DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, AYODHYA
FORMAT FOR DEVELOPING SYLLABUS FOR A SUBJECT
Proposed Structure of Syllabus for the
PROGRAMME (M. Sc.), SUBJECT (Microbiology)
w.e.f. 2022-2023

Syllabus Developed by				
SNo	**Name of Expert/BoS Member**	**Designation**	**Department**	**College/ University**
1	Prof. Shailendra Kumar	Prof. & Head Convenor	Department of Microbiology	Dr. Rammanohar Lohia Avadh University, Ayodhya
2	Prof. Rajeeva Gaur	Professor	Department of Microbiology	Dr. Rammanohar Lohia Avadh University, Ayodhya
3	Prof. Tuhina Verma	Professor	Department of Microbiology	Dr. Rammanohar Lohia Avadh University, Ayodhya
4	Dr. Ranjan Singh	Associare Prof.	Department of Microbiology	Dr. Rammanohar Lohia Avadh University, Ayodhya
5	Prof. Ram Narain	External Expert	Department of Biotechnology	V. B. S. P. University, Jaunpur

Tuhina Ranjan Singh

Course Code		Course Title	Credits	T/P	Evaluation	
					CIE	ETE
A	B	C	D	E	F	G
SEMESTERI (YEARI)						
B080701T	CORE	General Microbiology	5	T	25	75
B080702T	CORE	Agriculture & Environmental Microbiology	5	T	25	75
B080703T	CORE	Instrumentation & Analytical Methods	5	T	25	75
B080704T	FIRST ELECTIVE (Select any one)	Basic Biochemistry	5	T	25	75
B080705T		Bioinformatics	5	T	25	75
B080706P	SECOND ELECTIVE (Select any one)	Microbiology Laboratory Course – IA	5	P	50	50
B080707P		Microbiology Laboratory Course –IB	5	P	50	50
SEMESTERII (YEARI)						
B080801T	CORE	Bacterial Physiology	5	T	25	75
B080802T	CORE	Biocatalysis, Bioenergetics and Metabolic Pathways	5	T	25	75
B080803T	CORE	Concepts of Immunology	5	T	25	75
B080804T	THIRD ELECTIVE (Select any one)	Environmental Issues	5	T	25	75
B080805T		Food Microbiology	5	T	25	75
B080806P	FOURTH ELECTIVE (Select any one)	Microbiology Laboratory Course – IIA	5	P	50	50
B080807P		Microbiology Laboratory Course – IIB	5	P	50	50
SEMESTERIII (YEARII)						
B080901T	CORE	Molecular Biology & Bacterial Genetics	5	T	25	75
B080902T	CORE	Medical Microbiology	5	T	25	75
B080903T	CORE	Evolution & Microbial Taxonomy	5	T	25	75
B080904T	FIFTH ELECTIVE (Select any one)	Industrial Microbiology	5	T	25	75
B080905T		Emerging Infectious Diseases	5	T	25	75
B080906P	SIXTH ELECTIVE (Select any one)	Microbiology Laboratory Course – IIIA	5	P	50	50
B080907P		Microbiology Laboratory Course – IIIB	5	P	50	50

Tulina Ranjan Singh

SEMESTERIV (YEARII)						
B081001T	CORE	Modern Microbial Technology	5	T	25	75
B081002T	CORE	Fermentation Technology	5	T	25	75
B081003P	SEVENTHELECTIVE (Select any one)	Seminar & Interactive Course	5	P	50	50
B081004P		Review and Assignment	5	P	50	50
B081005P	RESEARCHPROJECT/ DISSERTATION	Major Research Project/Dissertation	10	P	50	50

NOTE: All the theory papers shall be of 5 (4+1) credits, i. e. 4 Lectures and 1 Tutorial

Program Outcomes (POs) :

- The program has been designed in such a way so that the students acquire strong theoretical and practical knowledge in various domains of Microbiology.
- The programme includes details of microorganisms of general, agricultural, industrial and medical importance, their metabolism, instrumentation and analytical techniques, molecular biology, biochemistry of microorganisms, nucleic acids, lipids, proteins & enzymes, immunology, genetic engineering, bioethics followed by applied biotechnology to make the study of living system more comprehensive with deep knowledge in microbiology.
- The practical courses have been designed to equip the students with the laboratory skills in Microbiology. Students will able to design and conduct experiments, as well as to analyze and interpret scientific data in useful form.
- The program will offer students with the knowledge and skill base that would enable them to undertake advanced studies in general microbiology/ agriculture/ medical microbiology/ biotechnology/ industrial microbiology/ food microbiology/ molecular biology and related areas or in multidisciplinary areas that involve Microbiology.
- The students will get exposure to wide range of careers in microbiological /biotechnological sciences.
- The students will gain domain knowledge and know-how for successful career in academia, industry and research.
- Ultimate goal will be to develop the trained human resource to work in synergistic way for the sustainable development of society.

Tulika Ranjan Singh

Semester wise Paper Titles with Details					
Year	**Semester**	**Paper**	**Paper Title**	**Prerequisite for Paper**	**Elective for Major Subjects**
Master in Microbiology					
First	SEM-I	Core	General Microbiology	B. Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core	Agriculture & Environmental Microbiology	B. Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core	Instrumentation & Analytical Methods	B. Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		First Elective (Select any One)	Molecular Biology & Bacterial Genetics	B. Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Bioinformatics		
		Second Elective (Select any One)	Microbiology Laboratory Course –IA	B. Sc. (Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Microbiology Laboratory Course –IB		
	SEM-II	Core	Molecular Biology & Bacterial Genetics	M. Sc. –I Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core	Biocatalysis, Bioenergetics and Metabolic Pathways	M. Sc. –I Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core	Concepts of Immunology	M. Sc. –I Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Third Elective (Select any	Environmental Issues	M. Sc. –I Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science,

Tulika Ranjan Singh

		One)	Food Microbiology		Chemistry, Botany, Zoology)
		Fourth Elective (Select any One)	Microbiology Laboratory Course –IIA	M. Sc. –I Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Microbiology Laboratory Course –IIB		
Second	SEM-III	Core	Bacterial Physiology	M. Sc. –II Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core	Medical Microbiology	M. Sc. –II Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core	Evolution & Microbial Taxonomy	M. Sc. –II Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Fifth Elective (Select any One)	Modern Microbial Technology	M. Sc. –II Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Emerging Infectious Diseases		
		Sixth Elective (Select any One)	Microbiology Laboratory Course -IIIA	M. Sc. –II Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
			Microbiology Laboratory Course -IIIB		
	SEM-IV	Core	Industrial Microbiology	M. Sc. –III Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Core	Fermentation Technology	M. Sc. –III Semester (Microbiology)	M. Sc. (Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology)
		Seventh Elective (Select any One)	Seminar & Interactive Course	M. Sc. –III Semester (Microbiology)	
			Review and Assignment		
		Research Project/ Dissertation	Major Research Project work/Dissertation	M. Sc. –III Semester (Microbiology)	

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: I
Subject: Microbiology		
Course Code: B080701T	**Course Title: General Microbiology**	

Course Objectives:

The purpose of this course is to give students the knowledge about the different fields of microbiology, its history and the contribution of different pioneers. Students will also gain knowledge about the scope of Microbiology, different types of microorganisms and their significance and about the different techniques used in microbiology. Also, the objective is to give students the knowledge about the different cell organelles of microorganisms and their detailed functions. Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology. Students will also learn about viruses and bacterial gene transfer methods.

Course outcomes:

After completion of this course, a student will be able to:

CO1: Acquire the knowledge about the contribution of various pioneers/ investigators in the field of Microbiology.

CO2: Know general bacteriology and microbial techniques for the isolation of pure cultures of bacteria. Students will also gain knowledge on various aseptic techniques and its importance in the field of microbiology and handling safely.

CO3: Understand the basic microbial structure and function and will study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of protists, eubacteria and archaebacteria.

CO4: Gain knowledge on various culture media and their applications and will also understand the various physical and chemical means of sterilization.

CO5: Gain knowledge on the general properties and structure of different plant and animal viruses, mutation and bacterial gene transfer.

