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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-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન માઈક્રોબાયોલોજી વિષય ચલાવતી સ્નાતક અને અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓને તથા ડિપાર્ટમેન્ટનાં વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૦-૨૧ અમલમાં આવનાર બી.એસસી. એન્ડ એમ.એસસી. (માઈક્રોબાયોલોજી) સેમેસ્ટર-૧ અને ૨ નો અભ્યાસક્રમ અંગે માઈક્રોબાયોલોજી 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.૩૦/૬/૨૦૨૦ ની સભાના ઠરાવ ક્રમાંક:૨૭ અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્દઉપરાંત તેનો અમલ કરવો.

માઈક્રોબાયોલોજી 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. (માઈક્રોબાયોલોજી) સેમેસ્ટર-૧ અને ૨ નાં અભ્યાસક્રમ માટે તા.૧૬/૧૨/૨૦૧૯ ની સભામાં નીમેલ 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, માઈક્રોબાયોલોજી 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. (માઈક્રોબાયોલોજી) સેમેસ્ટર-૧ અને ૨ નાં અભ્યાસક્રમ મંજૂર કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક : એકે./પરિપત્ર/૫૮૦૫/૨૦૨૦

તા. ૧૫-૦૭-૨૦૨૦

R.B.H.
16/07/20

ઈ.ચા. કુલસચિવ

પ્રતિ,

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

.....તરફ જાણ તેમજ અમલ સારૂ.



Veer Narmad South Gujarat University,
Surat

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 1.2 1.3 1.4 1.5 1.6 1.7	Nucleosomes DNA Structure DNA topology RNA Structure The replication fork The specialization of DNA polymerases 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 2.2	Transcription 2.1.1 RNA polymerase 2.1.2 Features of prokaryotic promoters 2.1.3 The transcription cycle in Bacteria 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 3.2 3.3 3.4	Enzymes 3.1.1 Enzymes used in Genetic Engineering 3.1.2 Restriction Endonucleases 3.1.3 Ligation of DNA fragments using DNA Ligases Vectors: plasmids as vectors in Genetic engineering, λ and M13 bacteriophages as cloning vehicle, phagemids, cosmids, YAC, BAC, HAC, MAC Polymerase Chain Reaction 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.

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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:

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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:

- Mims, C. A. et al., (2000). MIMS' Molecular pathogenesis of Infectious Disease, 5th Edition. Academic Press. (ISBN 9780123971883)
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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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- 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.
