પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે સાયન્સ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગતનો લાઈફ સાયન્સ વિષયનો (બી.એસસી. માઈક્રોબાયોલોજી વિથ ઓનર્સ) નો સેમેસ્ટર-૩ અને સેમેસ્ટર-૪ નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજુરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન,૨૦૨૪ થી અમલવારી કરવાની રહે છે. સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.

Bhakta Kavi Narsinh Mehta University Junagadh.

21/08/2024

ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૧૧૫૬/૨૦૨૪
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,
સરકારી પોલીટેકનિક કેમ્પસ,
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,
ખડીયા, જૂનાગઢ-૩૬૨૨૬૩
તા.૨૧/૦૮/૨૦૨૪

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમો ચલાવતી તમામ કોલેજોના આચાર્યશ્રીઓ તરફ....

નકલ સાદર રવાના:-

- માન.કુલપતિશ્રી/કુલસચિવશ્રીનાં અંગત સચિવશ્રી.
- પરીક્ષા નિયામકશ્રી, ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી, જુનાગઢ

નકલ રવાના જાણ તથા યોગ્ય કાર્યવાહી અર્થે:

- સીસ્ટમ મેનેજરશ્રી, આઇ.ટી.સેલ વિભાગ (વેબસાઇટ ઉપર પ્રસિદ્ધ થવા અર્થે.)

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
JUNAGADH

BOARD OF LIFE SCIENCE STUDIES

FACULTY OF SCIENCE

SYLLABUS FOR

B.Sc. (MICROBIOLOGY) (HONOURS) PROGRAMME

(SEMESTER- III & IV)

MAJOR/MINOR/MULTIDISCIPLINARY

EFFECTIVE FROM JUNE, 2024

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Major/Minor/Multidisciplinary
Syllabus of B.Sc. (Honors) as per NEP-2020
Faculty of Science
Effective from June 2024
Subject: Microbiology
SEMESTER-III & IV

SUMMARY OF THE SYLLABUS

SEMESTER- III

Sr. No	Course Group	Course (Paper) Title	Paper No.	Credit	Teaching Hours	Internal Marks	External Marks	Practical internal Marks	Practical external Marks	Total Marks	Page
1	MAJOR-5	Microorganisms: Classification and Significance	MAJMBT301	4	60	50	50	-	-	100	**3**
2	MAJOR-6	Applied Microbiology	MAJMBT302	4	60	50	50	-	-	100	**6**
3	MAJOR-7	Combine Practical	MAJMBP303	4	60	-	-	50	50	100	**9**
4	MDC-3	Microbial Biotechnology	MDCMBP301	4	60	25	50	25	-	100	**12**
Total				**16**							

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SUMMARY OF THE SYLLABUS

SEMESTER- IV

Sr. No	Course Group	Course (Paper) Title	Paper No.	Credit	Teaching Hours	Internal Marks	External Marks	Practical internal Marks	Practical external Marks	Total Marks	Page
1	MAJOR-8	Molecular Biology and Bio-engineering (Theory)	MAJMBT401	4	60	50	50	-	-	100	**21**
2	MAJOR-9	Bioprocess Technology (Theory)	MAJMBT402	4	60	50	50	-	-	100	**24**
3	MAJOR-10	Combine practical	MAJMBP403	4	60	-	-	50	50	100	**27**
4	MINOR-3	Environmental Microbiology and Microbial Ecology	MINMBP401	4	60	25	50	25	-	100	**29**
Total				**16**							

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Course Level	UG (5.0)		**Internal Marks**	50
Programme	B.Sc. Microbiology		**External Marks**	50
Semester	III		**Practical Internal**	-
Category of Course	**MAJOR-5**		**Practical External**	-
Course Credit	04		**Prac. External Exam Duration**	-
Teaching Hours	60		**Total**	100
Course Code	**MAJMBT301**		**Exam Duration**	2 hrs.
Course Title	**Microorganisms: Classification and Significance (Theory)**			

Course Objectives: After competing this course students have able to:

- To understand the classification and significance of microorganism.
- To explore the structural and morphological feature of the organisms.

