Gujarat Vidyapeeth, Ahmedabad

Curriculum of M.Sc Microbiology Course, Semester I,II,III,IV, Choice Based Credit System (Effective from June-2016)

CORE PAPERS

Sr. No	Paper Code	Name of Paper	Semester	Theory			Practical		
				Credit	Hours	Marks	Credit	Hours	Marks
1	MIC-101	Microbial Diversity	I	4	60	100	3	90	100
2	MIC-102	Microbial Physiology	I	4	60	100	3	90	100
3	MIC-103	Bio-Instrumentation	I	4	60	100	3	90	100
4	COMPL-101	Padyatra-1	I	-	-	-	2	-	Grade
5	COMPL-102	Udhyog-1	I	-	-	-	2	-	Grade
6	FC-101	Gandhian Thoughts	I	2	30	50	-		-
7	MIC-201	Enzymology	II	4	60	100	3	90	100
8	MIC-20	Molecular Bioliogy and Microbial Genetics	II	4	60	100	3	90	100
9	MIC-203	Recombinant DNA Technology	II	4	60	100	3	90	100
10	COMPL-201	Udhyog-2	II	-	-	-	3	-	Grade
11	MIC-301	Bioprocess Technology	III	4	60	100	3	90	100
12	MIC-302	Environmental Biotechnology	III	4	60	100	3	90	100
13	MIC-303	Microbial Technology	III	4	60	100	3	90	100
14	COMPL-301	Padyatra-2	III	-	-	-	2	-	Grade
15	COMPL-302	Udhyog-3	III	-	-	-	2	-	Grade
16	MIC-401	Biostatistics and Computer Application	IV	4	60	100	-	-	-
17	MIC-402	Research Methodolgy and Scientific Writing	IV	4	60	100	-	-	-
18	MIC-403	Dissertation Work	IV	-	-	-	12	-	Grade
19	COMPL-401	Udhyog-4	IV	-	-	-	2	-	Grade

ELECTIVE PAPERS

Sr. No	Paper Code	Name of Paper	Semester	Theory			Practical		
				Credit	Hours	Marks	Credit	Hours	Marks
1	**EC-101**	**Immunology**	**I**	4	60	100	3	90	100
2	EC-102	Clinical Microbiology	I	4	60	100	3	90	100
3	EC-103	Forensic Microbiology	I	4	60	100	3	90	100
4	**EC-201**	**Bioinformatics**	**II**	4	60	100	3	90	100
5	EC-202	Nanotechnology	II	4	60	100	3	90	100
6	EC-203	Biostatistics	II	4	60	100	3	90	100
7	**EC-301**	**Biomethanation**	**III**	4	60	100	3	90	100
8	EC-302	Anaerobic Bioreactor Design	III	4	60	100	3	90	100
9	EC-303	Bioenergy	III	4	60	100	3	90	100

Papers Shown in Bold Letters are currently being Taught

SUMMARY

Semester	Total Credit
Semester-I	**34**
Semester-II	**30**
Semester-III	**32**
Semester-IV	**22**
Grand Total	**118**

ગૂજરાત વિદ્યાપીઠ,અમદાવાદ

એમ.એસ.સી માઈક્રોબાયોલોજી નો અભ્યાસક્રમ, સેમેસ્ટર I, II, III, IV

ચોઈસ બેસ્ડ ક્રેડિટ સિસ્ટમ (જુન-૨૦૧૬ થી લાગુ)

CORE PAPERS

ક્રમ	પેપર કોડ	પેપર નું નામ	સેમેસ્ટર	સૈધાંતિક			પ્રાયોગિક		
				ક્રેડિટ	કલાક	કુલ ગુણ	ક્રેડિટ	કલાક	કુલ ગુણ
૧	MIC-101	માઈક્રોબીઅલ ડાયવર્સિટી	પ્રથમ	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૨	MIC-102	માઈક્રોબીઅલ ફિશીઓલોજી	પ્રથમ	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૩	MIC-103	બાયો-ઇન્સ્ટ્રુમેનટેશન	પ્રથમ	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૪	COMPL-101	પદયાત્રા-૧	પ્રથમ	-	-	-	૨	-	ગ્રેડ
૫	COMPL-102	ઉધોગ-૧	પ્રથમ	-	-	-	૨	-	ગ્રેડ
૬	FC-101	ગાંધ્યન થોટ	પ્રથમ	૨	૩૦	૫૦	-		-
૭	MIC-201	એન્ઝાયમોલોજી	દ્વિતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૮	MIC-20	મોલીક્યુલર બાયોલોજી એન્ડ માઇક્રોબીઅલ જેનેટીક્સ	દ્વિતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૯	MIC-203	રીકોમ્બીનેન્ટ ડીએનએ ટેકનોલોજી	દ્વિતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૧૦	COMPL-201	ઉધોગ-૨	દ્વિતીય	-	-	-	૩	-	ગ્રેડ
૧૧	MIC-301	બાયોપ્રોસેસ ટેકનોલોજી	તૃતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૧૨	MIC-302	એન્વાયરનમેન્ટલ બાયોટેકનોલોજી	તૃતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૧૩	MIC-303	માઈક્રોબીયલ ટેકનોલોજી	તૃતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૧૪	COMPL-301	પદયાત્રા-૨	તૃતીય	-	-	-	૨	-	ગ્રેડ
૧૫	COMPL-302	ઉધોગ-૩	તૃતીય	-	-	-	૨	-	ગ્રેડ
૧૬	MIC-401	બાયોસ્ટેટીસ્ટીક એન્ડ કોમ્પ્યુટર એપ્લીકેશન	ચોથો	૪	૬૦	૧૦૦	-	-	-
૧૭	MIC-402	રીસર્ચ મેથોડોલોજી એન્ડ સાયન્ટીફીક રાયટીંગ	ચોથો	૪	૬૦	૧૦૦	-	-	-
૧૮	MIC-403	ડેઝરટેશન વર્ક	ચોથો	-	-	-	૧૨	-	ગ્રેડ
૧૯	COMPL-401	ઉધોગ-૪	ચોથો	-	-	-	૨	-	ગ્રેડ

ELECTIVE PAPERS

ક્રમ	પેપર કોડ	પેપર નું નામ	સેમેસ્ટર	સૈધાંતિક			પ્રાયોગિક		
				ક્રેડિટ	કલાક	કુલ ગુણ	ક્રેડિટ	કલાક	કુલ ગુણ
૧	**EC-101**	**ઇમ્યુનોલોજી**	પ્રથમ	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૨	EC-102	કલીનીકલ માઇક્રોબાયોલોજી	પ્રથમ	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૩	EC-103	ફોરેન્સિક માઇક્રોબાયોલોજી	પ્રથમ	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૪	**EC-201**	**બાયોઇન્ફોર્મેટીક્સ**	દ્વિતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૫	EC-202	નેનોટેકનોલોજી	દ્વિતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૬	EC-203	બાયોસ્ટેટીસ્ટીક	દ્વિતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૭	**EC-301**	**બાયોમીથેનેશન**	તૃતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૮	EC-302	એનએરોબીક બાયોરીયકટર ડીઝાઇન	તૃતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦
૯	EC-303	બાયોએનરજી	તૃતીય	૪	૬૦	૧૦૦	૩	૯૦	૧૦૦

Papers Shown in Bold Letters are currently being Taught

SUMMARY

સેમેસ્ટર	ક્રેડિટ
સેમેસ્ટર-I	૩૪
સેમેસ્ટર-II	૩૦
સેમેસ્ટર-III	૩૨
સેમેસ્ટર-IV	૨૨
કુલ ક્રેડિટ	૧૧૮

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY

MIC 101-Microbial Diversity

Credits-4 **Teaching Hrs.- 60**

Learning outcomes:-

1. Student will understand the evolution of life.
2. Student will understand the distribution of microorganisms in different ecosystems.
3. Student will understand the role of microorganisms in extreme environment and their importance.