Credits: 5	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks: 40

2Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	**History, development, and scope of microbiology:** Doctrine of spontaneous generation; controversy over a spontaneous generation: contribution of Antony of Leevenhok, Lazzaro Spallanzani, John Tyndall, Lois pasture, Joseph Lister, Iwanowski, Robert Koch in the development of microbiology. microbiology in the 20th century.	**12**
II	**Nature of the microbial world:** General features of eukaryotes and prokaryotes. Differentiating features of Protists, Eubacteria, and Archaebacteria.	**12**

Tulika Ranjan Singh

III	**Definition of nutritional groups of bacteria:** Photoautotroph, photohetrotrophs. chemoautotrophs, chemohetrotrophs. microbial growth: Definition, measurement of growth, generation time, Arithmetic growth v/s exponential growth. Growth curve and growth phases. Diauxic growth. Synchronous and continuous cultures. factors affecting growth: temperature; pH, oxygen.	**12**
IV	**Viruses:** General properties and structure. Differences between viruses and cellular organisms. An introduction to mutations: Definition, physical and chemical mutations, physical mutagens (ionizing and non-ionizing radiations), chemical mutagens (base analog, nitrous acid, hydroxyl amines, alkylating agents), Ames's test.	**12**
V	**An introduction to microbial genetics**: concepts of recombination bacteria-transformation, conjugation and transduction.	**12**

Suggested Readings:

1. General Microbiology (1987). Stanier, Ingrahm, Wheelis & Painter, 5th Ed.
2. Microbiology by Pelczar, Reid, & Chan, 4th Ed.
3. Microbiology by Pelczar, Reid, & Chan, Ed.
4. Brocks Biology of Microorganisms by Madigan, Parker & Martinko, 8th Eds.
5. Introduction to Microbiology by Tauro, Kapoor & Yadav.
6. Microorganism and Man by Wyss & Ecklund.
7. Microbes in Action- A Laboratory Manual of Microbiology by Seeley & Van Denmark, 3rd Ed.
8. Experiments in Microbiology, Plant Pathology & Tissue Culture by Aneja, K. R.
9. Microbiology by Prescott, Harley & Klein, 3rd Ed.
10. Fundamentals of Microbiology by Alcamo, Ed.
11. A Text Book of Microbiology (1999) by Dubey & Maheshwari, 1st Ed.
12. Foundations in Microbiology by Talaro & Talaro.
13. Microbiology by Atlas, R. M.
14. Encyclopedia of Microbiology, Vol. I to V.
15. General Microbiology, Vol I & Il by Powar & Daginawala, 2nd Ed.
16. General Microbiology, Shoroth Chrandra Patil & Ramakant Raidu.
17. Handbook of General Microbiology (2014) by Neelam Tyagi 1st Ed.
18. Textbook of Microbiology (2014) by Ananthanarayan & Paniker's 9th Ed.
19. Alcamo's Fundamentals of Microbiology (2013) by Jaffrey C. Pommervitle 10th Ed.
20. Microbiology (1986) by Pelczar, Chan & Krieg 5th Ed.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry/Biochemistry/Microbiology/Biotechnology

Tulika Ranjan Singh

Suggested equivalent online courses: ……
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulina Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: I
Subject: Microbiology		
Course Code: B080702T	**Course Title: Agriculture & Environmental Microbiology**	
Course Objectives:		
To prepare students for contributing towards Bio-Agriculture and Environmental safety by treating toxic pollutants of industries.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Learn about the soil micro flora and various type of geochemical cycle. CO2: Learn about bio-fertilizers and different types of microbial association. CO3: Learn about Air and Microbiology. CO4: Learn about Bioremediation and microbial decomposition of organic matter.		
Credits: 5	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	Soil environment: Distribution, abundance, Common methods of enumeration and maintenance of soil microflora. Effect of pesticides on microbial population. Transformation of carbon, nitrogen and phosphorus. Mineralization and immobilization of nitrogen: ammonification, nitrification, denitrification, nitrogenfixation (symbiotic and non symbiotic) and its significance in agriculture.	**12**
II	Biofertilizers: Their methods of preparation and seed bacterization. Humus formation. Microbiology of composting. Microbial associations: Symbiosis, Synergism, Commensalism, Antagonism, Parasitism, Competition. Host-microbe interaction: rhizosphere, phyllosphere, mycorrhiza, Plant growth promoting rhizobacteria (PGPR), Siderophores in relation to rhizobacteria	**12**
III	Microbiology of air including sampling techniques, role in air pollution and sanitation. Microbiology of water: Distribution and techniques. Algal bloom. Microbiology of water/waste water and treatment systems. Biogas generation.	**12**
IV	Microbial decomposition of organicmatter-cellulose, hemicelluloses and lignin. Degradation of pesticides, Xenobitics and plastics. Biodegradable plastic and biopesticides.	**12**
V	Microbial adaptation to environmental stress. Biomagnification and bioremediation. Genetically engineered microbes in environment. Effect of radiation and Green house effect.	**12**

Tulina Ranjan Singh

Suggested Readings:

1. Agriculture microbiology by Rangaswamy & Bhagyaraj
2. Soil microbiology by N. S. Subba Rao
3. Introduction to Soil Microbiology by Martin Alexander
4. General microbiology by R. Y. Stainnier
5. Text book of Microbiology by R. P. Singh
6. Text book of microbiology by Dubey and Maheshwari

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: I
Subject: Microbiology		
Course Code: B080704T	**Course Title: Instrumentation & Analytical Methods**	

Course Objectives:

To develop understanding about the basic principles, design, construction, working, and experimental know how of analytical techniques used in microbiology laboratory.

Course outcomes:

After completion of this course, a student will be able to:
CO1: Learn basic principles of various microscopic techniques used in study of microorganisms.
CO2: Understand the principles and application of centrifugation, chromatography, radiotracer techniques, etc.
CO3: Understand principles and applications of various electrophoresis techniques used for protein and nucleic acids.
CO4: Perform the biostatistical analysis of the data generated through experiments in microbiology.

Credits: 5	Core Compulsory
Max. Marks: 25+75	**Min. Passing Marks: 40**

Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Microscopy: Principles and applications of light microscopy (bright field, dark field, phase contrast, fluorescence and confocal microscopy) and electron microscopy (scanning and transmission electron microscopy)	**12**
II	Centrifugation: Introduction, principles and application of laboratory centrifuges with reference to differential, density gradient, preparative and analytical ultracentrifuges.	**12**
III	Chromatography: Principles and applications of gel filtration, high-pressure liquid column, ion exchange, affinity, gas liquid chromatography, paper and thin layer chromatography. Autoradiography: Preparation, labeling, detection and measurement of radioactivity.	**12**
IV	Spectrophotometry: Ultra-violet, visible, AAS/AES, fluorometry, polarimetry, circular dichroism, electron spin resonance, nuclear magnetic resonance, mass Spectroscopy, Matrix assisted laser desorption ionization, pH meter, biosensors.	**12**
V	Electrophoresis: Principles and applications of polyacrylamide gel electrophoresis, 2D gel electrophoresis, isoelectric focusing and agarose gel electrophoresis. Biostatistics: Introduction to statistics: Mean, Median, Mode, standard deviation, probability distribution, chi square test, T test and F test.	**12**

Suggested Readings:

1. Principles and Techniques of Practical Biochemistry (2002) by Wilson & Walker 5th Ed.
2. Instrumental Methods of Analysis (1989) by Willard, Merit & Dean 7th Ed.
3. Thin layer Chromatography (1963) by Bobbit.
4. Modem Methods of Chemical Analysis (1976) by Prescok, Sheilds, Crains & Mcwillain 2nd Ed.