Course Learning Outcomes: After completion of the course:

- Has acquired a good understanding of the diversity and taxonomy of the microorganism.
- Has acquired a good understanding of the activities/importance of microorganism.
- Has acquired a good understanding of the structure and other salient characteristics of prokaryote, eukaryote and akaryote.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
3	1	**INTRODUCTION TO MICROBIAL DIVERSITY** • Introduction to Biodiversity- Microbial evolution and diversity • Microbial Taxonomy: Introduction and overview • Classification systems - Taxonomic ranks of microorganisms • Major characteristics used in taxonomy • Phylogeny- Survey of Prokaryotic Phylogeny and Phylogenetic Groups of Eukaryotes • Introduction to metagenomics	**15**

	2	**PROKARYOTIC DIVERSITY** • Introduction to Archaea and Eubacteria • Gram negative bacteria – General features of: Aerobic/Microaerophilic motile, helical vibriod Non-motile curved bacteria Aerobic/Microaerophilic rods and cocci Facultative anaerobes – rods, curved and helical bacteria Dissimilatory Sulfate reducers, Anaerobic cocci, Phototrophic bacteria • Gram positive bacteria – General features of: Endospore forming rods and cocci Asporogenous rods, Mycobacteria and Actinomycetes • Extremophilic Microorganisms	**15**
	3	**EUKARYOTIC DIVERSITY** FUNGI: • General characteristics: Definition, occurrence, Structure, Reproduction • Classification and introduction to major divisions of Fungi • Economic importance of fungi ALGAE: • General Characteristics: Definition, Occurrence, Ultra-Structure, Reproduction • Economic importance of Algae PROTOZOA: • General Characteristics: Definition, Occurrence, Ultra-Structure, Reproduction Economic importance of Protozoa	**15**
	4	**AKARYOTIC DIVERSITY(VIRUSES)** • Introduction and General Characteristics: Definition, Structure, Classification • Cultivation and Enumeration of Viruses • Bacterial Viruses: Classification, Lytic life cycle (T4 phage), lysogenic life cycle (Lambda phage) • Introduction to Animal Viruses: Classification, Replication, Cytocidal effects, Viruses and Cancer, Prions • Introduction to Plant Viruses: Classification, Structure & Replication of TMV, Economic importance, Viroids	**15**

Suggested Reading:

1. Prescott, Healey and Klein., Microbiology-5th International Edition, Tata-McGraw Hill publications, Delhi
2. Atlas. R.M., Principles of Microbiology- 2nd Edition
3. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education
4. Modi, H.A. Elementary Microbiology - Vol -I, Akta Prakashan, Nadiyad
5. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGraw Hill Publication Co. Ltd.
6. Stainer, R.Y., Iingraham, J.L., Wheelis, M.L., Painter, R.K. General Microbiology, 5th Edition. MacMillan Press Ltd., London
7. Frobisher M., Hinsdill, Crabtree and Goodherat, Fundamentals of Microbiology, 9th Edition. W.B Saunders Co. USA
8. Dubey, R.C.and Maheshwari, D.K., A Text Book of Microbiology, S. Chand Publications, New Delhi.
9. Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai
10. Mani, A., Selwaraj, A.M., Narayanan L.M., and Arumngam, N., Microbiology, Saras Publication, Delhi

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Course Level	UG (5.0)		**Internal Marks**	50
Programme	B.Sc. Microbiology		**External Marks**	50
Semester	III		**Practical Internal**	-
Category of Course	**MAJOR-6**		**Practical External**	-
Course Credit	04		**Prac. External Exam Duration**	-.
Teaching Hours	60		**Total**	100
Course Code	**MAJMBT302**		**Exam Duration**	2 hrs.
Course Title	**Applied Microbiology (Theory)**			

Course Objectives: by completing the course, students have:

- To understand the role of microorganism, present in various samples.
- To understand the importance and applications of microbes.
- The course also provides the comprehensive understanding about the good manufacturing and laboratory practise.

Course Learning Outcomes: After completion of the course:

- Developed a clear understanding of the multifarious roles of microorganisms in soil, in association with plants and thus in the field of agriculture
- Are able to describe the role of microorganisms in the production of food, its spoilage, including their role in homemade fermented foods.
- Are able to identify the role of microorganisms in the causation of the diseases and how to protect against plant pathogens.
- Enhanced the theoretical and experimental skill for testing of pharmaceutical products and understanding of the GMP and GLP.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
3	1	**SOIL AND AGRICULTURAL MICROBIOLOGY** • Physical & Chemical Characteristics of Soil • Rhizosphere & Microbial flora of Soil • Interactions among soil microorganisms: Neutral, Beneficial & Harmful interactions • Introduction to sedimentary and gaseous biogeochemical cycles and role of microorganisms • Nitrogen fixation and Winogradsky's column	**15**

