and the response of the host against the pathogens which would enable in developing therapy, vaccine development and the control of transmission.

UNIT 1	RECEPTOR BIOLOGY
	Teaching duration: Lectures 15
1.1	The MHC Complex 1.1.1 Structure of MHC molecules 1.1.2 Binding of peptide to MHC molecules 1.1.3 Genomic organization of the MHC 1.1.4 Expression of MHC molecules
1.2	B cell surface receptor for antigen
1.3	T cell surface receptor for antigen
1.4	Transplantation

UNIT 2	HAEMATOPOIESIS AND ACTIVATION OF LYMPHOCYTES
	Teaching duration: Lectures 15
2.1	Activation of T cells 2.1.1 Activation of CD4+ Lymphocyte 2.1.2 Activation of CD8+ T cells
2.2	Activation of B cells 2.2.1 Antigen recognition and antigen induced B cell activation 2.2.2 Helper T cell dependent antibody response to protein antigen 2.2.3 Antibody response to T cell independent antigen
2.4	Primary B and T cells deficiencies

UNIT 3	CANCER AND IMMUNOTHERAPY
	Teaching duration: Lectures 15
3.1	Cancer: Origin and Terminology
3.2	Malignant transformation of cells
3.3	Oncogenes and cancer induction
3.4	Tumors of the immune system 3.4.1 Tumor antigens 3.4.2 Tumor invasion of immune system 3.4.3 Cancer Immunotherapy
3.5	Engineered antibodies for therapy
3.6	Immuno conjugates and its applications

UNIT 4	MOLECULAR PATHOGENESIS
	Teaching duration: Lectures 15
4.1	Attachment and entry of microorganisms into the body 4.1.1 Gastrointestinal Tract
4.2	Encounter of microbes with phagocytic cells 4.2.1 Cell biology of phagocytosis 4.2.2 Phagocytosis in polymorpho-nuclear leucocytes 4.2.3 Phagocytosis in macrophages 4.2.4 Microbial strategies in relation to phagocytes
4.3	The spread of microbes through the body 4.3.1 Microbial factors promoting spread 4.3.2 Spread via lymphatics 4.3.3 Spread via Blood
4.4	Mechanism of cell and tissue damage 4.4.1 Microbial toxins

REFERENCES:

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- Nash A.A., Dalziel R.G., and Fitzgerald J.R., (2015) Mims' Pathogenesis of Infectious Disease, 6th Edition, Academic Press (Elsevier). (ISBN;978-0-12-397188-3)

MB-2004 BIOSTATISTICS AND RESEARCH METHODOLOGY

Student learning objective: 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.

UNIT 1	RESEARCH METHODOLOGY - 1
	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 - 2
	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.

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.

4.3	4.2.1 Introduction. 4.2.2 Student's t-Distribution. 4.2.3 Application of t-Distribution. Analysis of Variance (ANOVA). 4.3.1. Principle of Anova.
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REFERENCES:

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- Gurumani N. (2011) Research Methodology for Biological Sciences, MJP Publishers, Chennai. (ISBN; 978-81-8094-016-0)
- Gurumani N. (2010) An Introduction to Biostatistics, Revised 2nd Edition, MJP Publishers, Chennai. (ISBN; 978-81-8094-006-4)
- Khan I.A. and Khanum A. (2009) Fundamentals of Biostatistics, Revised 5th Edition, Ukaaz Publications, Hyderabad. (ISBN; 978-81-9004-410-3)
- Ranjit Kumar. (2011) Research Methodology-A step by step Guide for Beginners. 3rd Edition, Sage Publications. (ISBN; 978-1-84920-301-2)
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M.Sc. Microbiology Semester-II

LIST OF PRACTICALS MBP-2005

1. Determination of cellulase activity using CMC as substrate
2. Determination of K_m & V_{max} of amylase/cellulase.
3. Determination of effect of pH, temperature, activators and inhibitors on amylase activity.
4. Immobilization of amylase/cellulase and determine its activity yield.
5. Isolation of respiratory deficient mutants by UV radiation in yeast.
6. Study of chemical mutagenesis in *E. coli*.
7. Isolation of VAM spores from soil.
8. Microbial synthesis of nanoparticles and its characterization by UV-VIS spectroscopy.
9. Sequence retrieval for nucleic acid and proteins.
10. Study of protein structure database (PDB).
11. Sequence based analysis by BLAST and MSA.
12. EMBOSS applications for nucleotide and protein sequence analysis.
13. Computer assisted oligonucleotide primer designing.
14. Protein secondary structure prediction.
15. Biostatistical analysis:
 - Calculate mean, median, mode, range, variance, standard deviation, standard error, confidence interval of microbiological data using MSEXcel/suitable software.
 - Calculate regression analysis for maltose/glucose standard curve data using LINEST function of MSEXcel/suitable software.
 - Plot line-scatter graph, bar graph with error bars of microbiological data using MSEXcel/suitable software.