Tulina Ranjan Singh

5. Molecular Cloning- A Laboratory Manual, Vol. 1-111 by Manniatis 4th Ed.
6. Methods in Enzymology (2015) by Chuan He.
7. Biochemical Experiments by Bruering, Criddle, Preiss &Rudert.
8. An Introduction to practical Biochemistry (2006) by David T. Plumer 2nd Ed.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: I
Subject: Microbiology		
Course Code: B080704T	**Course Title: Basic Biochemistry**	
Course Objectives:		
Perseverance of better knowledge pertaining to bimolecular structure and function of almost all living cells which is the most fundamental part		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Learn about understanding regarding the structure and properties of water CO2: Learn about the structure and function of Carbohydrate CO3:Learn about structure and function of various Lipid CO4:Learn about components of nucleic acid and their properties		
Credits: 5	**First Elective**	
Max. Marks: 25+75	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	**Water**: Structure physical and chemical properties Handerson Hassel balch equation. Dissociation of water and its ionic products. Dielectric constant. PH and buffers Vander- waals, electrostatic, hydrogen bonding, and hydrophobic- interactions.	**12**
II	**Carbohydrates:** Chemical structure, nomenclature, classification, properties, and biological significance	**12**
III	**Amino acids and proteins:** structure, properties, reaction of amino acids. Proteins Structure: Primary, secondary (Ramachandran plot), tertiary and quaternary structure. Protein designing, Sequencing targeting, protein engineering.	**12**
IV	**Lipids:** Functions and properties of saturated and unsaturated fatty acids. Biomembranes: Membrane structure and composition, membrane channels.	**12**
V	**Nucleic acids:** Components of nucleic acids, structures and properties. Factor affecting structures of nucleic acid (melting curve, hydrophobic interaction, ionic strength).	**12**

Tulina Ranjan Singh

Suggested readings

1. Lehninger, Albert, Cox, Michael M. Nelson, David L. (2017) Lehninger principles of biochemistry, New York: W. H. Freeman.
2. Voet, D., & Voet, J. G. (2011). Biochemistry. NewYork:J. Wiley&Sons
3. Biochemistry – Lubertstryer Freeman International Edition.
4. Biochemistry – Keshav Trehan Wiley Eastern Publications
5. Fundamentals of Bochemistry-J. L. Jain S. Chandand Company
6. Voet & Voet: Biochemistry Vols 1 & 2: Wiley (2004)
7. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
8. Biochemistry and Molecular Biology: Oxford University Press
9. Taiz, L., Zeiger, E.,. Plant Physiology. Sinauer Associates Inc., U. S. A. 5th Edition.
10. Hopkins, W. G., Huner, N. P.,. Introduction to Plant Physiology. John Wiley & Sons,

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: I
Subject: Microbiology		
Course Code: B080705T	**Course Title: Bioinformatics**	
Course Objectives:		
Keeping in view the importance of and bioinformatics in scientific data processing, the course has main objective to provide the students with the significant knowledge of bioinformatics		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Carryout scientific searches on internet CO2: Learn about the databases and their maintenance, data generation and preservation CO3: Perform phylogenetic analysis of the sequence data obtained through laboratory experiments CO4: Learn software used for bioinformatic analysis		
Credits: 5	**First Elective**	
Max. Marks: 25+75	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	Basics of Computer and operating systems, Linux Operating system (text editor, basic commands like directory creation, deletion, permission setting etc. &Python).	**12**
II	Introduction of Bioinformatics, Biological databases: Overview, mode of database search, mode of data storage (flat file format, BD tables) flat file format of gene Bank, EMBL, DDBJ, PDB.	**12**
III	Sequence alignment: Concept of local and global sequence alignment, pair - wise sequence alignment, scoring an alignment, substitution Matrix, multiple sequence alignment.	**12**
IV	Phylogenetic analysis: Basic concept of phylogenetic analysis, rooted / unrooted trees approaches for phylogenetic tree construction, UPGMA neighbourjoining, maximum parsimony, maximum likelihood).	**12**
V	Tools for bioinformatics analysis (genome assemblers, annotation pipeline, comparative genomics, etc.). Open source software (Github, sourceforge, etc.) and its advantages. License agreement of bioinformatics softwares.	**12**

Suggested Readings:

1. Introductory Statistics for Biology (1991) by Parker.
2. Statistical Method (1968) by Snedecor & Cochrain 6th Ed.
3. Introduction to bioinformatics by Arthur M. Lesk
4. Bioinformatics and Functional Genomics, by Jonathan Pevsner

Suggestive digital platforms web links

https://www. ncbi. nlm. nih. gov/

https://www. embl. org/

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Tulika Ranjan Singh

Suggested Continuous Evaluation Methods:
Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology
Suggested equivalent online courses: ……
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: I
Subject: Microbiology		
Course Code: B080706P	**Course Title: Microbiology Laboratory Course –IA**	
Course Objectives:		
To develop trained human resource to carryout experiments in microbiology independently and in group.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory. CO2: Practical skills in the preparation of microbiological media and other chemical/biochemical solutions. CO3: Develop skills for isolation, identification of microorganisms of environmental and agricultural importance and their characterization. CO4:Perform biochemical studies of biomolecules.		
Credits: 5	**Second Elective**	
Max. Marks: 50+50	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
I	• Acquaintance with microbiology laboratory and equipments. • Techniques in Microbiology: Sterilization methods. Isolation of pure cultures. Cultivation of aerobic and anaerobic bacteria. Preservation and maintenance of microbial cultures. • Calibration of micrometer and bacterial size measurements. • Structures and morphological features of yeasts, molds, bacteria, algae, protozoa, and actinomycetes. • Isolation and enumeration of soil and air microflora. • Isolation of free-living nitrogen-fixing bacteria. • Isolation of rhizobia from root nodules. • Isolation of actinomycetes from soil. • Demonstration of Mycorrhiza in plants. • Microbial analysis of water by most probable number (MPM) technique and presumptive, confirmatory and completed tests for coliforms. • Estimation of BOD/COD in wastewater. • Demonstration of NH_3 liberation from nitrogenous organic compound. • Staining techniques of bacteria- simple, negative, Gram and special techniques for staining bacterial endospore and capsule. • Microscopic observation of bacterial motility. • Isolation and identification of fungal endophytes. • Determination of pKa of amino acids. • Qualitative determination of sugars by Benedict's. • Estimation of glucose by Anthrone.	120

Tulika Ranjan Singh

	• Chromatography: paper chromatography (ascending, descending). • Thin layer chromatography. • Column chromatography (gel exclusion, ion exchange), • Demonstration of PAGE, SDS-PAGE, agarose gel electrophoresis.	

Suggested Readings:

1. Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology by K. R. Aneja.
2. Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
3. William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
4. An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
5. Sadasivam "Biochemical Methods"

Suggestive digital platforms web links

This course can't be opted as an elective by the students

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: I
Subject: Microbiology		
Course Code: B080707P	**Course Title: Microbiology Laboratory Course –IB**	
Course Objectives:		
To develop trained human resource to carryout experiments in microbiology independently and in group.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: To understand the instruments, microbial techniques and good lab practices for working in a microbiology laboratory. CO2: Practical skills in the preparation of microbiological media and other chemical/biochemical solutions. CO3: Develop skills for isolation, identification of microorganisms of environmental and agricultural importance and their characterization. CO4: Perform biochemical studies of biomolecules.		
Credits: 5	**Second Elective**	
Max. Marks: 50+50	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
I	• Introduction with microbiology laboratory and equipments. • Media preparation, sterilization, cultivation and preservation oof microbial cultures. • Bacterial size measurements using bright field microscopy. • Structures and morphological features of yeasts, molds, bacteria, algae, protozoa, and actinomycetes. • Enumeration of soil and air microflora. • Cultivation of free-living nitrogen-fixing bacteria. • Isolation of Azospirilum from grass. • Isolation of thermophilic microbes from soil. • Demonstration of Mycorrhiza in plants • Analysis of Microbial Quality of water by most probable number (MPM) technique and presumptive, confirmatory and completed tests for coliforms. • Staining techniques of bacteria- simple, differential and special techniques for staining bacterial endospore and capsule. • Staining of nuclear material of bacteria. • Hanging drop technique for demonstrating bacterial motility. • Isolation and identification of fungi. • Determination of pI of amino acids. • Qualitative determination of sugars by Fehling's test. • Estimation of glucose by Nelson Somogyi method. • Chromatography: paper chromatography descending. • Thin layer chromatography. • Column chromatography ion exchange, affinity.	120

Tulika Ranjan Singh

	• Demonstration of PAGE, SDS-PAGE, agarose gel electrophoresis.	