		• Pathogens for plant diseases: Plant mycology, Plant bacteriology and Plant virology • Management of plant disease • Biofertilizers, Biopesticide and biocontrol	
	2	**FOOD MICROBIOLOGY** • Microbial flora of fresh food • Microbial spoilage of foods: Fresh foods & Canned foods • Food Borne infection & intoxication: Role of *S.aureus*, *C.botulinum* & *Salmonella* Spp.in food poisoning • Preservation of foods: General principles & methods of food preservation • Microbiological examination of food; Introduction to AGMark • Brief introduction about fermented foods: Pickles, Sauerkraut, Silage, Sausages & Bread • Microorganisms as food: Single Cell Protein, Mushrooms and Functional foods	**15**
	3	**DAIRY MICROBIOLOGY** • Milk as a medium, normal flora of milk • Types of microorganisms in milk: Biochemical types, Pathogenic types, Temperature types • Spoilage of milk & milk products • Microbial analysis of milk: SPC, Direct count, MBRT, Resazurin test • Grading of milk • Fermented milk Beverages & Manufactured Dairy Products: Starter Culture, • Cheese, Yogurt, Buttermilk, Acidophilus milk, Kefir • Preservation of milk: Principles & methods of preservation	**15**
	4	**PHARMACEUTICAL MICROBIOLOGY** • Introduction to pharmaceutical microbiology and pharmacopoeia • Sterility testing of pharmaceutical products • Quality assurance and validation: GMP and GLP in pharmaceutical industries • Quality assurance and quality management in pharmaceuticals: ISO, WHO and other certifications • Total Quality Management	**15**

Suggested Reading:

1. Principles of Microbiology by Atlas R.M.: 2nd edition
2. Microbiology by Pelczar M.J. & Chain E.C.S.: 5th edition
3. Introduction to soil microbiology by Alexander M: 2nd edition
4. Biotechnology fundamental & applications By Purohit S.S.
5. Diseases of Crop plants in India by Rangaswami G.
6. Microbiology fundamental & applications By Purohit S.S.
7. Fundamentals of Microbiology by Frobisher M.: 9th edition
8. Industrial Microbiology by Prescott S.C.: 3rd edition
9. Food Microbiology by Frazier W.C.: 3rd edition
10. Food science & Experimental foods By Swaminathan M.
11. Modern food microbiology by J James
12. Fundamentals of Dairy Microbiology by Prajapati J.B.
13. Pharmaceutical Microbiology by Ashutosh Kar, New Age International Publishers
14. Pharmaceutical Microbiology – Edt. by W.B.Hugo & A.D.Russell 6th edition. Blackwell scientific Publications.
15. Quality control in the Pharmaceutical Industry - Edt. by Murray S. Cooper Vol.2. Academic Press New York

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Course Level	UG (5.0)		**Internal Marks**	-
Programme	B.Sc. Microbiology		**External Marks**	-
Semester	III		**Practical Internal**	50
Category of Course	**MAJOR-7**		**Practical External**	50
Course Credit	04		**Prac. External Exam Duration**	4 hrs.
Teaching Hours	60		**Total**	100
Course Code	**MAJMBP303**		**Exam Duration**	4 hrs.
Course Title	**Combine Practical**			

Course Objectives: by completing the course, students have:

- To explore the practical and hands-on experience by manipulation of microorganism and performing the given experiment.
- To understand the microorganism's structure, morphology and unique characteristics.
- To examine and perform the microscopic observation and quantitate testing of product.

Course Learning Outcomes: After completion of the course:

- Has acquired practical skills of handing microorganisms in the laboratory for study.
- Has improved the knowledge and understanding of microorganisms by examination of microscopic structure.
- Developed experimental skills for testing the milk and different foods for the presence of microorganisms.
- Developed practical skills for testing pharmaceutical products for sterility and product testing.

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Practical Course Content

Sr. No	Practical content	Teaching Hrs
1.	Isolation of Gram-negative bacteria from the given sample.	60
2.	Identification of Gram negative bacteria from the given pure culture using biochemical media (*E.coli, Entrobacter aerogens, Proteus, Salmonella*)	
3.	Isolation of Gram-positive bacteria from the given sample.	
4.	Identification of Gram-positive bacteria from the given pure culture using biochemical media (*Bacillus megaterium, Bacillus subtilis, staphylococcus aureus, Streptococcus*)	
5.	Identification of Fungi on the basis of Morphological Characteristics.	
6.	Cultivation of yeast from different natural samples and its morphological characterization using microscopic observation.	
7.	Microscopic observation of different algae from the given samples.	
8.	Microscopic observation of different protozoa from the given sample.	
9.	Isolation and cultivation of bacteriophage of *E. coli* from the given sewage sample.	
10.	Isolation of nitrogen fixing bacteria	
11.	Cultivation of nitrifying and denitrifying bacteria (Demo)	
12.	Cultivation and microscopic observation of cyanobacteria	
13.	study of oozing, and isolation of pathogen from diseased specimen of lemon leaf showing citrus canker and isolation of *Xanthomonas* spp.	
14.	Construction of Winogradasky column	
15.	Standard qualitative analysis of milk	
16.	Methylene Blue Reduction Time test for milk	
17.	Preparation of Yogurt/Dahi	
18.	Sampling of pharmaceuticals for microbial contamination and load (syrups, suspensions, creams and ointments, ophthalmic preparations)	
19.	Sterility testing by *Bacillus stearothermophilus*	

Suggested reading

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi
4. Konika Sharma., manual of Microbiology – Tools & Techniques, Ane Books, Delhi.