Veer Narmad South Gujarat University,
Surat

M.Sc. (Microbiology) Syllabus
(Effective from June, 2021)

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

Teaching & Evaluation Scheme

Semester III

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB 3001	Fermentation technology	4	-	70	30	100	4
MB 3002	Microbial products	4	-	70	30	100	4
MB 3003	Biochemical engineering	4	-	70	30	100	4
MB 3004	Pharmaceutical microbiology	4	-	70	30	100	4
MBP 3005	Practical	-	16	140	60	200	8
Total		16	16	420	180	600	24

M.Sc.SEMESTER III

MB 3001: FERMENTATION TECHNOLOGY

Student Learning Objective: 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.

UNIT 1	THE ISOLATION AND IMPROVEMENT OF INDUSTRIALLY IMPORTANT MICROORGANISMS
	Teaching Duration: Lectures 09
1.1	Isolation methods utilizing selection
1.2	Isolation methods not utilizing selection of the desired characteristic—from the “waksman platform” to the 1990s of the desired characteristics
1.3	Screening methods and high throughput screening
1.4	Broadening the base of the discovery process and maximizing gene expression
1.5	Improvement of strains producing primary biosynthetic products
1.6	Improvement of strains producing secondary biosynthetic products

UNIT 2	MEDIA FOR INDUSTRIAL FERMENTATIONS
	Teaching Duration: Lectures 09
2.1	Introduction
2.2	Typical media
2.3	Medium formulation
2.4	Water
2.5	Energy sources
2.6	Carbon sources
2.7	Nitrogen sources
2.8	Minerals
2.9	Growth factors
2.10	Nutrient recycle
2.11	Buffers
2.12	The addition of precursors and metabolic regulators to media
2.13	Oxygen requirement and antifoams
2.14	Medium optimization

UNIT 3	FERMENTORS: DESIGN, OPERATION, AND APPLICATIONS
	Teaching Duration: Lectures 09
3.1	Bioreactors: an overview
3.2	Component parts of bioreactors
3.3	Component parts of a “typical” vessel
3.4	Peripheral parts and accessories
3.5	Alternative vessel designs
3.6	Bioreactor instrumentation
3.7	Common measurement and control systems
3.8	Additional sensors
3.9	“Substrate sensors”
3.10	Bioreactor preparation and use
3.11	Examples of common bioreactor applications

3.12	Current trends and future prospects in fermenter design and applications
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UNIT 4	THE RECOVERY AND PURIFICATION OF FERMENTATION PRODUCTS
	Teaching Duration: Lectures 09
4.1	Introduction
4.2	Removal of microbial cells and other solid matters
4.3	Foam separation (floatation)
4.4	Precipitation
4.5	Filtration
4.6	Centrifugation
4.7	Cell disruption
4.8	Liquid-liquid extraction
4.9	Solvent recovery
4.10	Two-phase aqueous extraction
4.11	Reversed micelle extraction and supercritical fluid extraction
4.12	Adsorption
4.13	Removal of volatile products
4.14	Chromatography
4.15	Membrane processes
4.16	Drying
4.17	Crystallization
4.18	Whole broth processing

References:

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- 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, 3th 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)

MB 3002: MICROBIAL PRODUCTS

Student Learning Objective: 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.