Unit I : Microbial Evolution and Taxonomy

1. Origin of earth and life,
   Microbial evolution and biogeochemical cycles
2. Impact of oxygen, Endosymbiotic evolution, Origin of ozone layer,
   Evolutionary chronometers,
   Sequence of Major events during biological evolution
3. Taxonomy of Eubacteria and Archaea- Nomenclature, classification, Identification
4. Nomenclature, Bergey's Manual- The nature of bacterial identification schemes, prokaryote or eukaryote, the four major categories of bacteria, groups within the four major categories of bacteria

Unit II: Basics of Microbial Diversity

1. Prokaryotic diversity:
   Bacteria- Purple and Green bacteria, Cyanobacteria, Prochlorophytes, Spirilla, Pseudomonads, Free-living aerobic nitrogen fixing bacteria, and Filamentous Actinomycetes
   Archaea- Diversity and physiology of methanogenic Archaea, overview of Hyperthermophilic Archaea
   Eukarya- Algae, Protozoa
2. The challenges of studying microbial diversity
3. Microbial metabolism of Hydrogen
4. Aerobic metabolism of Glucose
5. Aerobic metabolism of Methane and Methanol
6. Microbial metabolism of carbon dioxide
7. Microbial diversity loss- causes and restoration
8. National Biodiversity Strategy and Action Plan

Unit III: Extremophiles

1. Extremes of environmental conditions allowing bacterial growth and survival
2. Extremophilic microbes- acidophiles, alkaliphiles, psychrophiles, barophiles, halophiles, thermophiles,
   Taxonomy and physiology of Extremely Halophilic Archaea,
3. Microbial diversity of rumen
4. Microbial diversity of desert ecosystem

Unit- IV : Importance and Exploitation of Microbial Diversity

1. Biotechnology- why genetic engineering
2. Biotechnology of artificial cells including application to artificial organs
3. Bioactive microbial metabolites as pharmaceuticals (microbial products in perspective)
4. Marketed microbial agents with therapeutic and other utilities (antibacterials, antifungals, antineoplastics)
5. Biotechnology applied to Raw Mineral Processing, Microbially Enhanced Oil Recovery
6. Microbial diversity and biodegradation of xenobiotics
7. Exploitation of fungal and cyanobacterial diversity
8. Societal issues of biotechnology

Practical MIC 101-Microbial Diversity

1. Study of Physiological diversity of microorganisms
2. Study of Metabolic diversity of microorganisms
3. Study of fungal diversity
4. Isolation of phosphate solubilizes.
5. Isolation of Antibiotic producers.
6. Isolation of Amylase producers.
7. Isolation of yeast

References :

1. Brock Biology of Microorganisms" Eighth Edition By- Madigan, T.M.; Martinko, J.M. and Parker, J. Prentice Hall Publication, U.K.
2. Microbiology: Dynamics & Diversity, - Perry JJ and Staley JT, Saunders College Publishing, US
3. Microbiology: Diversity, Disease and the Environment, by Abigail A Salyers and Dixie D Whitt, Fitzgerald Science Press, Maryland
4. Bergey's Manual of Determinative Bacteriology, by John G Holt, Noel R Krieg, Peter HA Sneath, James T Staley and Stanley T Williams, Lippincott Williams & Wilkins, Maryland
5. Biology Life on Earth, by Audesirk & Audesirk, Macmillan Publishing Company, New York
6. Manual of Industrial Microbiology and Biotechnology, Second Edition Editor-in Chief- Arnold, L.; Demain and Julian, E. Davies Editors- Ronald, M. Atlas; Gerald Cohen; Charles, L. Hershberger; Wei-Shou Hu; David, H. Sherman; Richard, C. Willson and David Wu, J.H. ASM Press, Washington
7. Global Biodiversity Status of The Earth's Living Resources, Editor-Groombridge, B. Chapmman and Hall Publication, London.

8 Global Biodiversity Assessment, Editor-Heywood, V.H. and Watson, R.T. Cambridge University, Press.

9 Biodiversity of Microbial Life, Editor-Staley, JT and Reysenbach, A.L, Wiley-Liss Publication, NY.

10 Molecular Biotechnology: Principles and Applications of Recombinant DNA, by Bernard R. Glick, Jack J Pasternak, Cheryl L Patten.

11 The Prokaryotes-A Handbook on The Biology of Bacteria: Ecophysiology, Isolation, Identification, Application, Second Edition, Volume-I Editors-Balows, A.; Truper, H.G.; Dworkin, M.; Harder, W. and Schleiffer, K.H. Springer-Verlag Publication, New York.

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY
MIC-102 MICROBIAL PHYSIOLOGY

Credits-4 **Teaching Hrs.- 60**

Learning Outcomes:-

1. Student will understand the different metabolic activity.
2. Student will understand the effect of radiation, inorganic and organic components on microbes.

Unit-1: INTRODUCTION TO MICROBIAL PHYSIOLOGY

- 1.1 The *Escherichia coli* Paradigm
- 1.2 Cell surface
- 1.3 Microbial genetics
- 1.4 Chemical Synthesis
- 1.5 Special Topics (Growth, Growth cycle, Continuous Culture)
- 1.6 Factors affecting Growth

Unit-2: MEMBRANE TRASPORT, PHYSIOLOGICAL ADPTATIONS AND INTERCELLULAR SIGNALING

- 2.1 Cytoplasmic Membrane and Transport
  - 2.1.1 Membrane Structure
  - 2.1.2 The Functions of cytoplasmic membrane
  - 2.1.3 Nutrient Transport
- 2.2 Physiological Adaptation and Intercellular signaling
  - 2.2.1 Overview of Regulation of gene expression
  - 2.2.2 DNA-Binding Proteins structures
  - 2.2.3 Singnal Transduction
  - 2.2.4 Molecular mechanisms of Singanal transduction
  - 2.2.5 Quorum Sensing
  - 2.2.6 Celluler Differntiation
  - 2.2.7 Microbial Stress Responses

Unit 3: PHYSIOLOGICAL AND METABOLIC DIVERSITY OF MICROORGANISMS

- 3.1 Metabolic Strategies for Generating Cellular Energy
- 3.2 Evolution and Diversity of Photosynthetic and Autotrophic Bacteria
  - 3.2.1 The Phototrophic way of Life (Photosynthesis, Chlorophyll and Bacteriochlorophylls, Carotenoids and Phycobilins, Anoxygenic Photosynthesis, Oxygenic Photosynthesis)

Unit-4: DIVERSITY OF HETEROTROPHIC AND AUTOTROPHIC METABOLISM

- 4.1 Respiration
  - 4.1.1 Oxydative Phosphorylation
  - 4.1.2 Aerobic Chemoorganotrophic Process
  - 4.1.3 Anaerobic Respiration

4.2 Autotrophy (The Calvin Cycle, Other Autotrophic pathways, Nitrogen Metabolism)

Practicals (MIC-102 MICROBIAL PHYSIOLOGY)

1 Growth Kinetics: Calculation of Generation time, Growth rate , μMax Substrate utilization (Glucose -Coles method)
2 Growth Measurement by Biomass (Fungal culture), Gravimetric Method
3 Factors affecting growth: pH, Temperature, Aeration, Agitation, Carbon source, Nitrogen source
4 Measurement of Water Activity (Aw).
5 Measurement of Death Rate of Bacteria.
6 DNA Estimation: DPA Method, UV Method-260 nm
7 RNA Estimation: Orcinol Method.

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY

MIC 103: Bioinstrumentation (Sem-1)

Credits-4 **Teaching Hrs.- 60**

Learning Outcomes:-

1. Student will learn principles, working and applications of various instruments.
2. Student will understand the application of various instruments for analysis.

Unit	Topic
1	**Principle, Instrumentation and Applications:** i. Principle and application of scanning and transmission electron microscopy, scanning tunneling microscopy, confocal microscopy. ii. PCR and Sequencing Techniques. iii. **Biosensors**: Principle and application: Introduction, applications of biosensor, generation of biosensors, glucose biosensor, and urea biosensor.
2	**Specialized Spectroscopy: (Principle, Instrumentation and Applications)** i. Infrared Spectroscopy, Flame emission Spectroscopy and Atomic absorption spectroscopy. ii. Nuclear Magnetic Resonance Spectroscopy, Electron Spin Resonance Spectroscopy, Mass Spectroscopy- MALDI-TOF and X- Ray Spectroscopy.
3	**Separation Techniques :1: (Principle, Instrumentation and Applications)** i. **Chromatography:** Paper; TLC; Conventional Column Chromatography- Ion- Exchange; Affinity; Adsorption. ii. **Specialized Technique-I:** GLC- Column; Detectors. HPLC: Pumps; Columns; Instrumentation. iii. **Specialized Technique-II:** HPTLC, FPLC
4	**Separation Techniques: 2: (Principle, Instrumentation and Applications)** i. **Centrifugation Techniques:** Types of centrifugation; Rate Zone; Isopycnic; High speed; Ultra; preparative; Gradient. ii. **Electophoretic Techniques:** Native, SDS, Agarose and 2D; Zone EP; Isoelectric; Slab Gel; DISC EP; Immuno EP; Pulsed Field; Cellular Gel EP.