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Course Level	UG (5.0)		**Internal Marks**	25
Programme	B.Sc. Microbiology		**External Marks**	50
Semester	III		**Practical Internal**	-
Category of Course	MDC-3 (Multidisciplinary Course-3)		**Practical External**	-
Course Credit	03		**Prac. External Exam Duration**	-
Teaching Hours	60		**Total**	75
Course Code	MDCMBT301		**Exam Duration**	2 hrs.
Course Title	Microbial Biotechnology (Theory)			

Course Objectives:

1. To study the fundamental about the microbial biotechnology and its Industrial applications.
2. To explore the purification techniques to recover the bioproducts.

Course Learning Outcomes: After completion of the course:

1. Developed an understanding how microbiology is relevant to technological developments for agriculture and environment.
2. Developed an understanding how microbiology is relevant to technological developments for industries related to food and fermentations.
3. Developed an understanding how developments in recombinant DNA technology are compared with microbially-based technological developments for agriculture, industry and environment.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
3	1	**Microbial Biotechnology** • Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology. • Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial applications: Bacteria and yeast	**15**
	2	**Microbial Transformations** • Microbial based transformation of steroids and sterols.	**15**

		• Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute	
	3	**Microbial Production and Recovery** • Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, • Biogas production: Methane and hydrogen production using microbial culture. • Microbial enhance oil recovery, mineral recovery, removal of heavy metals from aqueous effluents	**15**
	4	**Product Purification** • Microbial product purification: filtration, ion exchange & affinity chromatography techniques • Immobilization methods and their application: Whole cell immobilization, drug resistance, therapeutics, and host pathogen interactions	**15**

Suggested Reading:

1. Prescott, Healey and Klein., Microbiology-5th International Edition, Tata-McGraw Hill publications, Delhi
2. Richard H. Baltz. Julian E Davies and Arnold L. Demain Manual of Industrial Microbiology and Biotechnology. 3rd edition, ASM Press (2010).
3. Daniel Forciniti. Industrial Bioseperation: Principles and practice. 1st edition edition, Wiley-Blackwell (2008).
4. Reed. G. Prescott and Dunn's Industrial Microbiology. CBS Publishers. (1999).
5. Demain, A. L. Industrial Microbiology and Biotechnology. 2nd Edition. (2001).
6. EL Mansi. E.M.T., Fermentation Microbiology and Biotechnology. 2nd Edition, CRC Taylor & Francis (2007).
7. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. Industrial Microbiology: An lntroduction. Blackwell Science Publishers (2002).
8. Stainer, R.Y., Iingraham, J.L., Wheelis, M.L., Painter, R.K. General Microbiology, 5th Edition. MacMillan Press Ltd., London

9. Frobisher M., Hinsdill, Crabtree and Goodherat, Fundamentals of Microbiology, 9th Edition. W.B Saunders Co. USA
10. Dubey, R.C.and Maheshwari, D.K., A Text Book of Microbiology, S. Chand Publications, New Delhi.
11. Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai
12. Casida LE, Industrial Microbiology, J. Wiley, (1968).

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Course Level	UG (5.0)		**Internal Marks**	-
Programme	B.Sc. Microbiology		**External Marks**	-
Semester	III		**Practical Internal**	25
Category of Course	MDC-3 (Multidisciplinary Course-3)		**Practical External**	-
Course Credit	01		**Prac. External Exam Duration**	1 Hrs.
Teaching Hours	30		**Total**	25
Course Code	MDCMBT301		**Exam Duration**	-
Course Title	Microbial Biotechnology (Practical)			

Course Objectives:

1. To study the basic about the microbial biotechnology and its Industrial applications.
2. To explore the the micoorganisms for the biotechnology bioproducts.

Course Learning Outcomes: After completion of the course:

1. Developed an understanding how microbiology is relevant to technological developments for agriculture and environment.
2. students developed hand in the industries bioproducts and fermentations.
3. Developed an understanding how developments microbially-based bioproducts for agriculture, industry and environment application.