UNIT 1	FERMENTED FOOD AND DAIRY
	Teaching Duration: Lectures 09
1.1	Fungal biomass production: Bakers' yeast
1.2	Milk based fermented foods: Yogurt and Cheese
1.3	Grain based fermented foods: Soy sauce, Soy paste
1.4	Alcohol based fermented products: Beer and Wine
1.5	Vegetable based fermented foods: Sauerkraut and Olives
1.6	Fermented sausages and fish
1.7	Mushroom production

UNIT 2	MICROBIAL FERMENTATIONS
	Teaching Duration: Lectures 09
2.1	Antibiotics: Cephalosporin
2.2	Hormones: Insulin
2.3	Anticancer agents: Anthracyclines
2.4	Organic acids: Citric acid
2.5	Amino acids: L-Lysine
2.6	Enzymes: Cellulase and Protease
2.7	Vitamins: B12

UNIT 3	MODERN TRENDS IN MICROBIAL PRODUCTION - I
	Teaching Duration: Lectures 09
3.1	Biosurfactants
3.2	PHA: Separation, purification and manufacturing methods
3.3	Carotenoids: β carotene
3.5	Microbial polysaccharides: Dextran
3.6	Microbial flavors: Vanillin, Terpenes
3.7	Microbial biotransformation of steroids and sterols

UNIT 4	MODERN TRENDS IN MICROBIAL PRODUCTION - II
	Teaching Duration: Lectures 09
4.1	Techniques and technologies to produce biomass of cyanobacteria and microalgae
4.2	Single Cell Protein (SCP)
4.3	Bioinsecticides
4.4	Rhizobium inoculants
4.5	Monoclonal antibodies: Production and recovery
4.6	Bacterial siderophores
4.7	Ergot alkaloids

References:

- 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)
- 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)
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MB 3003: BIOCHEMICAL ENGINEERING

Student Learning Objective: 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 behavior of fluids and mass transfer and population dynamics in a fermentor.

UNIT 1	REACTOR ENGINEERING
	Teaching Duration: Lectures 09
1.1	Bioreactor configurations: Overview
1.2	Monitoring and control of bioreactors
1.3	Bioprocess control
1.4	Sterilization
1.5	Microtiter Plate fermentation: Introduction, Routine and next generation MTP fermenter, Impact on bioprocessing and synthetic biology
1.6	Statistical optimization of fermentation

UNIT 2	FLUID FLOW AND MIXING
	Teaching Duration: Lectures 09
2.1	Classification of fluids
2.2	Fluids in motion
2.3	Factors affecting broth viscosity
2.4	Viscosity measurement
2.5	Non-Newtonian fluids
2.6	Mixing
2.7	Role of shear in stirred fermenters
2.8	Rheological properties of fermentation broths

UNIT 3	HEAT AND MASS TRANSFER
	Teaching Duration: Lectures 09
3.1	Heat transfer equipment
3.2	Mechanisms of heat transfer and conduction
3.3	Heat transfer between fluids
3.4	Relationship between heat transfer, cell concentration and stirring conditions
3.5	Convective mass transfer
3.6	Oxygen uptake in cell cultures
3.7	Oxygen transfer in fermenters
3.8	Measurement of kLa

UNIT 4	MULTIPLE INTERACTING MICROBIAL POPULATIONS
	Teaching Duration: Lectures 09
4.1	Classification of interactions between two species
4.2	Competition
4.3	Predation and parasitism
4.4	Spoilage and product manufacture by spontaneous mixed cultures

References:

- Doran P. M., (2013), Bioprocess Engineering Principles, 2nd Edition, Academic Press, (ISBN 9780122208515)
- 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)
- Ollis D. F. and Bailey J. E., (2010), Biochemical Engineering Fundamentals. 2nd edition McGraw-Hill Education (India) Private Limited, (ISBN: 978-0070701236)
- Vogel H. C and Todaro C. M., (2014), Fermentation and biochemical engineering handbook. 3rd edition, William Andrew publisher, (ISBN: 978-1-4557-2553-3)

MB 3004: PHARMACEUTICAL MICROBIOLOGY

Student Learning Objective: This paper gives insight of microbiological analysis and quality control in pharmaceutical industries. It includes the learning of good manufacturing practices and its monitoring in pharmaceutical companies. The students would also learn quality check and quality maintenance of pharmaceutical products and microbiological auditing.