References:

1. Instrumental methods of chemical analysis. *Sharma B.K*.
2. Instrumental methods of analysis. *Skoog D.A*.
3. An introduction to practical Biochemistry. *Plummer*.
4. Instrumentation: Spectroscopy. *Chatwal and Anand.*
5. Modern experimental Biology. *Boyer*.
6. Biochemistry. 6th Edition. *Freeman, New York. . Berg, J. M., Tymoczko, J. L. and Stryer, L.* (2006)
7. Biophysics: An Introduction. John Wiley & Sons, England. *Cotterill, R. M. J.* (2002)
8. Principles of protein X-ray crystallography. 3rd Ed. Springer, Germany. . *Drenth, J*. (2007)
9. Biochemistry.3rd Ed. Brooks/Cole, Publishing Company, California. *Garrett, R. H. and Grisham, C. M.* (2004)
10. Understanding NMR Spectroscopy. John Wiley & Sons, England. *Keeler, J.* (2002)
11. Methods in modern biophysics. Second Edition. Springer, Germany. *Nölting, B*. (2006)
12. Biophysics. Kluwer Academic Publishers, New York and Narosa Publishing House, Delhi. *Pattabhi, V. and Gautham, N.* (2002)
13. Principles and Techniques of Biochemistry and Molecular Biology, 6th Ed.Cambridge University Press, New York. *Wilson Keith and Walker John* (2005).
14. Biosensors: An Introduction, Brain Eggins, Wiley Teuinee

MIC 103: Bioinstrumentation (Practicals)
Total Number of Hours: 60
Total Number of Credit: 02

Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments

1. Estimation of Carbohydrates by Anthrone's Method.
2. Estimation of Reducing Sugars by DNSA Method.
3. Estimation of Carbohydrate by Nelson Somogyi's Method
4. Estimation of Protein by Folin Lowry's Method.
5. Determination of Compounds by Chromatography: Paper, TLC Separation of bacterial lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography, ETC.
6. Analysis of Elements by Flame Photometer
7. Separation of serum protein by horizontal submerged gel electrophoresis.
8. Quantitative estimation of hydrocarbons/pesticides/organic
9. Demonstration of HPLC, HPTLC and AAS.
10. Demonstration of Fermenters
11. Separation of biomolecules by gel filtration
12. Demonstration on glucose Biosensors.

GUJARAT VIDYAPEETH : AHMEDABAD
M.D. Gramseva Mahavidyalaya, Sadra, Dist: Gandhinagar
Department of Microbiology
M.Sc. Semester-I

FC-101: Gandhian Thought (ગાંધીવિચાર)

(Syllabus of theoretical portion) (With Effect From 1st July, 2016)
(External Evaluation: 60% + Internal Evaluation: 40%)

Learning outcomes:-

1. Student will study Gandhian thoughts in detail.
2. Students will be enlightened about the way of life Gandhi followed.

એકમ ૧ મંગલપ્રભાત **૪ કલાક**

1.1 વ્રત એટલે શુંઆવશ્યકતા વ્રતની ?

1.2 એકાદશ વ્રત

શાશ્વત વ્રત અપરિગ્રહ ,બ્રહ્મચર્ય ,અસ્તેય ,સાઅહિં ,સત્ય :યમ - દેશકાળની પરિસ્થિતિ પ્રમાણે ઉમેરેલા વ્રતો ,અસ્વાદ :નિયમ - સર્વધર્મસમભાવ ,નિવારણ અસ્પૃશ્યતા ,અભય ,જાતમહેનત , સ્વદેશી

1.3 જીવનમાં વ્રતનું મહત્વ

એકમ ૨ રચનાત્મક કાર્યક્રમ ૧૧ કલાક

2.1 રચનાત્મક કાર્યક્રમ એટલે શું?

2.2 રચનાત્મક કાર્યક્રમની પ્રસ્તુતતા

2.3 ખાદી:

ખાદીનો ઈતિહાસ

ચરવડાચક્ર અને અંબર ચરખાનો પરિચય ,

ખાદીનું મહત્વ ,જીવાદોરી ખેડૂતોની અને ગરીબો ,ગૌરવ શ્રમનું)

ગ્રામોધ્ધાર માટે ખાદી(આરોગ્ય અને ખાદી ,પર્યાવરણ અને ખાદી ,

2.4 વ્યસનમુક્તિ

વ્યસન એટલે શું પર આરોગ્ય વ્યસનની ,પ્રકાર વ્યસનના ?

અસરઅસર સામાજિક વ્યસનની ,

વ્યસન મુક્તિના કાર્યક્રમો

એકમ ૩ આચારની કેળવણી ૪ કલાક

3.1 આચારની કેળવણી અને તેનું મહત્વ

3.2 કુટુંબમાં સમૂહજીવનનો આચાર

3.3 શૈક્ષણિક સંસ્થાઓમાં સમૂહજીવનનો આચાર

3.4 જાહેર સ્થળોના રખસ્વચ્છતા અને રખાવ-

3.5 સામાન્ય વિવેક

એકમ ૪ ઉર્જા અને તેનું મહત્વ: ૮ કલાક

4.1 ઉર્જા એટલે શું ?

4.2 ઉર્જા ના સ્વરૂપ ,ઉર્જા રાસાયણિક ,ઉર્જા ઉષ્મા ,ઉર્જા યાંત્રિક :
ગુરુત્વાકર્ષણીય ઉર્જાઉર્જા વિદ્યુત ,ઉર્જા સૌર ,ઉર્જા નાભીય ,

4.3 ઉર્જા ના સ્ત્રોતસ્ત્રોત ઉર્જા પુનઃઅપ્રાપ્ય અને નઃપ્રાપ્યપુ :

4.4 ઉર્જા બચત અને ગાંધીવિચાર

4.5 બિનપરંપરાગત ઉર્જાના સાધનો સોલાર ,હીટર સોલાર ,સૂર્યકુકર :
ડ્રાયર ,બાયોગેસ ,સૌરલાઈટ ,તળાવ સૌર ,પવનચક્કી ,
બાયોમાસ વગેરે

4.6 ઉર્જા સંરક્ષણ

References :

1 સમૂહ જીવનનો આચારમહેતા બબલભાઈ ,

2 આરોગ્યની ચાવીગાંધીજી ,

3 ખાદી શા માટેગાંધીજી ,?

4 સમયનો તકાદોપુનઃપ્રાપ્ય : ઉર્જા.વડોદરા ,જેડા ,આવૃત્તિ પાંચમી ,

5 મંગલપ્રભાત ગાંધીજી -

6 રચનાત્મક કાર્યક્રમો આજના સંદર્ભમાંશાહ દશરથલાલ -

7 રચનાત્મક કાર્યક્રમો– સ્થાન અને રહસ્ય તેનું : ગાંધીજી

8 પર્યાવરણ સાથી ,સાવલિયા રમેશ -CEE

9 ગાંધીના પાવન પ્રસંગોદેસાઈ મકનજી લલ્લુભાઈ -

10 "રહેવાય નહિ ચુપ"(ટોલ્સટોય ના નિબંધોનો અનુવાદ ,મંદિર પ્રકાશન નવજીવન (અમદાવાદ

અનુ.નં .	વિષય તજજ્ઞનું નામ
૧	શ્રી તેજસભાઈ ઠાકર
૨	ડોપટેલ હરીભાઈ .
૩	શ્રી કપિલભાઈ દેશવાલ
૪	ડોપટેલ .આર કૌશિક .
૫	ડોભટ્ટ નિખિલ .

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY
EC-101: IMMUNOLOGY

Credits-4 **Teaching Hrs.- 60**

Learning outcomes:-
1. Student will learn about basic concepts of immunology.
2. Students will learn in detail about Antigens and Antibodies.
3. Students will understand the application of immunology.

