ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF BIO SCIENCES

(RSBSC)

DEPARTMENT OF MICROBIOLOGY

Course Structure and Syllabus

Based on National Education Policy -2020

FOR

B.Sc. Microbiology

4 Year Single Major

W.E.F. 2023-24

Programme Structure- NEP

B.Sc. in Microbiology (4 year)

Year	Semester	Component	Course code	Course Title	Level	Total credit in the component
First Year	I	Major (Core)	MIB152M101	Fundamentals of Microbiology	100	3
		Major (Core)	MIB152M111	Practical on Fundamental Microbiology	100	3
		Minor	MIB152N101	Introduction and Scope of Microbiology	100	3
		Interdisciplinary	MIB152K101	Indian Knowledge System-1	100	3
		AEC1-Language	AEC982A101	Communicative English-1	100	2
		Skill Enhancement Elective course (SEC)	MIB152S111	Microbial Quality Control in Water and Food	100	3
		Value Addition Course-1	VAC-1	VAC- (To choose from a pool of courses)	100	3
						20
	II	Major (Core)	MIB152M201	Bacteriology	100	3
		Major (Core)	MIB152M211	Practical on Bacteriology	100	3
		Minor	MIB152N201	Introductory Virology	100	3
		Interdisciplinary	MIB152K201	Indian Knowledge System-2	100	3
		AEC1-Language	AEC-2	Communicative English-2	100	2
		Skill Enhancement	MIB152S211	Fermentation Technology	100	3

		Elective course (SEC)		and Application		
		Value Addition Course-2	VAC-2	VAC- (To choose from a pool ofcourses)	100	3
						20
Second Year	III	Major (Core)	MIB152M301	Biochemistry	200	(3+1) =4
			MIB152M311	Practical on Biochemistry	200	
		Major (Core)	MIB152M302	Cell Biology	200	(3+1) = 4
			MIB152C312	Practical on cell Biology	200	
		Minor	MIB152N301	Plant Pathology and plant-microbe interaction	200	4
		Interdisciplinary	MIB152K301	Indian Knowledge System-3	200	3
		AEC1-Language	AEC982A301	Communicative English	200	2
		Skill Enhancement Elective course (SEC)	MIB152S311	Biofertilizer and Biopesticide	200	3
						20
	IV	Major (Core)	MIB152M401	Immunology	200	4
		Major (Core)	MIB152M402	Microbial Genetics	200	4
		Major (Core)	MIB152M401	Practical on Immunology and Microbial Genetics	200	4
		Minor	MIB152N401	Biosafety and Intellectual property rights	200	3
		Minor	MIB152N402	Microbial Biotechnology	200	3
		AEC1-Language	AEC982401	Communicative English-II	200	2
						20

Year	**Semester**	**Component**	**Course code**	**Courses Title**	**Course Lev**	**Total creditin the**

					el	component
Third Year	V	Major (Core)	MIB152M501	Molecular Biology	300	4
		Major (Core)	MIB152M511	Practical on Molecular Biology	300	4
		Major (Core)	MIB152M502	Phycology Mycology and Virology	300	(3+1)
		Major (Core)	MIB152M512	Practical on Phycology Mycology and Virology	300	
		Minor	MIB152N501	Medical Microbiology	300	4
		Internship			300	4
						20
	VI	Major (Core)	MIB152M601	Genetic engineering	300	4
		Major (Core)	MIB152M602	PharmaceuticalMicrobiology	300	4
		Major (Core)	MIB152M603	Inheritance Biology	300	4
		Major (Core)	MIB152M604	Practical on Genetic engineering and clinical Microbiology	300	4
		Minor	MIB152N601	Food Microbiology	300	4
						20
Four	VII	Major (Core)	MIB152M701	Industrial and food Microbiology	400	4
		Major (Core)	MIB152M702	Environmental and Agricultural Microbiology	400	4
		Major (Core)	MIB152M703	Microbial Physiology & Metabolism	400	4
		Major (Core)	MIB152M704	Practical on Food and Environmental Microbiology	400	4