UNIT 1	BIOPHARMACEUTICAL: INTRODUCTION AND MICROBIOLOGICAL ASSAY
	Teaching Duration: Lectures 09
1.1	Introduction to pharmaceuticals: Microorganisms and medicines
1.2	The agar diffusion assay: Its quantitative basis
1.3	The theory and practice of tube assays for growth promoting substances
1.4	The theory and practice of tube assays for growth inhibiting substances
1.5	Standard reference materials

UNIT 2	MONITORING MICROBIOLOGICAL QUALITY
	Teaching Duration: Lectures 09
2.1	Principles of good manufacturing practice
2.2	Monitoring microbiological quality – Conventional testing methods
2.3	Monitoring microbiological quality – Application of rapid methods

UNIT 3	MICROBIAL ASPECTS OF PHARMACEUTICAL PROCESSING
	Teaching Duration: Lectures 09
3.1	Microbial spoilage and preservation of pharmaceutical products
3.2	Sterilization control and sterility assurance
3.3	The quality assurance and quality control of pharmaceutical products

UNIT 4	PHARMACEUTICAL STERILE PRODUCTS AND MICROBIOLOGICAL AUDITING
	Teaching Duration: Lectures 09
4.1	Types of sterile products: Injections, non-injectable sterile fluids, ophthalmic preparations, dressing, implants, absorbable haemostats, surgical ligatures and sutures, instruments & equipment
4.2	Vaccines: Seed lot system, production, fermentation, blending, filling, and drying
4.3	In-vitro diagnosis
4.4	Immune sera
4.5	Human immunoglobulin & monoclonal antibodies
4.6	Microbiological auditing

References:

- Barredo, J. L., (2005), Microbial Processes and Products. Humana Press, New Jersey, (ISBN: 978-1-59259-847-2)
- Denyer, S. P. and Baird, R. M., (2008), Guide to microbiological control in pharmaceuticals and medical devices. 2nd Edition, CRC Press, Boca Raton, (ISBN: 9781444330632)
- Flickinger, M. C. and Drew, S. W., (1999), Encyclopedia of Bioprocess Technology. Wiley- Interscience, New Jersey, (ISBN: 9780471138228)
- Gad, S. C., (2007), Handbook of Pharmaceutical Biotechnology. Wiley-Interscience, New Jersey, (ISBN: 978-0-470-25958-0)
- Hewitt, W. (2004). Microbiological Assays for Pharmaceutical Analysis-A rational approach, Indian Edition, CRC, (ISBN: 0-203-58859-2)
- Hugo and Russells, (2007), Pharmaceutical Microbiology, Blackwell Publishing.
- Walsh G., (2007), PharmaceurcalBiotechnolog- Concepts and Applications, Wiley (ISBN: 978-0-470-01244-4)

M.Sc. Microbiology Semester 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. Determination of *KLa* of laboratory fermenter.
7. Sterility testing of pharmaceutical products by direct inoculation & membrane filtration methods as per Indian Pharmacopoeia (IP).
8. Cell disruption by sonication and estimation of intracellular protein.
9. 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.
10. 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
11. Microbial production of dextran/xanthan by
Leuconostocmesenteroides/Xanthomonascampestris.
12. Microbiological assay of amino acid.
13. Detection of anti-HIV sera by ELISA.
14. Detection of anti-HBsAgsera by ELISA.

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

Teaching & Evaluation Scheme

Semester IV

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB 4001	Seminar Presentation	4		70	30	100	4
MB 4002	Dissertation	12	16	350	150	500	20
TOTAL		16	16	420	180	600	24

Guidelines for MB 4001 & MB 4002

<p>MB 4001</p>	<ul style="list-style-type: none"> ➤ Faculty has to mentor the allotted students for selected topics of seminar. ➤ Students have to individually deliver a seminar on the advance or novel topic 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 handouts (4 slides /page) of his/her presentation to the examiner.
<p>MB 4002</p>	<ul style="list-style-type: none"> ➤ Faculty has to mentor the allotted students for the dissertation. ➤ Faculty will mentor the students for Scientific writing & communication which includes: <ul style="list-style-type: none"> • 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 References: <ul style="list-style-type: none"> ▪ 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) ➤ Dissertation work can be done individually or in a pair on any topic related to microbiology. ➤ Dissertation may be carried in-house or outside the campus after due permission granted by the supervising teacher and institute head at the following recognized institutions or industries like: <ul style="list-style-type: none"> • Any UGC recognized University PG departments. • Any Agriculture University. • All National and State level research institute. • ISO or FDA/USFDA industry or research center having R & D and Q.C. facilities. ➤ The thesis will be evaluated by examiner(s) which includes thesis evaluation and dissertation presentation. ➤ The dissertation presentation shall be done in audio-visual mode by the candidate within 15 minutes. ➤ The candidate has to submit their dissertation in a standard hard-bound thesis and soft copy in PDF format.