Unit		Topics
1	**A)**	General principles of immunology: History of immunology: structure, composition and function of cells and organs involved in immune system. Immune response (humoral and cell mediated) innate immunity, acquired immunity; blood groups, blood transfusion and Rh-incompatibility
	B)	Antigens – antibodies: Antigens-structure and properties; types-iso and allo; haptens adjuvants, antigen specificity. Membrane receptors for antigens; immunoglobulins; structure-heterogeneity-types and subtypes-properties; theories of antibody production.
2	**A)**	Antigen and antibody interactions: *In vitro* methods-agglutination, precipitation, complement fixation, immunofluorescence, ELISA, radio immunoassay; *in vivo* methods; phagocytosis, opsonization, neutralization.
	B)	Complement system; complement components. complement activation - pathways,regulation of complement system, biological consequences of complement activation, complement deficiencies.
3	**A)**	Immunogenetics**:** Structure, distribution and functions of histocompatibility antigens.Major histocompatibility gene complex (MHC) and the HLI-A system; gene regulation and immune response (IR) genes; HL-A and tissue transplantation-tissue typing methods for organ and tissue transplantations in humans; graft versus host reaction and rejection.
	B)	Tumor immunology: Tumor immunology - tumor antigens, Host immune response to tumors, antibody dependent cell cytotoxicity (ADCC), tumor escape mechanisms Immuno diagnosis and therapy.
4	**A)**	Immunopatholog**y**: Classification of immunopathological disorders. General account of immune deficiency disorders. Primary and secondary, phagocytic cell disorder. Gammopathies. Complement deficiencies. Hypersensitivity reactions: type I, II, III and IV the respective diseases, immunological methods of their diagnosis. Autoimmunity mechanism and diseases .General account of interferon's, Lymphokines and cytokines.
	B)	Immuno biotechnology: Active and passive immunization, Isolation of spleen cells, Myeloma cell lines used as fusion partner, fusion method, detection and application of monoclonal antibodies, recombinant antibodies, immunotoxins types of vaccines, whole - organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, subunit vaccines, immunization procedures, adverse

reactions to vaccines.

References:

1. Essentials of Immunology by Riott I .M. 1998. ELBS, Blackwell Scientific Publishers, London.
2. Immunology 2 nd Edition by Kuby J. 1994. W.H. Freeman and Co. New York.
3. Immunology - Understanding of Immune System by Claus D. Elgert. 1996. Wiley - Liss, New York.
4. Fundamentals of Immunology by William Paul.
5. Cellular and Molecular Immunology. 3rd Edition by Abbas.
6. Immunobiology: The Immune System in Health and Disease. 3rd Edition by Travers.
7. Immunology- A short Course. 2 nd Edition by Benjamin.
8. Manual of Clinical Laboratory and Immunology 6th Edition. 2002 by Noel R. Rose, Chief Editor: Robert G. Hamilton and Barbara Detrick (Eds.) , ASM Publications.
9. Pocket Guide to Clinical Microbiology. 2 nd Edition. 1998 by Patrick R. Murray, ASM Publications.

Practicals:

1. Ouchterlony double diffusion (Ab titration)
2. Ouchterlony double diffusion (Antigen – Antibody titration)
3. DOT ELISA
4. Single radial Immuno diffusion
5. Rocket immune electrophoresis
6. RA test
7. Immuno electrophoresis
8. Quantitative precipitin assay
9. Antibody labelling

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY

MIC- 201 Enzymology

Credits-4 **Teaching Hrs.- 60**

Learning outcomes:-

1. Students will learn about kinetics of enzyme action.
2. Students will learn about practical aspects of application of enzymes.
3. Students will learn about catalytic action of enzymes in detail.

Unit- 1: Structure and Functions of Enzymes

1 Introduction to Enzymes (History, naming and classification of Enzymes)

2 Sources of enzymes

3 Specificity of Enzyme action- Active site of enzymes, The Fischer's 'Lock and Key' hypothesis, The Koshland 'Induced fit' hypothesis, and Hypothesis involving strain or transition-state stabilization

Unit- 2: Enzyme Kinetics

1 **Kinetics of Single-substrate-enzyme catalysed reactions**-
The relationship between initial velocity and substrate concentration- Derivation and significance of the 'Henri and Michaelis-Menten' equation; The 'Briggs-Haldane' modification of the 'Michaelis-Menten' equation; Derivation of the 'Line Weaver-Berk' equation and plots; The 'Eadie-Hofstee' and 'Hanes' plots; The 'Eisenthal and Cornish-Bowden' plots; Derivation of the 'Haldane' relationship for reversible reactions.
Rapid-Reaction kinetics: Pre-steady state kinetics & Relaxation kinetics
The King and Altman procedure

2 **Kinetics of Multi-substrate-enzyme catalysed reactions**-
Examples of possible mechanisms- Introductory knowledge of Ping-Pong bi-bi mechanism; Random-order mechanism; and Compulsory-order mechanism
Steady-state kinetics- 'General Rate Equation' of Alberty and Dalziel and their Rate constants
Investigation of Reaction Mechanisms using Steady-state methods: The use of Primary plots; and the use of inhibitors which compete with substrate for binding sites
Investigation of Reaction mechanisms using non-steady-state methods: Isotope exchange at equilibrium and Rapid-reaction studies

3 **Sigmoidal Kinetics and Allosteric Enzymes**- The 'Monod-Wyman-Changeux (MWC) Model;
The 'Koshland-Nemethy-Filmer (KNF) Model;
Differentiation between models for cooperative binding in proteins;
Sigmoidal kinetics in the absence of cooperative binding

4 **Significance of Sigmoidal Behavior**- Allosteric enzymes and Metabolic regulation

Unit- 3: Mechanisms of Enzyme-catalysed Reactions

1 Enzyme Inhibition-

Reversible inhibition-

Competitive Inhibition - Characteristics of competitive inhibition, Michaelis-Menten and Lineweaver-Burk plot showing the effect of a competitive inhibitor, Steady-state Kinetics of a single-substrate single-binding-site single-intermediate enzyme-catalysed reaction in the presence of a Competitive inhibitor

Uncompetitive inhibition - Characteristics of Uncompetitive inhibition, Lineweaver-Burk plot showing the effect of a uncompetitive inhibitor, Steady-state Kinetics of a single-substrate single-binding-site single-intermediate enzyme-catalysed reaction in the presence of a uncompetitive inhibitor

Non-competitive inhibition- Characteristics of non-competitive inhibition, Lineweaver-Burk plot showing the effect of a non-competitive inhibitor, Steady-state Kinetics of a single-substrate single-binding-site single-intermediate enzyme-catalysed reaction in the presence of a non-competitive inhibitor

Mixed inhibition - Characteristics of mixed inhibition, Lineweaver-Burk plot showing the effect of a mixed inhibitor, Steady-state Kinetics of a single-substrate single-binding-site single-intermediate enzyme-catalysed reaction in the presence of a mixed inhibitor

Partial inhibition

Substrate inhibition and Michaelis-Menten and Lineweaver-Burk plots showing the effects of substrate inhibition

Allosteric inhibition

Irreversible inhibition

2 **Study of active site structure**:

Binding sites and catalytic sites- enzyme-substrate complex, substrate analogues, Enzyme modification by chemical procedure affecting amino acid side chains, by treatment with proteases, by site-directed mutagenesis, Effect of changing pH

3 **Chemical nature of enzyme catalysis**:

Metal activated enzymes and metalloenzymes: Definitions of metal-activated enzymes and metalloenzymes, Activation by alkali metal cations (Na^+ and K^+), Activation by alkaline earth metal cations (Ca^{2+} and Mg^{2+}), Activation by transition metal cations (Cu, Zn, Mo, Fe and Co cations)

Coenzymes in enzyme-catalysed reactions: Nicotinamide nucleotides (NAD^+ and $NADP^+$), Flavin nucleotides (FMN and FAD), Adenosine phosphates (ATP, ADP and AMP), Coenzyme A (CoA.SH), Thiamine pyrophosphate (TPP), Pyridoxal phosphate, Biotin, Tetrahydrofolate, Coenzyme B_{12}

4 Protein-ligand binding and cooperativity:

General considerations of binding of a ligand to a protein having a single ligand-binding site

Types of cooperativity,

Positive homotrophic cooperativity and derivation of the 'Hill' equation,

The Adair equation for the binding of a ligand to a protein having two binding sites for that ligand- General considerations, under no interaction between the binding sites, under positive homotropic cooperativity; under negative homotropic cooperativity.

The Adair equation for the binding of a ligand to a protein having three and four binding sites for that ligand
Study of cooperative effects
Binding of oxygen to hemoglobin

Unit- 4: Application of Enzymes

1. Immobilization Techniques for Enzymes and Cell :
   adsorption, covalent binding, cross linking, entrapment, encapsulation
   Properties of immobilized enzymes compared to free enzymes: Change in stability, pH, apparent Km
   General applications of immobilized enzymes
2. Handling of enzymes and coenzymes to maintain their activity
3. As Analytical Reagents:
   Advantages and disadvantages of using enzymes as analytical reagents
   Principles of enzymatic analysis: End-point methods, Kinetic methods and Immunoassay methods
   In Industry: Medical applications and Industrial applications

References :

1. Enzymes- Biochemistry, Biotechnology, Clinical Chemistry- by Trevor Palmer (2004), Affiliated East-West Press Pvt. Ltd, New Delhi.