Suggested Readings:

6. Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology by K. R. Aneja.
7. Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
8. William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
9. An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
10. Sadasivam "Biochemical Methods"

Suggestive digital platforms web links

This course can't be opted as an elective by the students

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: II
Subject: Microbiology		
Course Code: B080801T	**Course Title: Bacterial Physiology**	
Course Objectives:		
Students will learn about the structure and function of prokaryotic cell including type of Extremophiles. The course also includes bacterial transport system, bacterial photosynthesis and nitrogen cycle.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Learn about structure and function of Prokaryotic cells. CO2: Learn about different types of Extremophiles. CO3: Learn about transport system in Bacterial cell. CO4: Learn about Bacterial photosynthesis and Nitrogen cycle		
Credits: 5	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	**Relation between structure and function in prokaryotic cells**: cell wall, cell membrane, capsule, flagella, pili. Tactic movements, storage granules, metabolism of volutin (polyphosphates), glycogen, poly-hydroxyalkanoates. Endospore structure and process of sporulation.	**12**
II	**Physiology of extremophiles:** thermophiles, psychrophiles, osmophiles (halophiles, saccharophiles), acidophiles and alkalophiles. Luminescent bacteria and mechanism of Luminescence.	**12**
III	**Bacterial transport system:** Donnan equilibrium, thermodynamics of transport systems, transport proteins, PEP-PTS system in relation to catabolite repression. Signal transduction and two-component regulatory system	**12**
IV	**Bacterial photosynthesis**: Oxygenic and anoxygenic photosynthesis, photosystems, electron transport system, photophosphorylation, photorespiration	**12**
V	**Nitrogen fixation:** Structure of nitrogenase complex, mechanism of nitrogenase system, Symbiotic nitrogen-fixation, ammonia regulation of nitrogenase, protection of nitrogenase against oxygen, nitrate and ammonia assimilatory enzymes	**12**

Suggested Readings:

1. Brock biology of Microorganisms by M. T. Madigan
2. Pelczar MJ Jr. ; Chan ECS and Kreig NR. ; Microbiology
3. General microbiology by R. Y. Stainnier
4. Text book of Microbiology by R. P. Singh
5. Text book of microbiology by Dubey and Maheshwari
6. Microbial Physiology By Moat and Foster

Suggestive digital platforms web links

Tulina Ranjan Singh

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology
Suggested Continuous Evaluation Methods: Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology
Suggested equivalent online courses: ……
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: II
Subject: Microbiology		
Course Code: B080802T	**Course Title: Biocatalysis, Bioenergetics and Metabolic Pathways**	
Course Objectives:		
Biocatalysis is the use of enzymes in chemical synthesis. Bioenergetics is the flow of energy in a biological system, and describes the conversion of macronutrients (carbohydrates, protein, fat, which all contain chemical energy) into micronutrients (glucose, ATP) that can be used for energy. The energy is harvested from the breakdowns of chemical bonds within the macronutrients.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Learn about enzymes and their Functions CO2: : Learn about laws of Thermodynamics CO3: : Learn about metabolism and regulation of Bio-molecules CO4: : Learn about Biochemical pathways and cycle		
Credits: 5	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	**Enzymes:** Introduction, basic properties, and classification. Kinetics: negative and positive co-operativity, Michalis-Menton equation. Enzyme inhibition, active sites, allosteric enzymes, isozymes, ribozymes, deoxyribozymes, abzymes, and artificial enzymes. Structure and biochemical functions of vitamins, coenzymes, and hormones.	**12**
II	**Biochemical energetics:** laws of thermodynamics; concepts of energy. Oxidation- reduction potential. Hydrolysis of energy-rich intermediates. Photophosphorylation and pigment systems. Respiratory electron transport: components and inhibitors of the electron transport chain, energy transduction and proton-motive force, chemiosmotic theory of ATP generation.	**12**
III	**Catabolism and regulation of carbohydrates:** Glycolysis. Krebs cycle. Pentose phosphate pathway (PPP), gluconeogenesis, glycogenesis, starch synthesis. Hormonal regulation of carbohydrate metabolism.	**12**
IV	Amino acid biosynthesis and degradation, Urea cycle. Biosynthesis of proteins and their regulation. Protein engineering.	**12**
V	**Fatty acid metabolism:** a β-oxidation and biosynthesis of fatty acids. Purine and pyrimidine biosynthesis by de-novo pathway. Catabolism of	**12**

Tulika Ranjan Singh

	nucleotides.	

Suggested Readings:

1. Lehninger, Albert, Cox, Michael M. Nelson, DavidL. (2017) *Lehninger principles of biochemistry /* NewYork:W. H. Freeman.
2. Voet, D., &Voet, J. G. (2011). Biochemistry. New York: J. Wiley & Sons
3. Biochemistry – Lubertstryer Freeman International Edition.
4. Biochemistry – Keshav Trehan Wiley Eastern Publications
5. Fundamentals of Bochemistry-J. L. Jain S. Chandand Company
6. Voet & Voet: Biochemistry Vols 1 & 2: Wiley (2004)
7. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
8. Biochemistry and Molecular Biology: Oxford University Press
9. Taiz, L., Zeiger, E.,. Plant Physiology. Sinauer Associates Inc., U. S. A. 5th Edition.
10. Hopkins, W. G., Huner, N. P.,. Introduction to Plant Physiology. John Wiley & Sons,

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: II
Subject: Microbiology		
Course Code: B080803T	**Course Title: Concepts of Immunology**	

Course Objectives:

To develop understanding about the basics of immunology including Antigens, antibody, hybridoma technology etc.

Course outcomes:

After completion of this course, a student will be able to:

CO1: Understand about the history of cells and organs of the immune systems and immunogenicity toxins and toxoids

CO2:understand structure and function of antibody molecules, hybridoma technology and monoclonal antibodies

CO3: understand about different types of immunity, Major histocompatibility complex and graft rejection

Credits: 5	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40

Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	History of immunology. Cells and organs of the immune system. Active & passive immunity. Antigens, antigenicity & immunogenicity. Adjuvant &haptens. Toxins & Toxoids.	12
II	Structure and function of antibody molecules, generation of antibody diversity, antibody engineering. Hybridoma and monoclonal antibodies.	12
III	Non-specific immunity: role of normal microflora of body, physical & physiological barriers, phagocytosis, inflammation, complement system, interferon. Specific immunity: humoral &cell-mediated immunity.	12
IV	Major histocompatibility complex (MHC) and graft rejection. Antigen processing and presentation. Development of B & T-cells	12
V	Comparative study of Type I-V hypersensitivities with examples. Immunodeficiency diseases- defects of T cells, B cells, complement, phagocytic cells, etc. Immunotherapy & vaccines.	12

Suggested Readings:

1. Virology and Immunology by Jollik el al.
2. Immunology (2012) by Roitt
3. Immunology: An Outline for Students of Medicine and Biology by Weir.
4. Textbook of Immunology (1988) by Barret Ed.
5. Immunology (2006) by Kubey 6th Ed.
6. Textbook of Microbiology & Immunology (2014) by Subhash Chandra Parija 2nd Ed.
7. Review of Medical Microbiology & Immunology (2014) by Warren Levison 13th Ed.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Tulika Ranjan Singh

Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology
Suggested equivalent online courses: **……**
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: II
Subject: Microbiology		
Course Code: B080804T	**Course Title: Environmental Issues**	

Course Objectives:

To develop understanding about the basics of environmental issues.