		Minor	MIB152N701	Environmental Microbiology	400	4
						20
	VIII	Major (Core)	MIB152M801	Research Methodology and Scientific Writing	400	4
		Minor	MIB152N801	Agriculture Microbiology	400	4
		Dissertation/Research Project			400	12
		Advanced Microbiology course to be taken in lieu of Dissertation/ Research Project)	MIB152M802	Microbial enzyme: Current trend in industry and healthcare	400	4
			MIB152M803	Parasitology, Medical and Veterinary Microbiology	400	4
			MIB152M804	Microbiome's role in human and plants health	400	4
						20

SYLLABUS (3rd SEMESTER)

Paper: Biochemistry		**Subject code: MIB152M301**
Course Level: 100	**Credit units: 3**	**L-T-P-C-3-0-0-3**

Course Objective:

This course is designed to generate fundamental concepts among students about different biomolecules present inside biological organisms. The course will develop the foundation for all other courses like microbial physiology and metabolism.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** various biomolecules and interactive forces that are required for the development and functioning of a bacterial cell.	**BT 1**
CO 2	**Understand** the structure, properties, and function of carbohydrates and lipids.	**BT 2**
CO 3	Apply Amino acid-related information to resolve the structure and folding pattern as well as the separation of proteins.	**BT 3**
CO 4	Analyze biocatalytic activity of enzyme kinetics, and calculate Vmax, Km, and Kcat values along with purification of the enzyme.	**BT 4**

Detailed Syllabus:

Modules	**Topic & Course Contents**	**Periods**
I.	Structure of atoms, molecules, and chemical bonds; Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.); Principle of	**12**

	biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).	
II.	Carbohydrate (chemistry) Classification and nomenclature -- Aldoses and Ketoses; optical activity, stereoisomerism, enantiomers, racemic mixture, Dia stereoisomers, epimers, anomers; hemiacetal and hemiketal; optical rotation; polysaccharide (homopolysaccharide, heteropolysaccharide); carbohydrate synthesis (C3, C2, C4 and CAM). Lipid (fat, oil, wax), Fatty acid (saturated and unsaturated fatty acid); Δ- and ω-nomenclature of fatty acid; derived lipid (phospholipid, glycolipid) and types; acid value, saponification value, iodine value.	**18**
III.	Classification, properties, and structure of Amino acids; Conformation of proteins (primary, secondary, tertiary, quaternary structure), domains, motif and folds; Ramachandran plot.	**15**
IV	Principle of catalysis, enzymes and enzyme kinetics, classification of enzyme; enzyme regulation, mechanism of enzyme catalysis; enzyme inhibition; cofactors, coenzyme, prosthetic group; bi-substrate reaction; allosteric enzyme; isozymes, allozyme, ribozyme; enzyme isolation and purification.	**15**
	TOTAL	**60**
Pedagogy: Lectures, Assignments, Seminar		

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
60 Hours	zero	30 (Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip)

Text books:

1. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 8th edition. McGraw Hill Higher Education.
2. Nelson D L, Cox M. M. Lehningers. (2004). Principle of Biochemistry. 4th ed. Freeman and company, New York, USA.
3. Harper, 1999. Biochemistry, McGraw Hill, NewYork

4. Lodish, H.T. Baltimore, A. Berck B.L. Zipursky, P. Mastsydaire and J. Darnell. 2004. Molecular Cell Biology, Scientific American Books, Inc. Newyork

Reference book:

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10:1-4292-3414-8.
2. Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt.Ltd. (New Jersey), ISBN: 978-1180-25024.
3. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 850229 X

Paper: Practicals on Biochemistry		**Subject code: MIB152M311**
Course Level: 100	**Credit units: 1**	**L-T-P-C-0-0-2-1**

Course Objective:

This course is designed to generate fundamental concepts among students about different biomolecules present inside biological organisms. The course will develop a foundation for all other courses like cell biology, microbial physiology, and metabolism.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Reminisce** synthesis of solution and pH from isolates.	**BT 1**
CO 2	**Understand** the basic principles of quantitative biochemical tests.	**BT 2**
CO 3	**Identify the** enzyme production ability of isolated microbes.	**BT 3**
CO 4	**Analyse** protein structures and their functions	**BT 4**

Detailed Syllabus:

Modules	& Course Contents	Periods
I.	Preparation of molar, normal, molal, percentage, and ppm solution, Preparation of buffers solution, Estimation of pH of plant juice, water, and soil sample, Handling of micropipettes and checking their accuracy.	15
II.	Qualitative tests for organic acids (oxalic, citric, tartaric,), carbohydrates (reducing, non-reducing), lipids, and proteins from laboratory samples	15
III.	Estimation of catalase activity, hydrolysis of starch, gelatin liquefaction, hydrolysis of casein,	15
IV	Study of protein secondary and tertiary structures with the help of models. Study of enzyme kinetics – calculation of Vmax, Km, Kcat values	15
	TOTAL	60
Pedagogy: Lectures, Assignments, Seminar		

Credit distribution:

Theory	Practical	Experiential Learning
zero	60 Hours	Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip)

Text books:

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning

2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

Reference book:

1. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.

2. Willey MJ, Sherwood, LM &Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill

3. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons

Paper: Cell Biology		**Subject code:** MIB152M302
Course level-300	**Credit units: 3**	**L-T-P-C-4-0-0-4**

Course Objective:

This course is designed to provide the basic features of living cells, particularly emphasizing more on the prokaryotic cells and detailed information about the cell components along with their role in maintaining the cell's structure and functions.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** the various components of the cell and their function.	**BT 1**
CO 2	**Understand** the function of the cells and their roles.	**BT 2**
CO 3	**Apply** the knowledge gained in solving of problems associated with the topic.	**BT 3**
CO 4	**Analyze** the components of the cellular structure in prokaryotes, eukaryotes and archaea.	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	**Introduction to cell** Cell theory, Structural organization of the prokaryotic cell, eukaryotic cells and their function. Comparative characters of prokaryotes and eukaryotes. Plasma membrane**:** Structural organization of cell membrane, plasma membrane, and their function. Mechanism of transport across the plasma membrane.	**15**

II.	**Cell organelles; structure & function** The endoplasmic reticulum, Golgi complex, lysosome, peroxisome, ribosomes and vacuoles, mitochondria; role of mitochondria in oxidative reactions and electron transport chain. Chloroplast and its role in photosynthesis.	**15**
III.	**Nucleus** Nucleus- Structure, organization and function, Nuclear envelope, role of nuclear pore in transport across the envelope, nucleoplasm and nucleolus, Chromatin structure and organization.	**15**
IV	**Cytoskeleton, Cell cycle & cell division** Microtubule and microfilaments: Intermediate filaments and Extracellular matrix. Cell cycle and its phase, Cell divisions (Mitosis & Meiosis), Apoptosis, Cell cycle control and its association with cancer.	**15**
TOTAL		**60**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
60Hours	zero	**30 Hours-** Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Textbooks:

1. Bruce Albert*set al*. *Molecular Biology of cell*. Garland Publications
2. Daniel. *Molecular Cell Biology*. Sceintific American Books.
3. Jack D. Bruke. *Cell Biology*. The William Twilkins Company.
4. Old and Primrose. *Principles of Gene Manipulations*. Black Well Scientific Publications.
5. Ambrose and Dorouthy M Hasty. *Cell Biology*. ELBS Publications.
6. Sharp. *Fundamentals of Cytology*. McGraw Hill Company.

