

B.Sc. in Microbiology Syllabus (Single Major and Single Minor), NBU, 2024

**Course syllabus for
Single Major and Single Minor
B.Sc. in Microbiology Syllabus
(Semester II)
(FYUGP Regulation 2024-25)
University of North Bengal**

**B.Sc. Syllabus in Microbiology according to the Course syllabus for Single Major and
Single Minor together with allied courses (FYUGP 2024)**

University of North Bengal

UG Syllabus scheme in microbiology for 2nd Semester

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Scheme of the 2nd Semester Syllabus under Single major and Single minor Combination**

Papers	No. Of Courses	Credit Distribution in each paper		Total Credit
		Theory	Practical	
Major	2	3	1	2x4=8
Minor	1*	3	1	1x4=4
AEC#	1	4	0	1x4=4
VAC#	0	0	0	0
IDC#	1	3	0	1x3=3
SEC#	1	2	1	1x3=3
Total Courses	6		Total Credit	22

** This course structure only depicts the syllabus for Microbiology as Major and Microbiology Minor Papers, University of North Bengal.

*Minor subject will be chosen by the students who have major subjects other than microbiology and as decided in the combination list provided by University of North Bengal.

Course structure as decided/recommended and listed centrally by university of North Bengal.

Courses for 1st Semester

Courses	Code	Course Type	Course Name	Credit
Major Paper 3	MICRMAJ203	Theory	Bacteriology	3
		Practical	Bacteriology	1
Major Paper 4	MICRMAJ204	Theory	Microbes in sustainable agriculture and development	3
		Practical	Microbes in sustainable agriculture and development	1
Minor Paper 2	MICRMIN202	Theory	Bacterial morphology and growth	3
		Practical	Bacterial morphology and growth	1

MAJOR

Paper: 3 (MAJOR) Paper code: MICRMAJ203 Paper level: 100

BACTERIOLOGY

(Paper type: Theory)

Semester II

Lecture Hours: 45 h Marks: 60 CREDITS: 3

Unit 1 Cell organization

No. of Hours: 20 h

Cell size, shape and arrangement, Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaeobacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. glycocalyx, capsule, flagella, endoflagella, fimbriae and pili Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation and staining.

Unit 2 Growth and nutrition

No. of Hours: 5h

Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media *Physical methods of microbial control*: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation *Chemical methods of microbial control*: disinfectants, types and mode of action

Unit 3 Reproduction in Bacteria

No. of Hours: 5h

Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate

Unit 4 Bacterial Systematics

No. of Hours: 5 h

Systems of classification

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing. Differences between eubacteria and archaeobacteria

Unit 5 Important archaeal and eubacterial groups

No. of Hours: 10 h

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Archaeobacteria: General characteristics, Overview to Nanoarchaeota, Crenarchaeota, Euryarchaeota, thermophiles and Halophiles

Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups:

Gram Negative:

General characteristics with suitable examples of Alpha proteobacteria (*Zymomonas mobilis*), Beta proteobacteria (*Neisseria meningitides*) and Gamma proteobacteria (*Escherichia.coli*)

Gram Positive:

Low G+ C (Firmicutes): General characteristics, examples (*Bacillus subtilis*) (High G+C (Actinobacteria): General characteristic examples (*Streptomyces sp.*)

Paper: 3 (MAJOR) Paper code: MICRMAJ203 Paper level: 100

BACTERIOLOGY

(Paper type: Practical)

Semester II

Total Hour: 30h Marks:20 CREDITS: 1

1. Preparation, isolation and enumeration of microorganism in Simon citrate agar (Synthetic media) using standard plate count method.
2. Preparation, isolation and enumeration of microorganism in McConkey agar (Complex media) using standard plate count method.
3. Preparation, isolation and enumeration of microorganism in EMB agar (Complex media) using standard plate count method.
4. Simple staining
5. Negative staining
6. Gram's staining
7. Capsule staining
8. Endospore staining.
9. Motility by hanging drop method.
10. Autoclaving and assessment of sterility.
11. Phenol coefficient.

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SUGGESTED READINGS

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers.
2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
5. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
9. Cappuccino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

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Paper: 4 (MAJOR) Paper code: MICRMAJ204 Paper level: 100

MICROBES IN SUSTAINABLE AGRICULTURE

AND DEVELOPMENT

(Paper type: Theory)

Semester II

Lecture Hours: 45 h Marks: 60 CREDITS: 3

Unit 1 Biofertilizers

No. of Hours: 15 h

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.