Course outcomes:

After completion of this course, a student will be able to:
CO1: Understand about the natural resources, conservation of natural resources.
CO2: Understand the concept of biodiversity and importance of biodiversity maintenance.
CO3: Understand about different environmental problems and challenges for the society

Credits: 5	Third Elective
Max. Marks: 25+75	Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Natural and Anthropogenic sources of air pollution, Primary and secondary air pollutants, Photochemical SMOG, FOG, Ozone layer depletion, Effect of air pollution. Water sources, Causes and type of water pollution, Waste water treatment, Water quality parameters and standards, Acid rain, Effect of water pollution.	12
II	Soil: Soil pollution, soil erosion, soil conservation, bioremediation. Solid waste: Source, types, e-waste, solid waste disposal and management.	12
III	Biodiversity: Types of biodiversity, biodiversity Conservation, Causes of biodiversity loss, Value of biodiversity.	12
IV	Global warming and climate change: Greenhouse effect, Causes and its effects, Global warming and climate change, Eucalyptus dilemma Beej bachao andolan, Chipko movement.	12
V	Natural resources: Concept and classification of natural resources, Water crisis, Water conservation, Integrated water resource management.	12

Suggested Readings:

1. **Environmental chemistry by A. K. De**
2. **Environmental Chemistry by S. S. Dara**

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Tulika Ranjan Singh

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology
Suggested equivalent online courses: **……**
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: II
Subject: Microbiology		
Course Code: B080805T	**Course Title: Food Microbiology**	
Course Objectives:		
This course focuses about microbiology of food and its spoilage. It also high lights about different type of fermented foods and SCP including Mushrooms.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Understand about microbial product ion of different acids and antibiotics CO2: Understand about deterioration of industrial products CO3: Understand about fermented foods CO4: Understand about food safety		
Credits: 5	**Third Elective**	
Max. Marks: 25+75	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	Introduction to food microbiology: history and development. Type of food based on perishability & nutritional status. Cereal, pulses, fruit, meat, vegetable, egg, sea food etc. general microorganisms found in the food like Bacteria, fungi, yeast etc.	**12**
II	Microbial specificity to food: spoiling, intoxicating, and disease causing. Intrinsic and extrinsic factors affecting the growth of microorganisms. Food fermentation & their products: therapeutics use of fermented food. Microbiology of processed food	**12**
III	Antimicrobial constituents of food: milk, meat, vegetables & fruits. Lactose Peroxidise system, role of citrate, Lysozyme, H2O2 and other constituents. Microbial indicators of various food. Microbiology of meat, milk, fruit, vegetable. Microbes as food and feed.	**12**
IV	Food preservation: physical, chemical and biological approaches for various food. Microbiology and Biochemistry of canned food, procedure and specification of canning. Role of pasteurization, Tyndallization and Appertization in food microbiology. Integrated approach of preservation of various foods.	**12**
V	Enumeration and detection approach of microorganisms of food: culture and plate count, direct microscopic count, Most Probable Numbers (MPN) test, Dye reduction, Roll tube. Food legislation: recovery/ Repair microorganism. Chemical methods of detection. National and International agencies of food specification, Hazards Analysis Critical Control Points (HACCP), Food Safety (FSO).	**12**

Suggested Readings:

1. Modern Food Microbiology by James
2. Dairy Microbiology by Robinson
3. Food Microbiology by Willaim Frazier
4. Food Microbiology by Adams
5. Food Microbiology by Montville and Mathews

Tulina Ranjan Singh

Suggestive digital platforms web links
This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology
Suggested Continuous Evaluation Methods: Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology
Suggested equivalent online courses: **……**
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: II
Subject: Microbiology		
Course Code: B080806P	**Course Title: Microbiology Laboratory Course –IIA**	
Course Objectives:		
Training of the students on biochemical characterization, identification, physiological features of microorganisms, and immunodiagnostic tests.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Carryout biochemistry experiments. CO2: Characterize microorganisms and identify them, biochemically. CO3: Understand the physiological activities of microorganisms CO4: Perform immunological characterization of microorganisms, viz. bacteria, viruses, etc.		
Credits: 5	**Fourth Elective**	
Max. Marks: 50+50	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
I	• Identification of the product of metabolic pathways in bacterial culture (s) - peroxidase activities, IMViC test, gelatin and starch hydrolysis, H_2S production and cellulose degradation. • To evaluate the acid and gas production from carbohydrate by the Durham's tubes method. • To determine the catalase and oxidase activity by the isolated bacterial culture. • Estimation of nitrate reductase. • Isolation of anaerobic *Clostridium* from the given soil sample. • To study the bacterial growth curve by spectrophotometer. • Microbial examination of reserve materials. • To study the effect of temperature and pH on the bacterial growth. • Study of enzyme kinetics. • Estimation of polysaccharides- starch and glycogen. • Estimation of proteins by Lowry method. • To isolate amylolytic bacteria and quantitative estimation of amylase enzyme. • Measurement of saponification value of lipids. • Serological test: blood groups, Widal, VDRL, pregnancy test. • Demonstration of ELISA, Immuno-diffusion, Immuno-electrophoresis techniques.	**120**

Suggested Readings:

1. Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology by K. R. Aneja.
2. Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
3. William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
4. An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition

Tulina Ranjan Singh

5. Sadasivam "Biochemical Methods" **Suggestive digital platforms web links**
This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology
Suggested Continuous Evaluation Methods: Total Marks: 25 House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks
Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology
Suggested equivalent online courses: **……**
Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: II
Subject: Microbiology		
Course Code: B080807P	**Course Title: Microbiology Laboratory Course –IIB**	
Course Objectives:		
Training of the students on biochemical characterization, identification, physiological features of microorganisms, and immunodiagnostic tests.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Carryout biochemistry experiments. CO2: Characterize microorganisms and identify them, biochemically. CO3: Understand the physiological activities of microorganisms CO4: Perform immunological characterization of microorganisms, viz. bacteria, viruses, etc.		
Credits: 5	**Fourth Elective**	
Max. Marks: 50+50	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
I	• Identification of the product of metabolic pathways in isolated bacterial culture- catalase test, peroxidase activities, IMViC test, gelatin and starch hydrolysis and cellulose degradation. • To perform the carbohydrate catabolism (oxidation/fermentation of glucose) by microorganisms. • To demonstrate the H_2S production test by the given bacterial culture. • To determine the oxidase activity in the given bacterial culture • Estimation of thermal death point (TDP) and thermal death time (TDT) of microorganisms. • Estimation of nitrate reductase. • To study the bacterial diauxic growth curve. • Isolation of anaerobic bacteria from the cow dung sample. s • Effect of oxygen and NaCl concentration on bacterial growth. • Study of enzyme kinetics. • Estimation of polysaccharides- cellulose and glycogen. • Estimation of proteins by Biuret methods. • Estimation of carbohydrate by the anthrone method. • To isolate proteolytic bacteria and quantitative estimation of protease enzyme. • Estimation of cholesterol from blood sample. • Serological test: blood groups, Widal, VDRL, pregnancy test. • Demonstration of ELISA, Immuno-diffusion, Immuno-electrophoresis techniques	**120**

Suggested Readings:

6. Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology by K. R. Aneja.
7. Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of

Tulina Ranjan Singh

Practical Biochemistry"
8. William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
9. An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
10. Sadasivam "Biochemical Methods"

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:
……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: III
Subject: Microbiology		
Course Code: B080901T	**Course Title: Molecular Biology & Bacterial Genetics**	

Course Objectives:

The purpose of this course is to give students the knowledge about the advanced concepts in molecular biology. Student will gain an understanding of molecular mechanisms of DNA replication, transcription, translation, genetic code and gene regulation in prokaryotic organisms. Also, the objective is to give students the knowledge about gene, gene regulation, gene expression, operon system, global regulatory network, genomics, transcriptomics, proteomics and bacterial recombination. The students will study about the techniques and mechanisms of mutations, mode of action of mutagens DNA damage and repair.

Course outcomes:

After completion of this course, a student will be able to:

CO1: Acquire the knowledge of the structure of DNA and RNA, nucleic acids as genetic material, repetitive and superhelical DNA.

CO2: Learn about the mechanisms of bacterial DNA replication, transcription and translation. DNA repair, transcription, gene regulation and gene expression.

CO3: Have concept on genetic code, tRNA processing, fine structure analysis of gene, genomics, transcriptomics, and proteomics.

CO4: Gain knowledge on DNA damage and repair, mutagens, mutations, operon systems and DNA transfer methods.