Reference Books:

1. Wilson and Marrision. *Cytology*. Reinform Publications
2. Smith. *Molecular Biology*. Faber and Faber Publications
3. EDP Roberties and EMF Roberties. *Cell and Molecular Biology*. Sauder College.
4. Gardener EJ, Simmons MJ and Snustad DP. *Principles of Genetics*. John Wiley and Sons Publications.

Paper: Practicals on cell Biology		Subject code: MIB152 M312
L-T-P-C-0-0-8-4	**Credit units: 1**	**Scheme of evaluation: (P)**

Course Objective:

The Cell Biology practical paper aims to provide students with a comprehensive understanding of cellular structures, functions and processes through hands-on experimentation. Students will acquire proficiency in essential laboratory techniques including microscopy, staining, and enabling them to investigate cellular dynamics and interactions.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** different staining techniques.	**BT 1**
CO 2	**Understand** cell division through practicals	**BT 2**
CO 3	**Apply** the knowledge of practical to study microorganisms in surrounding environment	**BT 3**
CO 4	**Analyze** problems associated with microbes' detection and growth in the lab	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	1. Study the phenomenon of plasmolysis and deplasmolysis 2. To study the motility of bacterial cells by hanging drop method, swimming, and twitching motility	**15**

II.	3. Study of different stages of mitosis by temporary preparation/ permanent slides of onion root tips. 4. Study of meiosis in onion bud cell or grasshopper testis by temporary preparation /permanent slides	**15**
III.	5. Isolation of DNA from blood cells. 6. Cytochemical staining of proteins by Bromophenol blue. .	**15**
IV	7. Karyotyping and Ideogram of metaphase plate of human 8.Linear differentiation of human chromosomes through G-banding and C-banding	**15**
TOTAL		**60**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
zero	60	Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Books:

1-De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.

2. Cooper G. M. Hausman R. E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press and Sunderland, Washington D. C.; Sinnauer Academic Press.

3. Becker W. M., Kleinsmith L.J. and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San fransisco.

Paper: Plant Pathology and Plant-microbe Interaction		**Subject code: MIB152N301**
L-T-P-C-4-0-0-4	**Credit units: 4**	**Scheme of evaluation:(T)**

Course Objective:

The course is developed with the following objectives: To enable the students to develop a proper understanding of the interaction taking place among the microorganism along with another organism. This course also includes the microbes present in the soil environment and their impacts on different plants. Furthermore, this course also includes plant pathogens and the social impact of plant diseases.

Course Outcome: On completion of the course the students will be expected to

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** about the plant immune system along with the causation of diseases in plants by different types of microorganisms namely bacterial, fungal and viral	**BT 1**
CO 2	**Understand** plant diseases, their etiology, salient characteristics and control measures.	**BT 2**
CO 3	**Apply** the knowledge to Identify different soil pathogens associated with plant diseases.	**BT 3**
CO 4	**Analyze** the diseased plant samples in the laboratory and are able to identify the salient features of the disease-causing microbe and the lesions produced on the plant parts.	**BT 4**

Detailed Syllabus:

Modules	**Topics / Course content**	**Periods**
I	**Introduction to Plant-Microbial interactions:** Mutualism, synergism, commensalism, competition, parasitism, endophytic association, Symbiotic and non-symbiotic interaction, lichen symbiosis	**15**
II	**Communication among rhizobia:** Insights into Rhizobia-Plant Communication, Rhizosphere; Non – rhizosphere; R : S ratio; Rhizosphere effect; Phyllo sphere effect; Spermosphere effect; Plant growth promoting rhizobacteria; epiphytic and endophytic microbiomes and their significance.	**15**

III	**Microbial Interactions and Plant Health:** Basal Resistance and PAMP-Triggered Immunity (PTI); Pathogen-Induced Resistance and Effector-triggered immunity (ETI); Effectors; Resistance Proteins; Avr/R Protein Interaction	**15**
IV	**Microbesas Plant Pathogens**: Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens. Biocontrol mechanisms and ways, Microorganisms used as biocontrol against plant pathogens and disease.	**15**
Total		**60**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
60Hours	zero	**30 Hours-** Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Textbooks:

1. Agrios GN. (2006). Plant Pathology.5th edition. Academic press, San Diego,

2. Singh RS. (1998). Plant Diseases Management.7th edition.Oxford& IBH, New Delhi.

3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 8th edition. McGraw Hill Higher Education.