2. Immobilized Enzymes and Cells- Rosevear, Kennedy, J and cabral, MS, Adam Hilger, Bristol and Philadelphia

3. Microbial Enzymes and Biotechnology, 2nd Edition, William M Fogarty and Catherine T Kelly, Elsevier Applied Science Publishers, New York.

4. Immobilized Enzymes- Michael D Trevan, John Wiley & Sons, New York.

5. Immobilized Enzymes- Michael D Trevan, John Wiley & Sons, New York.

Practical :

1. Immobilization of enzymes
2. Determination of Ks and Km effect
3. Determination of inhibition effect on enzyme kinetics
4. Determination of Acid-Phosphatase activity.
5. Determination of Alkaline-Phosphatase activity.
6. Determination of Urease activity by ammonium-N release method
7. Determination of Urease activity by urea remaining method.

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY
MIC202: Molecular Biology and Microbial Genetics

Credits-4 **Teaching Hrs.- 60**

Learning outcomes-

1. Students will able to learn molecular biology and genetics of microorganisms.
2. Students will learn about various methods of gene transfer.

Unit **Topics**

1 (A) Structure and organization of bacterial genome and Replication:

I. Structure of DNA- DNA is usually a double helix, Complementarities of two chains, Tautomeric forms of each base, DNA denatures as well as renatures, viruses have 1S (single stranded) DNA chromosomes, 1S (single stranded) DNA has compact structure

II. Crystallographic proof of double helix in DNA Alternative forms of right-handed DNA, 'Z' form of DNA Methylation of 'C' and 'A' in DNA and its effects on the forms of DNA, Spontaneous deformation of double helix in solution Sequence specific bending and Kinking of DNA

III. Bacterial DNA replication

(B) Transcription and translation of bacterial genes:

I. The structure and function of RNA- types of RNA, RNA precursors, RNA structure, RNA processing and modification

II. Transcription- Molecular mechanism; Bacterial RNA polymerase, Transcription Initiation, Polymerization reaction, Transcription Termination

III. Translation- Protein structure, Ribosome structure, the Genetic code, Translation initiation, elongation and termination, Polycistronic mRNA

IV. Post translational modification and Protein folding- Mechanism of post translational modification of protein, Protein folding mechanism- Chaperones, Protein disulfide isomerases, Membrane proteins

2 (A) Mutations and DNA repair:

I. Phenotypic classes of mutants, genotypic classes of mutants, conditionally lethal mutations, Silent mutations and its reasons, leaky mutations, methodology for the detection and selection of Auxotrophic mutants- phenotypic lag and phenomic lag, Suppressor mutations and its types.

II. Mutagenesis: U.V. (physical mutagenic agent), Chemical mutagen- Base Analogues (5 Bromo Uracil and 2 Amino Purine), Oxidative deaminating agents (Nitrous acid, Hydroxyl amine), alkylating agents and intercalating agents.

III. Repair: Direct repair-Photo reactivation and Removal alkyl group by Alkyl Transferases; Indirect repair- SOS repair, Mismatch repair, Excision repair, Adaptive response to alkylating agents; Post-replicative repair.

(B) Recombination models:

Requirements and Molecular Models of Recombination- Holiday double stranded DNA molecules, single stranded invasion model, Molecular basis for Recombination in *E.coli*-*chi* sites and RecBCD Nuclease, Synapse formation and RecA protein, Ruv protein

3 (A) Conjugation

- Mechanism of DNA transfer during Conjugation in Gram –ve bacteria- Transfer *tra* genes, the *oriT* sequence, function of plasmid primases in transfer, Mobilizable plasmids
- Chromosome transfer by plasmids- Formation of Hfr strains, transfer of chromosomal DNA by integrated Plasmids, chromosome mobilization and Prime factors
- Transfer systems of Gram +ve bacteria- Plasmid attracting Pheromones

(B) Transformation

- Natural Transformation
- Competence
- Uptake of DNA during Natural Transformation
- Mechanism of DNA uptake during Transformation
- Genetic evidence for single strand uptake
- Role of Natural Transformation
- Artificially induced competence- Calcium ion induction and Electroporation

(C) Transduction

- Phage λ and lysogeny
- cII gene product
- Maintenance of lysogeny
- Regulation of repressor synthesis
- Induction of λ
- Competition between lytic and lysogenic cycles
- Generalized and specialized Transduction and its consequences

4 (A) Extra chromosomal inheritance

- Nomenclature and classification of Plasmids, Plasmid structure, phenotypic traits encoded by Plasmids.
- Properties of Plasmids: Replication-theta and rolling circle mechanism; Functions of *ori* region- Regulation of copy number, Host range of Plasmids; Mechanisms to prevent curing of Plasmids- Resolution of multimeric Plasmids and Partitioning; Incompatibility- due to replication control and partitioning.
- Plasmids as Cloning Vectors: Desirable features of Plasmid Cloning Vectors and Broad Host range Cloning Vectors Plasmid pBR322 and Ti Plasmid

(B) TRANSPOSITON

- Structure of Transposons
- Types of bacterial Transposons- IS elements, Composite transposons, Non-composite transposons
- Assays of transposition- suicide vectors, Mating-out assay
- Molecular models for transposition- Replicative transposition, Cut and paste transposition, Relationship between replicative and cut and paste transposition and their target regulation

(C) Control

- Lac operon- Positive control, Negative control, Catabolite repression and role of CAP

- Tryptophan operon- Attenuation control

References and Further Reading:

Books:

1 Benjamin Lewin (2004), Gene VIII, Pearson Prentice Hall, Pearson Education, Inc. Upper Saddle, NT 07458.

2 De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition, Lippincott Williams and Wilkins, New York.

3 Gardner EJ, Simmons MJ and Snustad DP (2006) Principles of Genetics, 8th edition, John Wiley & Sons.

4 Gardner EJ, Simmons MJ and Snustad DP (2008) Principles of Genetics, 8th edition, Wiley India.

5 Griffiths AJF, Wessler SR, Lewontin RC and Carroll SB (2007) Introduction to Genetic Analysis, 9th edition, W. H. Freeman & Co.

6 Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.

7 Herve Seilgmann (2011) DNA Replication- Current Advances, InTech Publishers, Janeza Trdine 9, Rijeka, Croatia.

8 Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.

9 Sambrook J, Fritsch EF and Maniatis T (2001) Molecular Cloning-A Laboratory, Manual, 3rd edition, Cold Spring Harbor Laboratory Press.

10 Snyder L and Champness W (2007) Molecular Genetics of Bacteria, 3rd edition, ASM Press Washington DC, USA.

11 Stanier RY, Ingraham JL, Wheelis ML and Painter PR (2005) General Microbiology 5th edition, McMillan.

12 Tortora GJ, Funke BR and Case CL (2008) Microbiology: An Introduction. 9th edition, Pearson Education.

13 Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2004) Molecular Biology of Gene 5th edition, Pearson Publication.

14 Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication 2. Becker WM, Kleinsmith LJ.

15 Willey JM, Sherwood LM and Woolverton CJ (2008) Prescott, Harley and Klein's Microbiology, 7th edition, McGraw Hill Higher Education.

Practicals (MIC202: Molecular Biology and Bacterial Genetics, 60 Hours; Credits:02)

1 Isolation of pigment/antibiotic/Lac mutants of *S.marcescens/E.coli* using chemical mutagen/ physical mutagen (U.V.).

2 Isolation of drug resistant mutants of *E.coli/ S.marcescens* by gradient plate technique

3 Isolation of drug/biochemical mutants of *E.coli* by replica plating technique.

4 Determination of Mutation rate.

5 Fluctuation test.

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY
MIC-203: RECOMBINANT DNA TECHNOLOGY

Credits-4 **Teaching Hrs.- 60**

Learning outcomes:-
1. Students will learn about extraction of genetic material from microorganisms.
2. Students will learn about cloning.