Credits: 5	Core Compulsory
Max. Marks: 25+75	**Min. Passing Marks:40**

Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Physical and chemical structure of nucleic acids, Forms of DNA helix, Nucleic acids as genetic material, Genome organization, chromatin structure, coding and non-coding sequences, satellite DNA. Repetitive DNA, circular and superhelical DNA, Linking number.	**12**
II	DNA denaturation and renaturation, C-value paradox, Cot analysis, Structural variations in DNA. DNA replication**:** General principles, types, and properties of DNA polymerase, DNA replication mechanism. Discontinuous replication, Catenation and decatenation. Replication of circular DNA.	**12**
III	**Gene transcription:** Types and role of RNA polymerases in transcription, Promoters. General principle and mechanism of transcription. tRNA processing. Reverse transcriptase. General principle and mechanism of translation, Inhibitors of protein synthesis. Post-translational modifications. Central dogma, Concepts and properties of genetic code.	**12**
IV	Fine structural analysis of gene: Cistron, recon, muton. Genomics, transcriptomics, and proteomics. Mutation: Types of mutation, spontaneous and induced mutation. Physical, chemical and biological mutagens, mutant detection, mutant reversion, Ames test. Types of DNA damage, DNA repair.	**12**

Tulika Ranjan Singh

V	Restriction and modification. Regulation of gene expression: positive and negative control, induction, repression. Operon concepts: *lac, ara,* and *trp* - operons. Properties, types and replication of plasmids, cryptic plasmid, Plasmid incompatibility. Bacterial recombination: transformation, conjugation, and transduction.	**12**

Suggested Readings:

1. Experiments technique in Bacterial Genetics (1990) by Stanley R. Malyor 1st edition.

2. Molecular Biology (1987) by David Freifelder 2nd edition.

3. Genes V, VI, VII, VIII by Lewin.

4. Genetics (1985) by Strickberger 3rd edition.

5. Bacterial and Bacteriophage genetics (2000) by Birge 4th edition.

6. Molecular Biology of the Gene (2008) by Watson *et al* 5th edition.

7. Molecular cloning: A Laboratory Manual by Maniatis *et al* (1982).

8. Biochemistry of Nucleic acids (1977) by Davidson 8th edition.

9. Principles of Gene Manipulation (1994) by Old & Primrose, 5th edition.

10. Molecular Biotechnology: Principles and Application of Recombinant DNA (2010) by Glick & Pasternack, 4th edition.

11. Molecular Biotechnology by Glasier and Nicardo.

12. Molecular Genetics of bacteria (2012) by Larry Snynder 4th edition.

13. Gene Cloning by T. A. Brown

14. Principles of Genetics by Gardner *et al*. 8th edition.

Suggestive digital platforms web links

1. https://ocw. mit. edu/courses/find-by-topic/#cat=science&subcat_+biology&spec+genetics

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: III
Subject: Microbiology		
Course Code: B080902T	**Course Title: Medical Microbiology**	
Course Objectives:		
To develop understanding about microbial pathogenesis, general characteristics and diseases caused by various microorganism.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: understand about pathogenicity, epidemiology, prophylaxis of important microorganisms. CO2: understand about diseases caused by different viruses, fungus and protozoa's. CO3: understand about basics of chemotherapy		
Credits: 5	**Core Compulsory**	
Max. Marks: 25+75	**Min. Passing Marks: 40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	History of medical microbiology. Normal microflora of human body. Medically important microorganisms with respect to history, pathogenicity, epidemiology, prophylaxis, treatment- *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Clostridium, Enterobacteriaceae, Pseudomonas, Yersinia, Haemophilus, Mycobacterium, Spirochaete, Rickettsia,* and*Chlamydiae*.	**12**
II	General characteristics and diseases caused by adeno-, pox-, influenza-, herpes-, rhabdo, hepatitis-, polio-, rabies-, HIV-, MMR, and oncogenic viruses.	**12**
III	**Pathogenic fungal diseases**: (i) Dermatophytes- *Trichophyton, Microsporum*, *Epidermophyton*. (ii) Filamentous fungi causing subcutaneous infection- *Phialophoru. Madurella, Sporotrichum, Mucor, Rhizopus, Aspergillus*. (iii) Systemic mycoses- *Histoplasma, Blastomyces*. (iv) yeast-like fungi- *Cryptococci, Candida*.	**12**
IV	**Diseases caused by protozoa:** *Plasmodium, Leishmania,* Entamoebiasis. Use of animals as experimental models.	**12**
V	**Principles of chemotherapy:** Role of antimicrobial agents-synthetic compounds and antibiotics, their mechanism of action, drug resistance in bacteria, drug sensitivity test.	**12**

Suggested Readings:

1. Textbook of Microbiology by Ananthanarayan & Paniker, 9th Ed.
2. Medical Microbiology (2008) by Cruickshank, Vol I & Il 12th Ed.
3. Medical Microbiology (2013) by Murray Ed.
4. Microbiology in Clinical Practice (1998) by Shanson 3rd Ed.
5. General Virology (1978) by Luria & Damell 3rd Ed.
6. Virology and Immunology by Jollik el al.

Tulina Ranjan Singh

7. Jawetz, Melnick, &Adelberg's Medical Microbiology (2012). Brooks, Carroll, Butel& Morse 26th Ed.
8. Microbiology with Disease by Taxonomy by Robert W. Bauman
9. Medical Microbiology (2012) by David Greenwood 18th Ed.
10. Medical Microbiology (2006) by B. S. Nagoba & Asha Pichare 2nd Ed.
11. Medical Microbiology (2010) by Ryan and Ray 5th Ed.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:
……

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: III
Subject: Microbiology		
Course Code: B080903T	Course Title: Evolution & Microbial Taxonomy	

Course Objectives:

Evolution is a unifying theme in biology. It explains changes in organisms over long periods of time. This includes adaptation, which allows life forms to acquire new characteristics in response to their environment through the process of natural selection. Without this evolutionary interdependence, life as it exists would not be possible. Darwin postulated that crossbreeding strategy occurs naturally and produces evolutionary changes in species. Modern scientific methods can also manipulate DNA.

Course outcomes:

After completion of this course, a student will be able to:

CO1: Understand classification of different type of microorganism

CO2: Understand biochemical methods including rDNA analysis, RFLP, RAPD and other fingerprinting techniques

CO3: Understand Molecular evolution & their mechanisms

CO4:Understand Lamarck Darwin- concepts of variation, adaptation, natural selection, Mendelism

Credits: 5	Core Compulsory
Max. Marks: 25+75	Min. Passing Marks:40
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0	

Unit	Topics	No. of Lectures
I	Classification of Bacteria, Actinomycetes, Cyanobacteria, Mollicutes, Rickettsia, Chlamydia, Fungi, and Slime molds. Classification and Phylogeny of Bacteria: Poly- phasic approaches of bacterial Taxonomy, Numerical taxonomy, 16s RNA analysis, etc. Significance and potential applications of various groups of bacteria according to Bergey's Manual of Systematic Bacteriology.	12
II	Implications of molecular and biochemical methods including rDNA analysis, RFLP, RAPD and other fingerprinting techniques, fatty acids, polysaccharides and lipids, and the role of secondary metabolites in systematics.	12
III	**The emergence of Evolutionary thoughts:** Lamarck Darwin- concepts of variation, adaptation, natural selection, Mendelism	12
IV	**Origin of cells and unicellular evolution**: Origin of basic biomolecules, Abiotic synthesis of organic monomers; Concepts of Oparin and Haldane; Experiments of Miller (1953) ; The first Cell, Evolution of prokaryotic and eukaryotic cell.	12
V	**Molecular evolution & their mechanisms**: Population genetics, Concepts and rate of change in gene frequency through natural selection, random genetic drift. Adaptive radiation, Speciation, Convergent evolution.	12

Tulika Ranjan Singh

Suggested Readings:

1. Fundamentals of Molecular Evolution by Dan Graur
2. Biology of Evolution and Systematics By Dr. Paul Sanghera
3. Molecular Biology, Genetics, Taxonomy & Biostatistics By Dr. Sanjib Ghoshal
4. An introduction to Molecular Evolution and Phylogenetcs by Lindell Bromham