4. Pelczar MJ, Chan ECS and Krieg NR. (2010). Microbiology. 8th edition. McGraw Hill Book Company.

Reference books:

1. Singh DP, Singh HB, Prabha R (2017). Plant-Microbe Interactions in Agro-Ecological Perspectives. Vol. 1. Springer.
2. Boland GJ and Kuykendall LD (1998). Plant-microbe Interactions and Biological Control Books in Soils, Plants, and the Environment. CRC Press.

Paper I: Biofertilizers and Biopesticides		**Subject code: MIB152S311**
Course Level-200	**Credit units: 3**	**L-T-P-C: 0-0-6-3**

Course Objective:

This course is designed to provide basic information about the history of microbiological development, Classification of the living system, and basic instruments used for the observation of microbes. Further, this course is also designed to provide information about different culture media used for growing microbes, sterilization techniques, and distribution of microbes in different environments along with their application in industries.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** the contribution made by prominent scientists in this field along with identifying different systems of microorganisms in different kinds of biofertilizers and biopesticides.	**BT 1**
CO 2	**Understand** the basic tools and techniques used for the microorganism growth and application of biofertilizers and biopesticides.	**BT 2**
CO 3	**Apply** the knowledge gained in solving problems associated with the topic such as organic farming and industry.	**BT 3**
CO 4	**Analyze** the components of the cellular structure in prokaryotes, and eukaryotes and its analysis through sophisticated techniques.	**BT 4**

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	**Brief history and development of Biofertilizer and Biopesticide:** History and concept of Biofertilizer and Biopesticides. Definitions, Importance, scope and potential of biofertilizer and biopesticide. classification of biopesticides viz. pathogen, botanical pesticides.	**15**
II.	**Production of Biofertilizer and Biopesticides:** Rhizobia Inoculants, mineral solubilizers, mass production and method of application. Mechanism of phosphate solubilization and phosphate mobilization, K solubilization. Biopesticide: Viral, Bacterial, and Fungal biopesticide, Mode of application, Mass production.	**15**
III.	**Quality Control of Biofertilizer and Biopesticide:** Quality Control, BIS Norms of Biofertilizer and Biopesticide, Environmental impact of Biofertilizer and Biopesticide.	**15**
IV	**Application of Biofertilizer and Biopesticide:** Organic Farming, Different application of Biofertilizer and Biopesticide in Agriculture, Case study of Biofertilizer and Biopesticide.	**15**
TOTAL		**60**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
Zero	60 Hours	**30 Hours-** Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Textbooks:

1. Borkar,S.G. (2015). *Beneficial Microbes as Biofertilizers and its Production Technology* , 1st edition, Woodhead Publisher, India,New Delhi.

2. M T Madigan, and J M Martinko (2014). Biology of Microorganisms 14th Edn. Tata McGrow Hill Education Pvt. Ltd.

References:

1. Pearson.M J Pelczer (1998) Microbiology 5th Edn. Tata McGrow Hill Education Pvt. Ltd.
2. Strainer, R, (1987) General Microbiology. Palgrave Macmillan.Edward Alchano, 2002. Introduction to Microbiology. Jones and Bartlett hearing.
3. R P Singh, (2007) General Microbiology. Kalyani Publishers.
4. J Heritage, E G V Evans, R A Killington, (2008) Introductory Microbiology. Cambridge University press P. date. 6. Pelczar, jr. M.J.E.C.S.Chan and Krieg, N.R. 1996. Microbiology. Mc Graw Hill Publishers,

SYLLABUS (4th SEMESTER)

Paper: Immunology		**Subject code: MIB152M401**
Course Level-200	**Credit units: 4**	**L-T-P-C-3-1-0-4**

Course Objective:

This course is designed to provide knowledge about the immune response in the body along with the basic structure of antigens and antibodies. Further, the syllabus also includes the application of antigens and antibodies in the different serological tests.