Unit	Topics
1	**Elements of rDNA Technology:** Core techniques and essential enzymes used in recombination: restriction endonucleases, type I, II, III, recognition sequences, properties, nomenclature, classification of type II endonucleases, their activity. DNA ligase: Properties and specificity, S1 nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase its activity and mode of action. Chemical synthesis of DNA. Restriction digestion, ligation and transformation.
2	**Vectors:** Properties, incompatibility, isolation and purification techniques, plasmid vectors and their properties, PBR 322 – its construction and derivatives, single stranded plasmids, promoter probe vectors, runaway plasmid vectors. Bacteriophage lambda as a vector: Essential features, organization of genome, general structure, rationale for vector construction, improved vectors, gt series, EMBL vectors, invitro packaging, cosmids, phasmids, filamentous phage vectors, zap, blue print vectors.
3	**Specialized cloning strategies:** Expression vectors, promoter probe vectors, vectors for library construction, genomic DNA libraries, chromosome walking and jumping, cDNA libraries, short gun cloning, directed cloning, phage display. Recombinant DNA technology with reference to cloning and production interferon and insulin. Miscellaneous applications of Genetically engineered microorganisms (GEMS) / genetically modified organisms (GMO's).
4	**Molecular mapping of genome:** PCR methods and Applications DNA sequencing methods, Dideoxy and Chemical method. Sequence assembly. Automated sequencing. Genetic and physical maps, physical mapping and map –based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, Chromosome microdissection and microcloning, Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, molecular markers linked to disease resistance genes Application of RFLP in forensic, disease prognosis, genetic counseling, pedigree, animal trafficking and poaching: Germplasm maintenance, taxonomy and Biodiversity.

References :

1. Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.
2. DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford. 1995.
3. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford. 1994.
4. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.
5. PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.) Stockton Press. 1989.
6. Biotechnology: A Guide to Genetic Engineering by Peters.
7. Genetic Engineering – 2000 by Nicholl.
8. Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition by Helen Kreuz. 2001.ASM Publications.
9. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 2nd Edition. 1998 by Bernard R. Glick and Jack J. Pastemak, ASM Publications.
10. From genes to clones by Winnaker.
11. Manipulations and expression of recombinant DNA by Robertson.
12. Gene targeting – A practical approach by Joyner.

Practicals :

1. Agarose gel electrophoresis
2. Ultrapure genomic DNA spin mini preps kit from bacteria.
3. Restriction digestion
4. Separation of genomic DNA extraction from whole blood.
5. Separation of genomic DNA from plant (CTAB)
6. DNA Amplification
7. SDS PAGE

GUJARAT VIDYAPITH, AHMEDABAD
BIOGAS RESEARCH AND DEPARTMENT OF MICROBIOLOGY

EC 201: Bioinformatics (Sem-2)

Credits-4 **Teaching Hrs.- 60**

Learning outcomes:-

1. Students will learn to identify microorganisms based on its sequence analysis.
2. Students will become acquired about use of various softwares used for study of microorganisms.
3. Students will learn to use gene sequence data for preparation of phylogenetic tree for identification purpose.

Unit	Topics
1	1. Introduction to Bioinformatics: Overview, Internet and bioinformatics, Applications. 2. Databases: Databases in Bioinformatics, various biological databases, Protein and Nucleotide sequence Data bases. Protein sequence, structure and Classification databases. 3. Sequence analysis: Pairwise alignment, local and global alignment, Scoring matrices, multiple sequence alignment, tools for sequence alignment.
2	1. Gene prediction: Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods: Neural Networks, Pattern Discrimination methods, Signal sites Predictions, Evaluation of Gene Prediction methods. 2. Transcriptomics: Complete transcript cataloguing and gene discovery-sequencing based approach, Microarray based technologies and computation based technologies. 3. RNA secondary structure prediction
3	1. Protein Computational Biology: Structural classification of proteins, Protein structure analysis, Structure alignment and comparison, Secondary and tertiary structure prediction and evaluation, Prediction of specialized structures, Active site prediction, Protein folding, Protein modeling and Drug design 2. Tools in Bioinformatics: Protparam, Translate, Bioedit, findmod, Coils, Rasmol, Deep view.
4	1. Genomics: Genome Database, Gene Prediction, Metagenomics, DNA Microarray, Comparative Genomics, and Functional Genomics. 2. Proteomics: Types of proteomics, tools for proteomics-separation and

isolation of proteins, acquisition of protein structure information, databases and applications

3. Phylogenetic analysis: molecular basis of evolution, Phylogenetic trees & different methods for phylogenetic inference

Reference Books:

1 Bioinformatics: Rastogi.

2 Introduction to Bioinformatics: Arthur M. Lesk.

3 Bioinformatics: Principles and applications, Ghosh and Mallick.

4 Bioinformatics: A practical guide to the analysis of genes and proteins. 2nd Edition. John Wiley & Sons, New York. *Baxevanis, A. D. and Ouellette, B. F. F.* (2001)

5 Bioinformatics: Genes, Proteins and Computer, C. A. Orengo.

6 GIS For Dummies (For Dummies (Computer/Tech)) by: Michael N. DeMers

7 GIS Basics by: Stephen Wise

8 GIS for Environmental Decision-Making (Innovations in Gis) by: Andrew A. Lovett, Katy Appleton

9 Textbook of Remote Sensing and Geographical Information Systems by: Reddy, M. Anji

10 Agrometeorology: Principles and Applications of Climate Studies in Agriculture by: Harpal S., Ph.D. Mavi, Graeme J. Tupper

11 Developing Bioinformatics Computer Skills by: Cynthia Gibas

12 Bioinformatics and Functional Genomics, 2nd Edition by: Jonathan Pevsner

13 Bioinformatics: Sequence and Genome Analysis (Genome Analysis) by: David W. Mount

14 Bioinformatics Biocomputing and Perl: An Introduction to Bioinformatics Computing Skills and Practice by: Michael Moorhouse, Paul Barry,

15 An Introduction to Bioinformatics Algorithms (Computational Molecular Biology)by: Neil C. Jones Pavel A. Pevzner

16 Bioinformatics: From Genomes to Drugs by: Thomas Lengaue

17 Essential Bioinformatics by: Jin Xiong

18 Bioinformatics: Genomics and Post-Genomics by: Frédéric Dardel, François Képès

19 Foundations of Comparative Genomics by: Arcady R. Mushegian

20 Principles of Proteomics (Advanced Text Series) by: R. M. Twyman

21 Proteomics for Biological Discovery by: Timothy D. Veenstra John R. Yates

EC 201: Bioinformatics

Total Number of Hours: 60 **Total Number of Credit: 02**

Practicals:

1. A visit to Protein Data Bank, Ex Pasy, NCBI.
2. Study of Protein structures by Rasmol, Protein Explorer, Deep View.
3. Sequence alignment using FASTA and BLSAT.
4. LOCAL and GLOBAL alignment Tools.
5. Protein structure alignment.
6. PCR Primer designing.
7. Phylogenetic Tree Construction.
8. Use of Ex PASy Tools.
9. Active Site Prediction.
10. ORF Prediction.

NEW SYLLABUS: EFFECTIVE FROM JUNE 2017
DEPARTMENT OF MICROBIOLOGY
GUJARAT VIDYAPITH: SADRA
MIC 301: BIOPROCESS TECHNOLOGY
THEORY: 60 Hrs. CREDIT: 04: MARKS: 100 (EXTERNAL:60 & INTERNAL: 40)

Learning outcomes:-
1. Student will understand the fundamentals of Bioprocess and Bioengineering.
2. Student will understand various steps of upstream and downstream processing.
3. Student will understand the design and control of Bioprocess Technology.