Sr. No.	**Practicals**	**Teaching hours**
1	Study yeast cell immobilization in calcium alginate gels	30
2	Study enzyme immobilization by sodium alginate method	
3	Production of bioethanol from the waste using microorganisms	
4	Pigment production from fungi (*Trichoderma / Aspergillus /Penicillium*)	
5	Study the removal of textile dyes using microbes	
6	Isolation of xylanase producing bacteria	
7	Isolation of lipase producing bacteria	

Suggested reading

1. Richard H. Baltz. Julian E Davies and Arnold L.DemainManual of Industrial Microbiology and Biotechnology. 3rd edition, ASM Press (2010).
2. Daniel Forciniti. Industrial Bioseperation :Principles and practice. 1st edition edition, Wiley-Blackwell (2008)
3. Reed. G. Prescott and Dunn's Industrial Microbiology. CBS Publishers. (1999).
4. Demain, A. L. Industrial Microbiology and Biotechnology. 2nd Edition. (2001).

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Paper Style:
Time: 2 Hours **Total Marks: 50**
Instructions:
1. Illustrate your answer with neat and labelled diagrams.
2. Figure to the right side indicates full marks of questions.

EXTERNAL ASSESSMENT BY UNIVERSITY			
Que. No.	**Particulars**	**Unit**	**Marks**
Que. 1	**(1) …….**	**Unit 1**	**05**
	(2) …….		**05**
	Or		
	(1) …….		**05**
	(2) …….		**05**
Que. 2	**(1) …….**	**Unit 2**	**05**
	(2) …….		**05**
	Or		
	(1) …….		**05**
	(2) …….		**05**
Que. 3	**(1) …….**	**Unit 3**	**05**
	(2) …….		**05**
	Or		
	(1) …….		**05**
	(2) …….		**05**
Que. 4	**(1) …….**	**Unit 4**	**05**
	(2) …….		**05**
	Or		
	(1) …….		**05**
	(2) …….		**05**
Que. 5	**(1) …….**	**Unit 1 & 2**	**05**
	(2) …….		**05**
	Or		
	(1) …….	**Unit 3 & 4**	**05**
	(2) …….		**05**
Total			**50**

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INTERNAL EVALUATION SCHEME (MAJOR)			
INTERNAL ASSESSMENT			
No.	**Particulars**	**Marks**	**Weightage**
1	Internal Test	50	25
2	Assignment		10
3	Field visit report/ class presentation		10
4	Attendance		05
	Total		50

INTERNAL EVALUATION SCHEME (MDC)			
INTERNAL ASSESSMENT			
No.	**Particulars**	**Marks**	**Weightage**
1	Internal Practical	50	25
2	Internal Test		10
3	Field visit report/ class presentation		10
4	Attendance		05
	Total		50

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT		
No.	**Particulars**	**Weightage**
1	Practical Performance	40
2	Viva	10
	Total	50

Paper Style:

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT PRACTICAL		
No.	**Particulars**	**Weightage**
1	Perform any **Four** practical from the given list of exercises as per the instruction of the examiner.	40
2	Viva	10
	Total	50

ASSESSMENT BY UNIVERSITY		
Que. No.	**Particulars**	**Marks**
EXTERNAL EXAMINER		
1	Perform any **Three or Four** practical from the given list of exercises as per the instruction of the examiner	40
2	Viva-voce	10
	Total	50

SEMESTER- IV

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SEMESTER-III & IV

Course Level	UG (5.0)		**Internal Marks**	50
Programme	B.Sc. Microbiology		**External Marks**	50
Semester	IV		**Practical Internal**	-
Category of Course	**MAJOR-8**		**Practical External**	-
Course Credit	04		**Prac. External Exam Duration**	-
Teaching Hours	60		**Total**	100
Course Code	**MAJMBT401**		**Exam Duration**	2 hrs.
Course Title	**Molecular Biology and Bioengineering (Theory)**			

Course Objectives: After competing this course students have able to:

- To study the concept of genetics and gene expression of cell.
- To explore the gene expression and recombinant technology of cells.
- The course explores the possibilities of genetic bioengineering and protein bioengineering.

Course Learning Outcomes: After completion of the course:

- Developed a good knowledge about the three well known mechanisms by which genetic material is transferred among the microorganisms namely transformation, transduction and conjugation.
- Has acquired a good understanding of the genetic bioengineering and protein bioengineering.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
4	1	**History and Concept of Genetics** • History of genetics and molecular biology • Mendelian Laws of inheritance **<u>The Gene Concept</u>** • Units of genetic structure and genetic function • Gene Cistron relationship in Prokaryotes and Eukaryotes • Gene structure and architecture • DNA is the universal genetic material • DNA replication – mechanism and models	**15**

