HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC A (3.02) State University

PATAN- 384265

Faculty of Science

B. Sc. Microbiology

Syllabus/ scheme

Semester – 3 to 4

With effect from

June-2024

Date: 19/03/2024 Total page: 35

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN	
B. Sc. (Microbiology) Syllabus 2024 (according to NEP-2020)	
Document code	**Syllabus MIC- 2024**
Name of faculty	**Science**
Faculty code	**SCI**
Programme name	**B. Sc. MICROBIOLOGY**
Programme code	**SCIUG105**
Effective from	**June-2024**

The proposed new structure for B. Sc. course is based on NEP-2020 which is in force June-2024.

Course Pattern

1. This programme is divided into **Eight Semesters** (Four Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits and the programme is comprised of total 176 credits.

2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks × 4). The theory courses with 3 credits shall have 45 hrs of teaching workload (15 weeks × 3) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks × 2).

Attendance: The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

Medium of Instruction: The medium of instruction shall be Gujarati but students are free to write answers in Gujarati or English in examination.

Language of question paper: Question paper should be drawn in Gujarati and English translation of the questions must be given in the question paper.

Number of students in each batch for practical examination should be 15.

Evaluation

Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skill (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	Total	**50**

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	Total	**25**

Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each)
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each)
Q. 3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each)
Q. 4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each)
Q. 5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each)
Total	**50**	

2. For SEE of 25 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each)
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each)
Q. 3	05	08 short questions must be drawn from both units, out of which any 05 must be answered (1 marks each)
Total	**25**	

PROGRAM OBJECTIVE

1. The primary objective of the program is to impart quality education in the subject of Microbiology as a basic science and its applied branches to the students.
2. To provide quality education in a branch of Biological sciences i.e., Microbiology withdifferent specializations.
3. To facilitate Higher education & research in Microbiology.
4. To provide quality education offering skill-based programs and motivate the studentsfor self-employment in applied branches of Microbiology.
5. To inculcate the spirit of microbial resource conservation and love for nature.
6. To conduct field studies and different projects of local and global interests.
7. To provides opportunities for professional and personal development through curricular and co- curricular activities.
8. Provide consultancy and organize extension activities.

PROGRAMME OUTCOMES

1. To understand the complex organization of microbial world, physiology, immunology, bioprospecting and importance of microbes in various biogeochemical cycles and for overall development.
2. For instance, if you major in Microbiology, you can also still take courses from across theother complementary.
3. Apply the wide range of subject based skills of various fields that provide a base for future career in disciplines such as Fermentation technology, Food microbiology, Environmental microbiology, Microbial biotechnology, Agriculture, Publishing, Teaching and Research.
4. Understand the applications of biological techniques to various fields of biology.
5. When you graduate with a Bachelor of Science (Microbiology) you can serve as academician in different institutes.
6. The syllabus has been designed in such a way that it will give good experience to thestudent to work under pressure.

B.Sc. Semester IV (Microbiology)

Course	Course code	Paper title	Teaching hours per week	CCE	SEE	Total marks	Credit points	Exam duration (Hours)
Major Discipline Specific core course	SC23MJDS CMIC401	Molecular Biology and Genetics	4	50	50	100	4	2.5
Major Discipline Specific core course	SC23MJDS CMIC401A	Industrial Microbiology	4	50	50	100	4	2.5
Minor Discipline Specific core course	SC23MIDS CMIC402	Food and Dairy Microbiology	2	25	25	50	2	2
Major Discipline Specific core course Practical Paper	SC23PMJD SCMIC401	Molecular Biology and Genetics Practical Part A	4	25	25	50 (Part A) + 50 (Part B) = 100	2 (Part A) + 2 (Part B) = 4	More than 3
	SC23MJDS CMIC401A	Industrial Microbiology Practical Part B	4	25	25			More than 3
Minor Discipline Specific core course Practical Paper	SC23PMIDS CMIC402	Food and Dairy Microbiology practical	4	25	25	50	2	More than 3
Ability Enhancement Course		AEC Basket	2	25	25	50	2	2
Skill Enhancement Course		SEC Basket	2	25	25	50	2	2
Value added courses		IKS course Basket	2	25	25	50	2	2
Total			**30**	**275**	**275**	**550**	**22**	

Semester IV

B.Sc. Semester IV (Microbiology)