Unit	Topic and Content	Hours
Unit 1	**Elements of Bioprocess**	**15 Hrs**
	❖ Isolation, screening and preservation of industrially important microorganisms	
	❖ Strain improvement: isolation of mutant producing primary and secondary metabolites, isolation of auxotrophic, resistant and revertant mutants and use of recombination systems	
	❖ Media formulation, energy sources, antifoams and media optimization	
Unit 2	**Fermenter Design and control**	**15 Hrs**
	❖ Fermenter design, types of fermenters	
	❖ The achievement and maintenance of aseptic conditions	
	❖ Monitoring and control of process variables	
	❖ Aeration-agitation system	
Unit 3	**Upstream processing**	**15 Hrs**
	❖ Sterilization of media, air and reactor	
	❖ Development of inoculum for industrial fermentations	
	❖ Mass transfer of oxygen-factors affecting KLa	
	❖ Fluid Rheology	
	❖ Fundamentals of scale up and Scale down	
Unit 4	**Downstream processing and Fermentation economics**	**15 Hrs**
	❖ Methods of cell separation- filtration and centrifugation, Cell disruption, liquid-liquid extraction, chromatography, membrane processes, Drying,Crystallization, Whole broth Processing	
	❖ Fermentation economics: Expenses for industrial organisms, strain improvement, media sterilization, heating, cooling, aeration, agitation etc., cost of plant	

	and equipment, batch process cycle time, continuous culture, recovery and effluent treatments, cost recovery due to waste usages and recycling	

MIC 301: BIOPROCESS TECHNOLOGY

PRACTICAL: 90 Hrs. CREDIT: 03: MARKS: 100 (EXTERNAL:60 & INTERNAL: 40)

PRACTICALS

1.Determination of oxygen transfer rate (OTR-Sulfite method)
2.Isolation , screening and optimization of conditions for production of Amylase
By Submerged fermentation
3. Primary Screening of Antibiotic Producer, Organic Acid Producer , Enzyme Producer,
4.Rheological study of culture broth by Oswald viscometer
5 .Recovery of Exopolysaccharides using acetone solvent
6. Bio assay of Penicillin

References: MIC 301 Bioprocess Technology

1..Principles of Fermentation Technology:Stanbury, Whittaker & Hall

2.Process Biotechnology Fundamentals: S. N. Mukhopadhyay

3.Fermentation Microbiology and Biotechnology :EL-Mansi & C.F.A.Bryce eds

4. Industrial Microbiology by L E Casida .

NEW SYLLABUS: EFFECTIVE FROM JUNE 2017
DEPARTMENT OF MICROBIOLOGY
GUJARAT VIDYAPITH: SADRA

MIC 302: ENVIRONMENTAL BIOTECHNOLOGY

THEORY: 60 Hrs. CREDIT: 04: MARKS: 100 (EXTERNAL:60 & INTERNAL: 40)

Learning outcomes:-

1. Student will understand the characterization of wastes.
2. Student will understand the treatment of wastes.
3. Student will know geology and geological techniques.

Unit	Topic and Content	Hours
	Principles of Waste Treatment	**15 Hrs**
1	**1**. Issues and scopes of environmental biotechnology. **2**.Waste water treatment: Waste water characterization and its significance: COD, BOD, Inorganic constituents, solids, biological components. **3**.Principles and aims of biological wastewater treatment processes: Primary, secondary and tertiary treatment of waste water. **4**. Biochemistry and Microbiology of inorganic phosphorus and nitrogen removal. **5**.Suspended growth technologies: Activated sludge, oxidation ditches, waste stabilization ponds. **6**.Fixed film technologies: Trickling filters, rotating biological contactors, fluidized bed and submerged aerated filters.	
2	**Techniques of Waste Treatment**	**15 Hrs**
	1.Toxicity testing in waste water treatment plants using microorganisms. **2**.Anaerobic digestion: microbiological and biochemical fundamentals, factors influencing anaerobic digestion. **3**.Anaerobic waste water treatment systems: RBC, UASB, anaerobic filters. Merits and demerits of anaerobic treatment of waste.	
3	**Biodegradation and Deterioration**	**15 Hrs**
	1.Biodegradation of organic pollutants: Mechanisms and factors affecting biodegradation. **2**.Pollution problems and biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. **3**.Bioremediation: Intrinsic bioremediation, Biostimulation and Bioaugmentation. In situ and ex situ bioremediation technologies. Bioremediation of oil spills. Bioremediation of heavy metal pollution, Phytoremediation. **4**. Use of GMO in bioremediation. Biological treatment of waste gas (polluted air): biofilters, bioscrubbers, membrane bioreactors, biotrickling filters.	

4	**Biogeotechnology**	**15 Hrs**
	1.Bioleaching of metals: Characteristics of commercially important microbes, mechanisms of bioleaching, factors affecting bioleaching and current biomining processes. **2**. Biobeneficiation of gold ores. Microbially enhanced oil recovery. **3**. Biodesulfurization of coal: Removal of organic and inorganic sulphur from coal.	

References:

1. Biotechnology-Rehm and Reid.
2. Waste water microbiology by G. Bitton
3. Biodegradation and bioremediation byM.Alexander
4. Waste water treatment for pollution control, 2nd edition. Arceivala
5. Environmental Biotechnology by H. Jordening and JosefWinter .
6. Comprehensive Biotechnology Vol-4, MurrayMoo Young.

NEW SYLLABUS: EFFECTIVE FROM JUNE 2017
DEPARTMENT OF MICROBIOLOGY
GUJARAT VIDYAPITH: SADRA

MIC- 303 "MICROBIAL TECHNOLOGY"

THEORY: 60 Hrs. CREDIT: 04: MARKS: 100 (EXTERNAL:60 & INTERNAL: 40)

Learning outcomes:-

1. Student will know preparation of various fermented food products.
2. Student will know preparation of various agricultural products.
3. Student will know preparation of various Industrial products.

Unit	Topic and Content	Hours
Unit-1	**Food Products**	**15 Hrs**
	Food products from Grains- Bread	
	Food products from Milk- Cheese, Butter	
	Food products from Vegetables- Sauerkraut, Pickling	
	Microbial cells as food- Single Cell Protein, Single Cell Oil	
	Food safety and quality requirements- HACCP	
Unit-2	**Agricultural Products**	**15 Hrs**
	Biofertilizers- Production and application of rhizobium, azotobacter and azospirillum inoculants, Phosphate solubilizers, Phosphate mobilizers and absorbers- Mycorrhiza and VAM, composting	
	Biocontrol agents- Bacterial and viral biopesticides, botanical pesticides, bioherbicides	
Unit-3	**Industrial products- Primary and Secondary metabolites**	**15 Hrs**
	Organic acids- Acetic acid, Citric acid	
	Amino acids- L-Lysin, L-Glutamic acid	
	Vitamins- B12 and Ascorbic acid	
	Enzymes- Protease, Amylase	
	Antibiotics- Streptomycin, tetracycline	
Unit-4	**Other Industrial Products**	**15 Hrs**
	Ergot alkaloids	
	Alcoholic beverages- Beer, Wine	
	Polymers- Xanthan, Dextran	
	Solvents- Acetone-butanol	

MIC- 303 "MICROBIAL TECHNOLOGY"

THEORY: 90 Hrs. CREDIT: 03: MARKS: 100 (EXTERNAL:60 & INTERNAL: 40)

Practicals-

Laboratory fermentation and estimation of Single cell protein
Laboratory fermentation and estimation of alcohol

Laboratory fermentation and estimation of alcoholic beverages
Laboratory fermentation and estimation of citric acid
Laboratory fermentation and estimation of single cell oil
Laboratory fermentation of Bread
Laboratory fermentation and estimation of Exopolyssaccharides.
Laboratory fermentation and estimation of enzyme.
Determination of microbiological quality of milk by MBRT
Laboratory fermentation and estimation of dairy product.

Reference Books-

Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol. 1 to 4, Editor in chief- Murray, Moo-young, Pergamon Press, Oxford
Industrial Microbiology- Prescott, SC and Dunn, CG, Agrobios Publication, Jodhpur
Biotechnology- Rehm HJ and Reed, G, VCH Publication
Biofertilizers in Agriculture and Forestry- Subba Rao, NS
Biological Nitrogen Fixation- SUbba Rao, NS, Venkataraman, GS and Kannaiyan S
Bacillus thuringiensis as a Biocontrol agent- Kadu, BB
Biotechnology of Industrial Antibiotics- Vandamme, EJ

NEW SYLLABUS: EFFECTIVE FROM JUNE 2017
DEPARTMENT OF MICROBIOLOGY
GUJARAT VIDYAPITH: SADRA
EC 301: BIOMETHANATION
THEORY: 60 Hrs. CREDIT: 04: MARKS: 100 (EXTERNAL:60 & INTERNAL: 40)

Learning outcomes:-
1. Student will understand principles and processes of anaerobic digestion.
2. Student will understand the role of various trophic groups in anaerobic conditions.
3. Student will understand the principles and working of various anaerobic digesters.