	2	**Gene Expression and Regulation** • Transcription and post transcriptional modifications • Genetic code and Ribosome • Translation and post translational modifications • Levels of gene expression and regulation • Types and principles of gene regulation • Transcriptional regulation • The Operon Model: Regulation of lactose utilization – The lac operon • The Operon Model: Regulation of arabinose utilization – The ara operon • The Operon Model: Regulation of tryptophan biosynthesis – The trp operon • Post transcription control	**15**
	3	**Gene Transfer and Recombination** • Types of Recombination: Homologous recombination, Site specific recombination, Illegitimate recombination • Transformation: Natural transformation, competence, DNA uptake, role of natural transformation, Artificial induced competence, electroporation • Transduction: Generalized transduction, Specialized transduction and Abortive transduction • Conjugation: Mechanism of DNA transfer in Gram positive and Gram-negative bacteria • Transposable genetic elements	**15**

	4	**Genetic and Protein Engineering**
		• Genetic engineering: aims and applications
		• Genetic manipulations of prokaryotes:
		  • Isolation of DNA
		  • Vectors of Recombinant-DNA Technology – pBR322, pUC, Bacteriophages, Cosmid, Phagmid, BACs, YACs
		  • Insertion of DNA molecules into a vector
		  • Transformation and Growth
		  • Detection of Recombinant molecules – Colony Hybridization
		  • Expression of foreign DNA
		• Genetic manipulations of eukaryotes: Genetic manipulation of plant cells, animal cells and yeasts
		• Site directed mutagenesis
			15

Suggested Reading:

1. Advanced Molecular Biology, Twyman R. M.
2. Genes VII, Benjamin Lewin
3. Microbiology, Atlas R. M.
4. Essential of Molecular Biology – Malacinski G. M.
5. Molecular Genetics of Bacteria – Synder L. & Champness
6. Microbial Genetics – R. Maloy
7. Microbiology – Prescott L. M.
8. Microbial Genetics – Freifilder. D
9. Principles of Gene Manipulation – Old and Primrose
10. Biotechnology – Trevan M.D.

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Course Level	UG (5.0)		**Internal Marks**	50
Programme	B.Sc. Microbiology		**External Marks**	50
Semester	IV		**Practical Internal**	-
Category of Course	**MAJOR-9**		**Practical External**	-
Course Credit	04		**Prac. External Exam Duration**	-
Teaching Hours	60		**Total**	100
Course Code	**MAJMBT402**		**Exam Duration**	2 hrs.
Course Title	**Bioprocess Technology (Theory)**			

Course Objectives: By completing the course, students have:

- To study the bioprocess technology in terms of fermentation technology and industrial process.
- To understand the importance and applications of microbes in fermentation industires.
- The course aims to provide the in-depth knowledge of fermentation techniques and its bioprocess.

Course Learning Outcomes: After completion of the course:

- Are capable of describing a large number of substrates that are used for the industrial fermentation processes
- Have developed an understanding of different types of reactors or fermenters which are used for laboratory, pilot and industrial scale fermentations and their processes parameters.
- Have acquired a detailed knowledge of number of products which are produced by industrial fermentation processes.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
4	1	**Fermentation Technology and Strain Improvement** Historical perspective and concept • General Concept and historical development of industrial microbiology • Range of Fermentation Processes • Component parts fermentation process • Economic aspects of fermentation industry Isolation & strain improvement	**15**

		• Primary & Secondary Screening • Isolation methods using selection of desired characters • Improvement of industrially important microbes: Application of protoplast fusion and recombinant DNA technology	
	2	**Formulation of Fermentation Media** • Introduction to Media and its Types • Media formulation • Raw materials: Crude Carbon and Nitrogen sources, Minerals, Precursors, Growth Regulators, Buffers, Antifoam agents • Inoculum and Production medium • Media Optimization	**15**
	3	**Design and Aseptic Operation** • Introduction and basic functions of fermentor • Criteria for design of a fermentor • Types of bioreactors • Aeration and Agitation • Fermentation process: Batch Fermentation, Continuous fermentation and their comparative advantages and disadvantages • Sterilization process in fermentation industries: a. Introduction of Del factor b. Fermentor sterilization c. Medium sterilization d. Sterilization of air and feed • Aseptic operation, Containment and its categorization	**15**
	4	**Fermentation Processes** • Production of organic solvents: Ethyl alcohol • Production of enzymes: Amylases and Proteases • Production of antibiotics: Penicillin and Streptomycin • Production of amino acids: Lysine • Production of organic acids: Citric acid • Production of vitamins: Riboflavin • Overview of Immobilization in fermentation process	**15**

Suggested Reading:

1. Principles of Fermentation Technology by Stanbury & Whittaker: 2nd edition.
2. Industrial Microbiology by Casida L.E.
3. A text book of Industrial Microbiology, 2nd edition by Wulf Crueger & Anneliese Crueger.
4. Industrial Microbiology by A.H. Patel.
5. Biotechnology: Food Fermentation Microbiology, Biochemistry & Technology vol. 1 & 2 by V.K. Joshi & Ashok Pandey.
6. Biotechnology By M.D.Trevan.