Symbiotic N₂ fixers: Biological pathway, *Rhizobium* - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants

Frankia - Isolation, characteristics, Alder, Casurina plants, non-leguminous crop symbiosis.

Cyanobacteria, General characteristic, Heterocyst and its function, *Azolla* - Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

Indole acetic acid (IAA) producer isolation, biological pathway, characteristics, inoculum production and field application

Unit 2 Non - Symbiotic Nitrogen Fixers

No. of Hours: 5 h

Free living *Azospirillum*, *Azotobacter* - free isolation, characteristics, mass inoculums, production and field application.

Unit 3 Phosphate Solubilizers

No. of Hours: 5 h

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field Application

Unit 4 Mycorrhizal Biofertilizers

No. of Hours: 5 h

Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

Unit 5 Microbial Control of Soil Borne Plant Pathogens

No of Hours: 6 h

Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds

Unit 6 Secondary Agriculture Biotechnology

No of Hours: 5h

Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters

Unit 7 GM crops

No of Hours: 4h

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Advantages, social and environmental aspects, Bt crops, golden rice, transgenic animals.

Paper: 4 (MAJOR) Paper code: MICRMAJ204 Paper level: 100
MICROBES IN SUSTAINABLE AGRICULTURE
AND DEVELOPMENT
(Paper type: Practical)
Semester II
Total Hour: 30 h Marks: 20 CREDITS: 1

1. Isolation of N₂ fixers from rhizospheric soil using Asbhy's N₂ free agar medium.
2. Quantification of fixed N₂ in the form of NH₃ using Nessler's reagent.
3. Isolation of phosphate solubilizer using Pikovskaya's Agar and quantification of soluble phosphorus.
4. Isolation of IAA producer and quantification of IAA using Salkowski reagent.
5. Isolation of Cyanobacteria using BG11 media.
6. Liquid formulation of biofertilizer (N₂ fixer, phosphate solubilizer, IAA producer) according to BIS standard and its application in seed germination.
7. Isolation of cellulase producing bacteria from soil.

Suggested Readings

1. Kannaiyan, S. (2003). Bioethnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt.Ltd. NewDelhi.
5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG
6. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

MINOR

Paper: 2 (MINOR) Paper code: MICRMIN202 Paper level: 100

BACTERIAL MORPHOLOGY AND GROWTH

(Paper type: Theory)

Semester II

Lecture Hours: 45 h Marks: 60 CREDITS: 3

Unit 1 Cell organization

No. of Hours: 20 h

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaeobacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation.

Unit 2 Microbial Control

No. of Hours: 10 h

Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation *Chemical methods of microbial control:* disinfectants, types and mode of action

Unit 3 Reproduction in Bacteria

No. of Hours: 5 h

Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate

Unit 4 Important archaeal and eubacterial groups

No. of Hours: 10h

General characteristics and Morphology, metabolism, ecological significance and economic importance of thermophiles and Halophiles, actinobacteria, cyanobacteria

Paper: 2 (MINOR) Paper code: MICRMIN202 Paper level: 100

BACTERIAL MORPHOLOGY AND GROWTH

(Paper type: Practical)

Semester II

Lecture Hours: 30 h Marks: 20 CREDITS: 1

1. Simple staining
2. Negative staining
3. Gram's staining
4. Capsule staining
5. Endospore staining.
6. Autoclaving and assessment of sterility.

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7. Phenol coefficient
8. Motility by hanging drop method.

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Format of question papers for semester end examination

1. For 60 Marks (Theory papers)

Sl.No	Question to be answered	Out of	Marks of each question	Total Marks
1.	06	08	01	1X6=6
2.	05	07	06	6X5=30
3.	02	04	12	12X2=24
			Total	60

2. For 20 Marks (Practical Papers)

Sl.No	Question to be answered	Marks of each question	Question type	Total Marks
1.	01	08	Practical	8X1=8
2.	01	05	Parctical	5X1=5
3.	01	05	Viva	5X1=5
4.	01	02	Lab recods	2X1=2
All questions are compulsory			Total	20