Unit	Topic and Content	Hours
Unit 1	**Historical overview**	**15 Hrs**
	❖ Historical overview, Modern Era, 1950, 1960, Microbial Basis, Methyl Cobalamine era, Serine Era, Esolution of methanobacillus omilanskii, 1970 to present.	
	❖ Diversity of Methanogens, Classification of Methanogens, Taxa of methanogens, Methanobacteriales, Methanococcales, Methanomicrobiales, Methaosarcinales, Methanopyrales	
Unit 2	**Physiology of Methaogens: Substrate range of Methanogens**	**15 Hrs**
	❖ Physiological Adaptations (Salinity, temperature, pH, Oxygen, Genetic and Metabolic Regulations, Motility and Gas vesicles reserve materials)	
	❖ Microbial Interactions: Competition for methanogenic substrates: General considerations, Competition for hydrogen, Competition for acetate, Competition for other methanogenic Substrates, Facultative Interspecies H_2 formate transfer, Obligate Interspecies H_2 formate transfer, Interspecies acetate transfer.	
	❖ Methods to study Methanogens in Natural Habitats: Cultural Methods, Microscopic, immunological, Molecular Biology, Activity measurement, Stable isotopes.	
	❖ Methanogenic Habitats: Anaerobic Digesters, Fresh water sediments and soils, marine habitats, Animal GIT, Geothermal habitats, Other habitats	
	❖ Biotechnological Uses of Mixed Methanogenic Cultures: Novel Substrates and Anaerobic bioreactor Configurations, Thermophilic Anaerobic Digestion, Anaerobic dehalogination.	
Unit 3	**Biochemistry of Methanogenesis:**	**15 Hrs**

	❖ Reactions and Enzymes involved in Methanogenesis From CO_2 and H_2: Hydrogenotropic methanogenesis and Bioenergetics, Transition metals required for growth on H_2 and CO_2, Activation of molecular H_2, F420 reducing and Non reducing hydrogenases, H_2 forming methylene tetrahydromethanopterin dehydrogenase, CO_2 reduction to MFR, Mo and Tungstun containing dehydrogenases, Formyl Gr transfer to H_4MPT, Conversion to N^5, N^{10}- Methenyl- H_4MPT, reduction to N^5, N^{10}- Methylene- H_4MPT, reduction to N^5 Methyl- H_4MPT, Methyl transfer to COM, MCR, HDR.	
	❖ Conversion of Methanol and Methylamine to Methane and CO_2: Metylotropic methanogenic bacteria, substrates utilized by Metylotropic methanogenic bacteria, Route of methanol reduction, reduction of CoM, Route of methanol oxidation, Methyl Gr oxidation to CO_2, Reduction of HDS, Proton translocation and electron transport, Methanogenesis from Methyl amines and Methyl sulphides, Metabolic regulation.	
	❖ Fermentation of Acetate: Ecology of Acetotrops, Growth and Physiology (Metahnosarcina and Methanothrix), Activation of acetate, C-C and C-s bond cleavage, CODH enzyme complex, Methyl transfer and reductive demethylation of CH_3-COM, electron transport and bioenergetics.	
Unit 4	**Biosynthesis of Co-enzymes**	**15 Hrs**
	❖ Methanofuran, Tertahydromethanopterin, HSHTP, COM Anabolic pathways: Central Anabolic pathways (Acetyl CoA, Pyruvate, Incomplete TCA cycle), Precursor Biosynthesis, Carbohydrate biosynthesis.	

References: EC 301: BIOMETHANATION

Methanogenesis: Ecology, Physiology, Biochemistry & Genetics. James G. Ferry.

NEW SYLLABUS: EFFECTIVE FROM JUNE 2017
DEPARTMENT OF MICROBIOLOGY
GUJARAT VIDYAPITH: SADRA
MIC 401: BIOSTATISTICS AND COMPUTER APPLICATIONS
THEORY: 60 Hrs. CREDIT: 04: MARKS: 100 (EXTERNAL:60 & INTERNAL: 40)

Learning outcomes:-

1. Students will learn to use various statistical measures for data analysis.
2. Students will learn to find out significance of experimental data.
3. Students will learn basics of computers useful for data analysis.

Unit	Topic and Content	Hours
	Unit-I Basics of statistics	**15 Hrs**
1	Introduction to Statistics; Collection, classification and tabulation of data Frequency distribution	
	Unit-II Statistical measures	**15 Hrs**
2	Measures of location- Arithmetic mean, median and mode Measures of dispersion- Range, standard deviation, coefficient of variation, skewness, kurtosis	
	Unit-III Statistical analytical techniques	**15 Hrs**
3	Tests of hypotheses Correlation and Regression Probability - normal, poison and binomial Time series analysis.	
	Unit-IV Bioinformatics and computers	**15 Hrs**
4	Bioinformatics and its applications Computer- classification, functional blocks of computer hardware, input & output devices, application of computers	

MIC 401: BIOSTATISTICS AND COMPUTER APPLICATIONS

References and suggested readings:

1. G. Nageswara Rao, Statistics for Agricultural Sciences, Oxford and IBH Publishing Co., New Delhi
2. Zar, Jerrold H. (1998). Biostatistical Analysis. Prentice Hall, N.J.
3. Textbook of Computer applications and biostatistics- ebook, Dr. S. B. Bhise, Dr. R. J. Dias, K. K. Mali and P. H. Ghanwat, Trinity publishing house, Satara
4. Modeling Tools for Environmental Engineers and Scientists, by N. Nirmala Khandan, CRC PRESS

4. Sokal, Robert and James Rohlf (1997). Biometry, Freeman Press, N.Y.
5. Walpole, R. and R. Myers (1993). Statistics for Engineers and Scientists, 5th edn. MacMillan, N.Y.
6. Wayne, R. Ott (1995). Environmental Statistics and Data Analysis, CRC Press.
7. Manly (2001) Statistics for environmental science and management, Chapman and Hall / CRC.
8. Ramsay and Schafer (1997). The Statistical Sleuth, Duxbury Press.

NEW SYLLABUS: EFFECTIVE FROM JUNE 2017
DEPARTMENT OF MICROBIOLOGY
GUJARAT VIDYAPITH: SADRA
MIC 402: RESEARCH METHODOLOGY AND SCIENTIFIC WRITING
THEORY: 60 Hrs. CREDIT: 04: MARKS: 100 (EXTERNAL:60 & INTERNAL: 40)

Objectives:

- To verify and test important facts
- To analyse an event or process or phenomenon to identify the cause and e□ ect relationship
- To develop new scientific tools, concepts and theories to solve and understand scientific problems.
- To find solutions to scientific.
- To overcome or solve the problems occurring in our everyday life.
- To Introduce The Concept of Scientific Research And The Methods of Conducting Scientific Enquiry

Unit	Topic and Content	Hours
	Research Methodology	**15 Hrs**
1	1. Research methodology: An Introduction: Creativity, innovation, originality and advancement of knowledge and application to the society 2. Define the research problem 3. Methods of Research 4. Ethics in research	
	Research Design	**15 Hrs**
2	1. Meaning and Objectives, 2. Characteristics of good research design. 3. Components of the research design. 4. Review of literature.	
	Research Project and Research Proposals	**15 Hrs**
3	1. Selecting a Research Topic. 2. Project Planning. 3. Identifying funding sources and special founding mechanisms. 4. Writing a Proposal. 5. Research Ethics and Responsibilities.	
	Scientific Writing (From Research to Manuscript)	**15 Hrs**
4	1. Tools and Techniques. 2. The Scientific Paper. 3. Scientific writing skills. 4. Preparing to Publish.	

References: MIC 402: RESEARCH METHODOLOGY AND SCIENTIFIC WRITING

1. Research Methodology: Methods and Techniques. (Second Revised Edition: New Age International Publishers: **2004**) By C.R. Kothari.
2. Research Projects and Research Proposals (A Guide for Research Scientist, Fellow seeking Funds: **2004**: Cambridge, U.K.) BY Paul G. Chapin.
3. From Research to Manuscript (A Guide to Scientific Writing: U.S.A. Springer: **2006**) By Michael Jaykatz.
4. Writing Skills (Success in 20 minutes a Day: Learning Express Skill Builders: New York: **1998**) By Judith F. Olson.
5. Research Methodology, Panneerselvam, R., Prentice Hall of India, New Delhi, **2004**.

SEMESTER 4 MIC 403: Project / Dissertation Work Theory

The candidate is required to show article to faculty in/before interpreting his/her experimental work.

Two typed/computerised bound copies of the dissertation shall be submitted to the University during the final M.Sc. at least fifteen days before the commencement of the final examination.

MIC 402: Seminar / Field Work / Study Tour

Atleast two seminars should be delivered during fourth semester.

There shall be one microbiological study tour / field work during fourth or any semester of P.G. study. It will pertain to different microbiological / environmental industries / research institute / various ecosystems even outside Gujarat State. The microbiological tour is highly essential for studying microbiological process and technology.

MIC 403: Assignments, Group Discussion / Industrial Training

Assignments and group discussions / industrial training accomplished with the bound copy of report are necessary for evaluation.