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: III
Subject: Microbiology		
Course Code: B080904T	**Course Title: Industrial Microbiology**	
Course Objectives:		
This course focuses about industrial microbiology, fermentation technology, type of fermented foods and SCP including Mushrooms.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: learn about the bioprocess technology, basic concepts and operational requirements CO2: Understand about commercial scale production of microbial metabolites CO3: Understand about fermented foods CO4: Understand about role of microbial enzymes in leaching and environmental processes		
Credits: 5	**Fifth Elective**	
Max. Marks: 25+75	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	**Bioprocess Technology:** Bioprocess Technology: Principles and components, Industrial quality of microorganisms and substrates. Microorganisms diversity and selection procedures: scaling-up, online monitoring and use of computers in Bioprocess Technology.	**12**
II	Types of Fermentation Process: Solid and Submerged fermentation. Batch, fed batch, continuous fermentation process. Microbial and fermentation kinetics of a fermentation process: Biomass production substrate utilization rate and metabolite production. Bioreactor/ Fermenter System: Types, Architecture and Design.	**12**
III	Microbial deterioration of industrial products (leather, cotton, paint, wood, etc.) and their control. Fermentation of tea, coffee, cocoa, and tobacco. Microbes as food and feed: mushroom, single-cell protein (substrate, organisms, advantages, disadvantages, and economic aspects of SCP), spoilage microbiology	**12**
IV	Microbial transformation of antibiotics and steroids. Microbial leaching of metal ores and desulfurization of coal. Immobilization of microbial cells/enzymes and their uses in various processes.	**12**
V	Microbial production of ethanol, organic acids- citric and lactic acid; amino acids - glutaric acid, lysine; enzymes- amylases, proteases, and lipases; vitamins- riboflavin; antibiotics (natural and synthetic) - penicillin, methicillin, streptomycin, bacitracin, tetracycline; hormones; vinegar, wine, beer, and polysaccharides.	**12**

Suggested Readings:

1. Industrial Microbiology by Waites, Morgan
2. Industrial Microbiology by Caseda
3. Industrial Microbiology by H. A. Patel

Tulina Ranjan Singh

4. Industrial Microbiology by K. G. Anitha
5. Industrial Microbiology by Singh
6. Pelczar MJ Jr. ; Chan ECS and Kreig NR. ; Microbiology
7. General microbiology by R. Y. Stainnier

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: III
Subject: Microbiology		
Course Code: B080905T	**Course Title: Emerging Infectious Diseases**	

Course Objectives:

To develop knowledge and understanding about emerging microbial pathogens and the diseases caused by them.

Course outcomes:

After completion of this course, a student will be able to:
CO1: learn about the emerging infectious diseases
CO2: learn to manage the situations of epidemic or pandemic
CO3: Create/determine action plans (identification of appropriate steps) to address complex infectious disease science and policy challenges facing the world, including the "war on science"

Credits: 5	Fifth Elective
Max. Marks: 25+75	**Min. Passing Marks:40**

Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Introduction to emerging infectious diseases (EID) ; science policy for infectious emerging and reemerging diseases; pathogens of epidemic and pandemic importance; Geographical regions important for emerging infectious diseases	**12**
II	Strategic plans to manage the infectious diseases; vaccines of importance for the prevention of infectious diseases and future infections; Biowarfare/ Bioterrorism; responsibilities of international organizations to restrict the emerging infectious diseases	**12**
III	Important pathogens of critical importance: Ebola, Zica, MERS-CoV, SARS-COV, SARS-CoV2	**12**
IV	Political and geographical challenges for the prevention of EIDs; Historical management and control of previous infectious diseases (Polio, Small pox), vector borne infectious diseases, with intervention of the governmental bodies	**12**
V	Role of media in emerging infectious diseases; The role of policy makers in management of EID	**12**

Suggested Readings:

1. Textbook of Microbiology by Ananthanarayan & Paniker, 9th Ed.
2. Medical Microbiology (2008) by Cruickshank, Vol I & Il 12th Ed.
3. Medical Microbiology (2013) by Murray Ed.
4. Microbiology in Clinical Practice (1998) by Shanson 3rd Ed.
5. General Virology (1978) by Luria & Damell 3rd Ed.
6. Virology and Immunology by Jollik el al.
7. Jawetz, Melnick, & Adelberg's Medical Microbiology (2012). Brooks, Carroll, Butel& Morse 26th Ed.
8. Microbiology with Disease by Taxonomy by Robert W. Bauman

Tulina Ranjan Singh

9. Medical Microbiology (2012) by David Greenwood 18th Ed.
10. Medical Microbiology (2006) by B. S. Nagoba& Asha Pichare 2nd Ed.
11. Medical Microbiology (2010) by Ryan and Ray 5th Ed.

Suggestive digital platforms web links

https://wwwnc. cdc. gov/eid/

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: III
Subject: Microbiology		
Course Code: B080906P	**Course Title: Microbiology Laboratory Course-IIIA**	
Course Objectives:		
Training of the students in molecular biology techniques, viz., isolation, characterization of macromolecules, characterization of microorganisms of medical importance, and industrially important microorganisms.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Carryout molecular biology experiments. CO2: Characterize microorganisms of infectious diseases and identify them. CO3: Isolate, identify and perform experiments on industrially important microorganisms. CO4: Isolate, purify and characterize industrially important enzymes.		
Credits: 5	**Sixth Elective**	
Max. Marks: 50+50	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
	• Isolation and characterization of DNA from the bacterial cell. • To perform plasmid curing studies in the given bacterial cell. • Production of auxotrophic mutants by UV irradiation. • To detect the mutant bacteria by the replica plating method. • Cloning of specific gene from bacteria Using PCR. • Isolation and characterization of bacterial proteins from the given bacteria by the SDS-PAGE method. • To determine the MIC of different antibiotics. • To determine the heavy metal tolerance in bacteria. • To demonstrate the genetic recombination in bacteria. • Isolation and identification of pathogenic microorganisms from: stool, urine, pus, mouth and their antibiotic sensitivity test. • TSIA (Triple Sugar Iron Agar) test for identification of enteric pathogen. • To examine the microbial flora of dental crevices & to check the susceptibility of dental caries. • Demonstration of staining technique for tuberculosis bacteria. • Isolation of cellulose degrading microorganisms. • Isolation of microorganisms from spoiled food and milk products. • Microscopic enumeration of bacteria from the raw and pasteurized milk. • MBRT test for milk. • Preparation of yoghurt. • Enumeration of microorganism from decaying material of commercial value. • Production of alcohol from molasses.	**120**

Tulika Ranjan Singh

Suggested Readings:

1. Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology by K. R. Aneja.
2. Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
3. William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
4. An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
5. Sadasivam "Biochemical Methods"

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: III
Subject: Microbiology		
Course Code: B080907P	**Course Title: Microbiology Laboratory Course-IIIB**	
Course Objectives:		
Training of the students in molecular biology techniques, viz., isolation, characterization of macromolecules, characterization of microorganisms of medical importance, and industrially important microorganisms.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Carryout molecular biology experiments. CO2: Characterize microorganisms of infectious diseases and identify them. CO3: Isolate, identify and perform experiments on industrially important microorganisms. CO4: Isolate, purify and characterize industrially important enzymes.		
Credits: 5	**Sixth Elective**	
Max. Marks: 50+50	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
	• Isolation and characterization of plasmid DNA from the bacterial cell. • To perform plasmid curing studies in the given bacterial cell. • Isolation of nutritional mutants (auxotrophs) of bacteria. • To determine the lethal effects of UV rays on microorganisms. • PCR amplification of gene from target species. • Isolation and separation of microbial proteins by the SDS-PAGE method. • To evaluate the multi drug resistance in provided bacterial culture. • To determine the MIC of various heavy metals in bacteria. • Sampling of biological specimen for isolation of clinically important microorganisms from lesions/stool/ pus/ urine/ mouth/ nasal passage and their antibiotic sensitivity test. • Examination of dental carries/surfaces for microbial flora. • Acid fast and acid alcohol fast staining for tuberculosis bacillus. • Isolation of cellulose decomposing microorganism. • Isolation and identification of microorganisms from spoiled food, milk/milk products. • Microscopic examination of milk for detection of bacteria. • Preparation of sour-krat. • Platform tests of milk- MBR test, Resazurine reduction test. • Isolation and enumeration of microorganisms from decaying materials of commercial value. • Production of alcohol from molasses and determination of fermentation efficiency. • Screening, isolation and identification of industrially important microorganisms producing important enzymes- amylase, cellulase, protease.	**120**
Suggested Readings:		

Tulina Ranjan Singh

6. Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology by K. R. Aneja.
7. Keith Wilson, John Walker, John Walker, John M. Walker "Principles and Techniques of Practical Biochemistry"
8. William M, O'Leary Robert, Dony Wu "Practical Handbook of Microbiology"
9. An Introduction to Practical Biochemistry, David T. Plummer (2006) Tata McGraw Hill Education, 3rd edition
10. Sadasivam "Biochemical Methods"

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:
……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: IV
Subject: Microbiology		
Course Code: B081001T	**Course Title: Modern Microbial Technology**	

Course Objectives:

The objective of this course is to make the student familiar with the currently used techniques to manipulate/ analyze DNA, RNA and proteins. The student will be made familiar with the methods used to clone genes, make and screen libraries, and the various applications of the polymerase chain reaction. The student will be made familiar with how recombinant DNA technology has been exploited in the study of biology as well as in the production of pharmaceutical products, enzymes, vaccines and monoclonal antibodies. The students will also be able to describe the roles of modern microbial technology in the improvement of plant variety and bioremediation.