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Course Level	UG (5.0)		**Internal Marks**	-
Programme	B.Sc. Microbiology		**External Marks**	-
Semester	IV		**Practical Internal**	50
Category of Course	**MAJOR-10**		**Practical External**	50
Course Credit	04		**Prac. External Exam Duration**	4 hrs.
Teaching Hours	60		**Total**	100
Course Code	**MAJMBP403**		**Exam Duration**	4 hrs
Course Title	**Combine Practical**			

Course Objectives: by completing the course, students have:

- To study the genetic materials by manipulation of macromolecules as DNA, plasmid protein etc.
- To understand the gene expression and regulation of cells.
- To understand the fermentation technology and microbial process.

Course Learning Outcomes: After completion of the course:

- Has acquired practical skills of gene extraction and manipulation in the laboratory conditions.
- Has improved the knowledge and understanding of gene regulation and expression.
- Enhanced the practical knowledge about strain improvement and industrial important microbes.
- Developed practical knowledge about the formulation of fermentation media for optimum production.

Practical Course Contents

Sr. No	Practical content	Teaching Hrs
1.	Isolation of DNA (only demonstration experiment).	60
2.	Estimation of DNA	
3.	Conjugation in *E. coli* by plate method.	
4.	Isolation of plasmid (Only demonstration experiment)	
5.	Transformation of plasmid.	
6.	Isolation and extraction of protein.	
7.	Estimation of protein	
8.	Primary screening of industrially important microorganisms capable of producing: Antibiotics, Organic acids, amylases	
9.	Bioassay of penicillin using *Bacillus*. spp.	
10.	Laboratory fermentation & estimation of Ethyl Alcohol by Saccharomyces	
11.	Laboratory fermentation & estimation of amylase by *Bacillus* spp.	
12.	Sterility testing of fermentation products	
13.	Immobilization of yeast cells by Ca- alginate entrapment method	
14.	Methylene Blue Reduction Time test for milk	
15.	Fermentation production & estimation of citric acid	

Suggested reading

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S. Chand & Company Ltd., New Delhi
4. Konika Sharma., manual of Microbiology – Tools & Techniques, Ane Books, Delhi.
5. International student edition: Microbiology- A laboratory Manual 4th edition. by James G. Chappuccino & Natalie Sherman.
6. Bacteriological Techniques by F.J. Baker.
7. Introduction to Microbial Techniques by Gunasekaran.

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Course Level	UG (5.0)		**Internal Marks**	25
Programme	B.Sc. Microbiology		**External Marks**	50
Semester	IV		**Practical Internal**	-
Category of Course	**MINOR-3**		**Practical External**	-
Course Credit	03		**Prac. External Exam Duration**	-
Teaching Hours	60		**Total**	75
Course Code	**MINMBT401**		**Exam Duration**	2 hrs.
Course Title	**Environmental Microbiology and Microbial Ecology (Theory)**			

Course Objectives: After competing this course students have able to:

- To study the concept of environmental microbiology and microbial ecology.
- To understand the different environmental habitat and survival mechanism of microbes.
- The course explores the waste management and biogeochemistry of ecology.

Course Learning Outcomes: After completion of the course:

- Have developed a fairly good knowledge and understanding of different types of environments and habitats where microorganisms grow including the microbiomes of the human gut and animal gut.
- Are able to identify the important role microorganisms play in maintaining healthy environment by degradation of solid/liquid wastes; how these activities of microorganisms are used in sewage treatment plants, production of activated sludge and functioning of septic tanks.
- Have understood the significance of BOD/COD and various tests involving use of enumerating fecal *E.coli* for assessing quality of water.

Course Contents

Sem	Unit No.	Syllabus	Teaching Hours
4	1	**Microbes in Environment** • Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats. • Atmosphere: Mendelian Laws of inheritance Aero microflora and dispersal of microbes.	**15**

		• Animal Environment: Microbes in/on human body (microbiomics) & animal (ruminants) body. • Extreme Habitats: Extremophiles: Microbes thriving at high& low temperatures, pH, highly drostatic & osmotic pressures, salinity, & low nutrient levels.	
	2	**Waste Management** • Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). • Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.	**15**
	3	**Microbial Treatments and Technique** ● Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inroganic (metals) matter, biosurfactants. ● Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) Standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique Presence/absence tests.	**15**
	4	**Biogeochemical Cycles** • Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and Chitin. • Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. • Phosphorus cycle: Phosphate immobilization and solubilisation. • Sulphur cycle: Microbes involved in sulphur cycle Other elemental cycles: Iron and manganese	**15**

Suggested Reading:

1. Medigan, M.T., Martinko, J. M. and Parker, J. Brock Biology of Microorganisms. Pearson Education Inc., New York
2. Alexander, M John. Microbial ecology. Wiley & Sons, Inc., New York.
3. Alexander, M John. Introduction to soil microbiology.Wiley & Sons Inc., New York.
4. Barker, KH, and Herson, D.S. Bioremediation. Mc Craw Hill Inc., New York.
5. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.