Course	Course code	Paper title	Teaching hours per week	CCE	SEE	Total marks	Credit points	Exam duration (Hours)
Major Discipline Specific core course	SC23MJDS CMIC401	Molecular Biology and Genetics	4	50	50	100	4	2.5
Major Discipline Specific core course	SC23MJDS CMIC401A	Industrial Microbiology	4	50	50	100	4	2.5
Minor Discipline Specific core course	SC23MIDS CMIC402	Food and Dairy Microbiology	2	25	25	50	2	2
Major Discipline Specific core course Practical Paper	SC23PMJD SCMIC401	Molecular Biology and Genetics Practical Part A	4	25	25	50 (Part A) + 50 (Part B) = 100	2 (Part A) + 2 (Part B) = 4	More than 3
	SC23MJDS CMIC401A	Industrial Microbiology Practical Part B	4	25	25			More than 3
Minor Discipline Specific core course Practical Paper	SC23PMIDS CMIC402	Food and Dairy Microbiology practical	4	25	25	50	2	More than 3
Ability Enhancement Course		AEC Basket	2	25	25	50	2	2
Skill Enhancement Course		SEC Basket	2	25	25	50	2	2
Value added courses		IKS course Basket	2	25	25	50	2	2
Total			**30**	**275**	**275**	**550**	**22**	

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME B. SC. MICROBIOLOGY SEMESTER IV
PROGRAM CODE: SCIUG105
MAJOR DISCPLINE SPECIFIC COURSE CODE: SC23MJDSCMIC401

MOLECULAR BIOLOGY AND GENETICS

Total Credits- 04 (04Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

OBJECTIVE:
This syllabus is fruitful in the terms of basic and advance knowledge of Genetics with various molecular biological concepts with perspective of theory and practical approaches.

UNIT 1 : **Genetic material and its structure**

- ***Nature of Genetic material***: Understanding of terms: Chromosome, Nucleoid, Plasmid, Genome, Genetic material, Gene, Genotype, Phenotype, Replicon
- Experimental proof for DNA as genetic material: Work of Griffith; Avery, McCarty and MacLeod; Hershey and Chase
- **Structure of DNA**
  The elucidation of DNA structure, Features of Watson-Crick's model of DNA, types of DNA,
- **Structure of RNA**
  Structure and types of RNA, functions of RNA, catalytic RNA

UNIT 2: Replication of DNA

- Semi conservative nature, Meselson and Stahl's experiment, Molecular mechanism: Strand separation,
- Synthesis of RNA primer, Formation of leading strand and lagging strands,
- Removal of primer, Joining of Okazaki Fragments, Proofreading activity of DNA polymerase
- Patterns of DNA replication: Cairn's (Ø) model and Rolling Circle, Mechanism (σ model)

UNIT 3: Mutation and Genetic recombination

- Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions.
- Mutagens - Physical and Chemical mutagens.
- Outlines of DNA damage and repair mechanisms.
- Genetic recombination in bacteria – Conjugation, Transformation and Transduction

UNIT 4: Gene and its regulation

- Concept of gene – Muton, Recon and Cistron. One gene one enzyme and one gene one polypeptide hypotheses, Genetic code.
- Types of genes – structural, constitutive, regulatory
- Protein synthesis – Transcription and translation.
- Regulation of gene expression in bacteria – *lac* operon.

Outcomes:

- ✓ Understand important definitions of Genome, Gene, Genotype, Phenotype characteristics. Various scientific experiments proved by scientist in the old era. Understand DNA structure and replication model.
- ✓ Students will understand gene expression pattern through transcription and translation. Important parameters of Gene regulation through the Lac operon and Tryptophan operon system which help to understand basic mechanisms.
- ✓ Through the mutation we can differentiate the wild type and mutant type characteristics of individual organisms through their types of mutation. Understand how the cells have multiple mechanisms for correcting mispaired and damaged DNA.
- ✓ Through the content, we can create additional genetic variability through conjugation, transformation and transduction experiments.

References

1. Crueger, W. and Crueger, A. (2000). Biotechnology: A Text Book of Industrial Microbiology, PrenticeHall of India Pvt. Ltd., New Delhi.
2. Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.
3. Freifelder, D. (1997). Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
4. Glazer, A.N. and Nikaido, H. (1995). Microbial Biotechnology – Fundamentals of Applied Microbiology, W.H. Freeman and company, New York.
5. Glick, B.P. and Pasternack, J. (1998). Molecular Biotechnology, ASM Press, Washington D.C., USA.