Course outcomes:

After completion of this course, a student will be able to:

CO1: Will be familiar with the use of various cloning vectors, and methods of DNA, RNA and protein analysis.

CO2: Will be able to describe the various applications of PCR, and know how to make and screen genomic and cDNA libraries.

CO3: Will be able to understand the methods by which DNA is sequenced and will gain insights into how entire genomes of organisms are sequenced.

CO4: Develop understanding abouthow recombinant DNA technology can be exploited for the production of commercial products of human benefit, in bioremediation and improvement of plant variety.

Credits: 5	Core Compulsory
Max. Marks: 25+75	**Min. Passing Marks: 40**

Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0

Unit	Topics	No. of Lectures
I	Introduction to modern microbial technology. Restriction endonucleases, plasmid vectors (natural and artificial), binary vectors, shuttle vectors. Bacteriophage lambda vectors, cosmid & plasmid vectors, yeast vectors. DNA ligase and ligation. Isolation and purification of DNA.	**12**
II	In-vitro synthesis of DNA. Genome sequencing. PCR: Concept of PCR, types of PCR and their applications. Thermostable enzymes- Taq and Pfu. Blotting techniques- Northern. Southern and Western blotting. Dot and slot blot techniques. Restriction fragment length polymorphism (RFLP) and its application.	**12**
III	DNA microarray, Strain Improvement, Cloning and screening strategies, cloning in gram-positive and gram-negative bacteria. Synthesis of commercial products using microbial systems- proteins: insulin, interferon and growth hormone, restriction endonucleases, L-ascorbic acid (vitamin C).	**12**
IV	Synthesis of microbial enzymes - lipase, acid protease, and alkaline proteases using modern microbial technology. Production of vaccines and therapeutic	**12**

Tulina Ranjan Singh

	agents- Peptide vaccines, live recombinant vaccines. Attenuated vaccines. Monoclonal antibodies as therapeutic agents. Therapeutic agents against HIV.	
V	Bioremediation- Genetic engineering of biodegradative pathways. PGPR- genetic engineering of nodulation genes, nitrogenase, hydrogenase, Siderophores, and gene clusters. Microbial insecticides- *Bacillus thuringiensis* and its genetic engineering. Use of *Agrobacterium tumefaciens* in transgenic plants.	**12**

Suggested Readings:

1. Molecular Biology by D. P. Clarke, N. Pazdernik. 2nd edition. Academic Press. 2012.

2. Molecular Cloning: A laboratory manual by J. Sambrook, D. Russell. 4th edition. Cold Spring Harbor Laboratory Press. 2012.

3. DNA Technology: The Awesome Skill by I. Edward Alcamo. Harcourt Academic Press. 2001.

4. Molecular Biology of the Gene by J. Watson, T. Baker, S. Bell, A. Gann, M. Levine, R. Losick. 7th edition. Pearson. 2014.

5. Gene Cloning and DNA Analysis: An Introduction by T. A. Brown. 7th edition. Wiley Black Well Publishers. 2016.

6. Principles of Gene Manipulation (1994) by Old & Primrose, 5th edition.

7. Molecular Biotechnology: Principles and Application of Recombinant DNA (2010) by Glick &Pasternack, 4th edition.

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: First	Semester: IV
Subject: Microbiology		
Course Code: B081002T	**Course Title: Fermentation Technology**	
Course Objectives:		
In this course the students will learn about Fermentation technology including type of fermenters, scaling up and choice of cultivation methods. It also includes operation of fermenters and plant and animal cell culture.		
Course outcomes:		
After completion of this course, a student will be able to: CO1: Understand about fomenters and their operation CO2: Understand about scaling up and product output CO3: Understand about type of fermentation systems		
Credits: 5	**Elective**	
Max. Marks: 25+75	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 4-1-0		

Unit	Topics	No. of Lectures
I	Basic component of a Fermenter: Bench Top, Scale, Industrial Scale. Types of Fermenter: Basic components and Designing a Fermenter.	12
II	Kinetics of Fermentation. Selection and Scale up of a process. Control of bioreactor and online monitoring. Aeration Agitation and heat transfer.	12
III	Bioreactor instrumentation and operation: instrumentation for measurement of active fermentation. Sterilization of fluid, air, gas lines and fermentation devices for continuous culture development from the standard norms.	12
IV	Choice of cultivation method. Modified batch and continuous bioreactor chemo-stat with recycle, multistate chemo state system, Fed batch system, immobilize Microbial cells, bio-films, solid state and solid substrate scaling.	12
V	Choice of cultivation method. Modified batch and continuous bioreactor chemo-stat with recycle, multistate chemo state system, Fed batch system, immobilize Microbial cells, bio-films, solid state and solid substrate scaling.	12
Suggested Readings:		

Tulina Ranjan Singh

8. Industrial Microbiology by Waites, Morgan
9. Industrial Microbiology by Caseda
10. Industrial Microbiology by H. A. Patel
11. Industrial Microbiology by K. G. Anitha
12. Industrial Microbiology by Singh
13. Pelczar MJ Jr. ; Chan ECS and Kreig NR. ; Microbiology
14. General microbiology by R. Y. Stainnier

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:
……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulina Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: IV
Subject: Microbiology		
Course Code: B081003P	**Course Title: Seminar & Interactive Course**	
Course Objectives:		
The students will be able to summarise the existing data related to a specific topic in the form of a presentation.		
Course outcomes:		
After completion of the course, a student will be able to: CO 1: Summarize the literature available on any specific topic. CO 2: Deliver power point presentations on an assigned topic. CO 3: To discus scientific findings		
Credits: 5	**Seventh Elective**	
Max. Marks: 50+50	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-5		

Unit	Topics	No. of Lectures
	The presentation and discussion of researches published in journals of international repute.	**60**

Suggested Readings:

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:

……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: IV
Subject: Microbiology		
Course Code: B081004P	**Course Title: Review & Assignment**	
Course Objectives:		
To make students learn about the compilation of the existing data related to a specific topic in the form of a review.		
Course outcomes:		
After completion of this course, a student will be able to: CO 1: Summarize the recent researches in the field of Microbiology. CO 2: Writing of review article. CO 3: Acquaint with writing of bibliography.		
Credits: 5	**Seventh Elective**	
Max. Marks: 100	**Min. Passing Marks:40**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-5		

Tulina Ranjan Singh

Program/Class: Master in Microbiology	Year: Second	Semester: IV
Subject: Microbiology		
Course Code: B081005P	**Course Title: Major Research Project/ Dissertation**	
Course Objectives:		
The objective of this course is to apprise the student with various techniques used in modern-day research in life sciences specifically in Microbiology.		
Course outcomes:		
After completion of this course, a student will be able to: CO 1: Prepare synopsis of a defined research problem. CO 2: Perform the bench work. CO 3: Prepare the research report and its oral presentations. CO4: Get exposure of vigorous laboratory training which will help students to boost their research carrier.		
Credits: 10	**Research Project/ Dissertation**	
Max. Marks: 100+100	**Min. Passing Marks:80**	
Total No. of Lectures-Tutorials-Practical (in hours per week) : L-T-P: 0-0-10		

Unit	Topics	No. of Lectures
	The research work on any topic chosen by the students to be carried out.	

Suggested Readings:

Suggestive digital platforms web links

This course can be opted as an elective by the students of following subjects: M. Sc. Biochemistry, Biotechnology, Environmental Science, Chemistry, Botany, Zoology

Suggested Continuous Evaluation Methods:

Total Marks: 100
House Examination/Test: 25 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 50 Marks
Class performance/Participation: 25 Marks

Course prerequisites: To study this course, a student must have completed B. Sc. with Botany/ Zoology/ Chemistry / Biochemistry / Microbiology / Biotechnology

Suggested equivalent online courses:
……..

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Tulika Ranjan Singh