6. Willey, Sherwood,Woolverton. Prescott, Harley, and Klein's Microbiology McGraw-Hill publication.
7. Tortora,Funke,Case. Microbiology.Pearson Benjamin Cummings.
8. Jacquelyn g. Black. Microbiology Principles and explorations. John Wiley & Sons, Inc.
9. Madigan,Martinko, Bender,Buckley,Stahl.Brock Biology of Microorganisms. Pearson
10. Tom Besty,D.C Jim Koegh. Microbiology Demystified Mcgraw-Hill.

Suggested reading

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S. Chand & Company Ltd., New Delhi
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Course Level	UG (4.0)		**Internal Marks**	-
Programme	B.Sc. Microbiology		**External Marks**	-
Semester	IV		**Practical Internal**	25
Category of Course	MINOR-4		**Practical External**	-
Course Credit	01		**Prac. External Exam Duration**	1 hrs.
Teaching Hours	30		**Total**	25
Course Code	MINMBT401		**Exam Duration**	-
Course Title	Environmental Microbiology and Microbial Ecology (Practical)			

Course Objectives: by completing the course, students have:

1. To explore the practical and hands-on experience by performing the given experiment.
2. To understand the microbial role in the environment.

Course Learning Outcomes: After completion of the course:

1. Have developed the practical skills for conducting experiments to assess the BOD/COD of wastewaters and their interpretation.
2. Have learnt about the assessment the portability of drinking water quality by the use of standard microbiological tests.

Suggested Practical

Sr. No	**Practical content**	**Teaching Hrs**
1.	Analysis of soil pH, moisture content, water holding capacity, percolation, capillary action.	30
2.	Isolation of microbes (bacteria & fungi) from soil (30 & 45^{o}C).	
3.	Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.	
4.	Assessment of microbiological quality of water.	
5.	Determination of BOD of wastewater sample.	
6.	Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.	
7.	Isolation of Rhizobium from root nodules.	
8.	Estimation of protein	

Suggested reading

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S. Chand & Company Ltd., New Delhi
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Paper Style:
Time: 2 Hours **Total Marks: 50**
Instructions:
1. Illustrate your answer with neat and labelled diagrams.
2. Figure to the right side indicates full marks of questions.

EXTERNAL ASSESSMENT BY UNIVERSITY			
Que. No.	**Particulars**	**Unit**	**Marks**
Que. 1	**(1) …….**	**Unit 1**	**05**
	(2) …….		**05**
	Or		
	(1) …….		**05**
	(2) …….		**05**
Que. 2	**(1) …….**	**Unit 2**	**05**
	(2) …….		**05**
	Or		
	(1) …….		**05**
	(2) …….		**05**
Que. 3	**(1) …….**	**Unit 3**	**05**
	(2) …….		**05**
	Or		
	(1) …….		**05**
	(2) …….		**05**
Que. 4	**(1) …….**	**Unit 4**	**05**
	(2) …….		**05**
	Or		
	(1) …….		**05**
	(2) …….		**05**
Que. 5	**(1) …….**	**Unit 1 & 2**	**05**
	(2) …….		**05**
	Or		
	(1) …….	**Unit 3 & 4**	**05**
	(2) …….		**05**
Total			**50**

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INTERNAL EVALUATION SCHEME (MAJOR)			
INTERNAL ASSESSMENT			
No.	**Particulars**	**Marks**	**Weightage**
1	Internal Test	50	25
2	Assignment		10
3	Field visit report/ class presentation		10
4	Attendance		05
	Total		50

INTERNAL EVALUATION SCHEME (MDC)			
INTERNAL ASSESSMENT			
No.	**Particulars**	**Marks**	**Weightage**
1	Internal Practical	50	25
2	Internal Test		10
3	Field visit report/ class presentation		10
4	Attendance		05
	Total		50

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT		
No.	**Particulars**	**Weightage**
1	Practical Performance	40
2	Viva	10
	Total	50

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Paper Style:

INTERNAL EVALUATION SCHEME		
INTERNAL ASSESSMENT PRACTICAL		
No.	**Particulars**	**Weightage**
1	Perform any **Four** practical from the given list of exercises as per the instruction of the examiner.	40
2	Viva	10
	Total	50

ASSESSMENT BY UNIVERSITY		
Que. No.	**Particulars**	**Marks**
EXTERNAL EXAMINER		
1	Perform any **Three or Four** practical from the given list of exercises as per the instruction of the examiner	40
2	Viva-voce	10
	Total	50