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COURSE NAME B. SC. MICROBIOLOGY SEMESTER IVPROGRAM CODE: SCIUG105
MAJOR DISCPLINE SPECIFIC COURSE CODE: SC23MJDSCMIC401A

INDUSTRIAL MICROBIOLOGY

Total Credits- 04 (04Period/Week)	**Theory**	**External-50 Marks**
		Internal- 50 Marks

UNIT 1: **Introduction to industrial microbiology**,

- Isolation, primary and secondary screening, preservation (principle, methods and quality control),
- Maintenance and improvement of industrially important organisms.
- Strain improvement Strategies, Selection of induced mutants, Selection of recombinants, Strain improvement for modifications of properties other than yield.

UNIT 2: Raw materials for fermentation processes

- Molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates,
- Medium optimization**,** Principles of media formulation. Media ingredients: Water, carbon sources, nitrogen sources, minerals, growth factors, buffers, chelators, precursors, inducers, inhibitors, antifoam agents.
- Media sterilization using high pressure steam: Principle, batch and continuous sterilization process. - Sterilization of media using filtration: Principle, types of filters.
- Inoculum development: General principles for development of seed culture for bacterial, yeast and fungal processes.

UNIT 3: Types of fermentation processes:

- Solid-state and liquid-state (stationary and submerged) fermentations. Batch, fed-batch (eg. baker's yeast) and continuous fermentations.
- Fermenter Design: Components of a typical bio-reactor, Types of bioreactors, Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters.
- Measurement and control of fermentation parameters: pH, temperature, dissolved oxygen, foaming and aeration

UNIT 4: Downstream processing:

- Bioseparation: filtration, centrifugation, sedimentation, flocculation, celldisruption, liquid-liquid extraction.
- Purification by chromatographic techniques, reverse osmosis and ultrafiltration, drying, crystallization,
- Storage and packaging.
- Economics in Fermentation technology.

Outcomes:

- ✓ Students will know about fundamental aspects fermentation technology
- ✓ Students will learn the basics of different approaches for the production and purification of industrially important products

References

1. Stanbury PF, Whitaker A and Hall SJ. Principles of Fermentation Technology, Butterworth
2. Heinemann and Elsevier. 2 Waites, MJ and Morgan NL. Industrial Microbiology: An Introduction, Blackwell Science
3. Crueger W andCrueger A. Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation, New Delhi, India
4. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, Taylor & Francis Ltd., UK.
5. Casida LE, Jr.Industrial Microbiology, Wiley Eastern Ltd, New Delhi, India.
6. Patel AH. Industrial Microbiology. Macmillan India Limited
7. Okafor N. Modern Industrial Microbiology and Biotechnology. Bios Scientific
8. Principles Of Fermentation Technology By P F Stanbury Dr. A Whitaker
9. Comprehensive Biotechnology: Murray Moo Young
10. Methods in Industrial Microbiology: Sikyta

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME B. SC. MICROBIOLOGY SEMESTER IV
PROGRAM CODE: SCIUG105
PRACTICAL MAJOR DISCPLINE SPECIFIC COURSE CODE:SC23PMJDSCMIC401 & SC23PMJDSCMIC401A
MOLECULAR BIOLOGY AND GENETICS PRACTICAL PART A
INDUSTRIAL MICROBIOLOGY PRACTICAL PART B

Total Credits-04	**Part A: 2 credit**	**(04 Period/Week)**	**Internal- 25 Marks**	**External-25 Marks**	**Total marks: 100**
	Part B: 2 credit	**(04 Period/Week)**	**Internal- 25 Marks**	**External-25 Marks**	

SC23PMJDSCMIC401: MOLECULAR BIOLOGY AND GENETICS PRACTICAL PART A

List of Practical

1. Study of different types of DNA and RNA using micrographs and model / schematic representations
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Isolation of genomic DNA from *E. coli*
4. Estimation of DNA using UV spectrophotometer.
5. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
6. Induction of mutations in bacteria by UV light.
7. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR
8. Study of chemical mutagen (PFMS) induced mutation in bacteria
9. Isolation of pigment less mutant of *Serratia marcescens* using UV radiations as mutagen.
10. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE)

SC23PMJDSCMIC401A: INDUSTRIAL MICROBIOLOGY
PRACTICAL PART B

List of Practicals

1. Study different parts of fermenter
2. Primary screening of Antibiotic producing bacteria: Crowded plate technique
3. Primary screening of Antibiotic producing bacteria: Wilkin's Method
4. Primary screening of organic acid producing bacteria
5. Primary screening of Amylase producing bacteria
6. Primary screening of Protease producing bacteria
7. Fermentative production of Antibiotics
8. Fermentative production of organic acids
9. Concept of inoculum development
10. Paper chromatography
11. Thin layer chromatography
12. Sterility testing

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME B. SC. MICROBIOLOGYSEMESTER IV
PROGRAM CODE: SCIUG105
MINOR DISCPLINE SPECIFIC COURSE CODE: SC23MIDSCMIC402

FOOD AND DAIRY MICROBIOLOGY

Total Credits- 02 (02 Period/Week)	**Theory**	**External-25 Marks**
		Internal-25 Marks

Course Objectives:

- This course will help understand the current trends and concepts related to Microbiology of food and other dairy products.
- Gives an insight into various types of food borne diseases and their prevention.

Unit-1 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
- Methods of food preservation, Food quality control measures.
- Brief introduction about fermented foods: Pickles, Sauerkraut, Silage, Sausages & Bread.

Unit-2 Dairy Microbiology

- Milk as a medium, normal flora of milk
- Spoilage of milk & milk products
- Microbial analysis of milk: SPC, Direct count, MBRT, Resazurin test.
- Fermented Dairy Products: Starter Culture, Cheese, Yogurt, Buttermilk, Acidophilus milk, Kefir
- Preservation of milk: Principles & methods of preservation

Course Outcomes:

- Understand the significance and activities of microorganisms in food the role of intrinsic and extrinsic factors on growth and survival of microorganisms and attain information on microbial food spoilage.

- Understand the principles in traditional food preservation techniques including salting, pickling, refrigeration, freezing, oxidation, and canning/bottling and chemical preservation.
- Analyze types of starter cultures like Lactic acid bacteria, fermented milk products, probiotics, SCP and Edible mushrooms.
- Acquire& remember the microbes causing food intoxications and food infections.

Reference Books:

1. Fundamentals of Microbiology By Frobisher M.: 9th edition
2. Microbiology by Pelczar M.J. & Chain E.C.S. : 5th edition
3. Industrial Microbiology by Prescott S.C. : 3rd edition
4. Food Microbiology by Frazier W.C. : 3rd edition
5. Food science & Experimental foods By Swaminathan M.
6. Modern food microbiology by J James.
7. Fundamentals of Dairy Microbiology by Prajapati J.B.
8. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
9. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
10. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi.

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME B. SC. MICROBIOLOGY SEMESTER IV
PROGRAM CODE: SCIUG105
PRACTICAL MINOR DISCPLINE SPECIFIC COURSE CODE:SC23PMIDSCMIC402

FOOD AND DAIRY MICROBIOLOGY

Total Credits- 02 (04 Period/Week)	**External-25 Marks**
	Internal- 25 Marks

List of Practical

1. Standard qualitative analysis of milk.
2. Methylene Blue Reduction Time test for milk.
3. Isolation of food borne microorganisms from vegetables and fruits.
4. Isolation of food borne microorganisms from milk.
5. Isolation of microorganisms from spoilage food.
6. Isolation of fungi from Bread.
7. Preparation of Yogurt.

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MOLECULAR BIOLOGY AND GENETICS PRACTICAL PART A
INDUSTRIAL MICROBIOLOGY PRACTICAL PART B

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 50**

MOLECULAR BIOLOGY AND GENETICS PRACTICAL PART A

Q 1	Perform the given experiment, Write principle, Methodology and show your results to the examiner	**10**
Q 2	Perform the given experiment, Write principle, Methodology and interpret your results	**05**
Q 3	Spotting	**04**
Q 4	Viva-voce	**04**
Q 5	Journal submission	**02**

INDUSTRIAL MICROBIOLOGY PRACTICAL PART B

Q 1	Perform the given experiment, Write principle, Methodology and show your results to the examiner	**10**
Q 2	Perform the given experiment, Write principle, Methodology and interpret your results	**05**
Q 3	Spotting	**04**
Q 4	Viva-voce	**04**
Q 5	Journal submission	**02**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATANCOURSE NAME

B. SC. MICROBIOLOGY SEMESTER IV

PROGRAM CODE: SCIUG105

PRACTICAL MINOR SPECIFIC COURSE CODE: SC23PMIDSCMIC402

FOOD AND DAIRY MICROBIOLOGY

PRACTICAL SKELETON

Time: 3 Hours **Total Marks: 25**

Q 1	Perform the given experiment, Write principle, Methodology and show your results to the examiner	**10**
Q 2	Perform the given experiment, Write principle, Methodology and interpret your results	**05**
Q 3	Spotting	**04**
Q 4	Viva-voce	**04**
Q 5	Journal submission	**02**