Course Outcome: On completion of the course the students will be expected to

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** the basic concepts about the innate and adaptive immune	**BT 1**
CO 2	Understanding of the antigen, antibody structure, and working mechanism of the Immune system.	**BT 2**
CO 3	**Apply** the knowledge of antigen, antibody, RIA, and other techniques in HLA typing and related research	**BT 3**
CO 4	**Analyze** the immune system-related disease and other related issues.	**BT 4**

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	History of immunology, Types of immunity: Innate and Acquired immunity; Cells and Organs of the immune system.	**15**
II.	Antigen – Antigenicity, Immunogenicity, Epitopes, Haptens, Adjuvants; MHC self-antigen – Class and structure. Antibodies- Structure, classes and function, Isotype, Allotype, and Idiotype; Genetic diversity of antibody class, Antigen and antibody interaction, affinity and avidity, cross-reactivity, precipitation, and agglutination reaction; Cytokines.	**15**
III.	Complement system. Allergy and Hypersensitivity – type – I, II, III, and IV their clinical manifestation; Autoimmune disorders, Immunity to the microbes	**15**
IV	Transplantation – Allograft rejection, Graft vs Host rejection, Immunosuppressor drugs. Demonstration of Single Radial Immuno-diffusion, Principle and applications of RIA and ELISA, Tumor immunology.	**15**
TOTAL		**60**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
60Hours	zero	**30 Hours-** Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Text Books:

1. Nelson D L, Cox M. M. Lehningers. (2004). Principle of Biochemistry. 4th ed. Freeman and company, New York, USA.
2. Janis Kuby. (2013). Immunology. 7th Edition, WH Freeman.

Reference Books:

1. Kuby J, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman,2002.
2. Janeway et al., Immunobiology, 4th Edition, Current Biology publications., 1999.
3. Paul, Fundamental of Immunology, 4th edition, Lippencott Raven, 1999.

Paper I: Microbial Genetics		**Subject code:** MIB152M402
Course Level-200	**Credit units: 4**	**L-T-P-C-4-0-0-4**

Course Objective:

The purpose of this course is to introduce the student to the advanced concepts of genetics micro-organisms, The Student will gain an understanding of molecular mechanisms of DNA transfer and mutation in prokaryotes and lower eukaryotes.

Course Outcome: On completion of the course the students will be expected to

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**remember** the core concept of genetic material and its transmission	**BT 1**
CO 2	**Understand** the genome organization in bacteria and the mechanism of DNA transfer	**BT 2**

CO 3	**Apply** the concepts of genetic material transmission, and recombination as a molecular biology tool and explain various levels of gene regulation in prokaryotic system	**BT 3**
CO 4	**Analyze** the process of genetic information flow and its regulation to understand the evolution process and antibiotic resistance development.	**BT 4**

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	Genetic material**,** vertical and horizontal gene transfer**,** Bacterial chromosomes and plasmids, types of plasmid, megaplasmid, organization of the genome in prokaryotes, Mechanisms behind the information flow, central dogma of life.Archaeal genomes and their differences with other prokaryotic and eukaryotic organisms.	**15**
II	Meselson and Stahl experiment, Hershey and Chase experiment, exon and intron isolation of bacterial mutants, Nutritional mutants, prototroph, and auxotroph. Transformation, conjugation, one gene-one enzyme hypothesis.	**15**
III	Mutation, types, rate, cause of mutation, Mutagenic agents, base analogues, Assay of mutagenic agents, Molecular basis of mutation, heavy metal/drug resistance in bacteria, Ames test.	**15**
IV	Genetics of Bacteriophages - General characteristics of the viral genome, T4 virulent Phage- Structure- life cycle. Lambda temperate phage- Structure – Transduction and its types. Lysogenic and Lytic cycle.	**15**
Total		**60**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
60Hours	zero	**30 Hours-** Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Text Books:

1. James D Watson *et al*. (2009). Molecular biology of the gene. 5th Edition, Pearson.
2. Karp, G. (2010);*Cell and Molecular Biology: Concepts and Experiments*, 6th edition, . John Wiley &Sons.Inc.
3. Stanley R Maloy. Microbial Genetics. 5th Edition, Narosa publishing house.

4. Daniel J Fairbanks. Genetics: The Continuity of Life, Wadsworth Publishing, ISBN-10: 0534252796

References:

1. Peter J Russel. Genetics. Pearsons Education India, ISBN-10: 9332571627.
2. William Klug, Michael Cummings, Charlotte A Spencer, Michael A Palladino. Concept of Genetics, 10th edition, Pearsons.

Practicals on Immunology and Microbial Genetics	**Subject code:** MIB152M401	
Course level-200	**Credit units: 4**	**L-T-P-C- 0-0-8-4**

Course Objective:

- The objective of the course is to familiarize the student with basic practical knowledge regarding different tests related to immune cells and their responses

Course Outcome: On completion of the course the students will be expected to

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** the basic concepts of blood grouping and other related tests.	**BT 1**
CO 2	Understanding of the antigen, antibody reaction, and working mechanism of the Immune system..	**BT 2**
CO 3	**Apply** the practical knowledge to confirm blood group and detection of infectious pathogen	**BT 3**
CO 4	**Analyze** the sample to understand the infection and disease.	**BT 4**

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	1: Demonstration of haemagglutination 2: Haemagglutination tests for identification of human blood groups 3: Demonstration of agglutination reaction concerning the Widal test and VDRL test.	**20**
II	5: Demonstration of ODD (Ouchtlerlony Double Diffusion) 6: Demonstration of Antigen-antibody reaction by ELISA.	**20**
III	7: Osmotic fragility of RBC 8: Estimation of Haemoglobin (Hb)	**20**
IV	**9:** Replica plating technique 10- Antibiotic **sensitivity test against Ampicillin and Gentamycin** 11-Genomic DNA Isolation from bacterial cell	**30**
Total		**90**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
zero	90 Hours	Problem-solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Text Books:

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 8th edition. McGraw Hill Higher Education.
6. Janis Kuby. (2013). Immunology. 7th Edition, WH Freeman.

References:

1. Kathleen park Talaro (2017). Foundations in Microbiology. 10th Edition, McGraw Hill. Science

2. White David (2000). Physiology and Biochemistry of Prokaryotes. 2nd ed. Oxford University Press, New York.

Biosafety and Intellectual property rights		**Subject code:** MIB152N401
Course level-200	**Credit units: 3**	**L-T-P-C-3-0-0-3**

Course Objective:

.This curriculum is structured to equip students with the essential principles of research methodologies, facilitating their comprehension and fostering familiarity with phenomena, as well as fostering fresh insights into the research journey. Moreover, it will establish a solid groundwork for subsequent courses on Intellectual Property Rights (IPR) and biosafety

Course Outcome: On completion of the course the students will be expected to

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** the necessary preventive measures, handling of live bacteria.	**BT 1**
CO 2	**Demonstrate** the process how to dispose infectious waste, care of the equipment requiring safety audit.	**BT 2**
CO 3	**Apply** the theoretical knowledge for patent and copyright	**BT 3**
CO 4	**Analyze** the issue in patent filing and other related issue	**BT 4**

Modules	**Topics & Course Contents**	**Periods**
I.	**Biosafety:** Introduction; Biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of the Microorganisms	**15**

II.	**Biosafety Guidelines:** Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture.	**15**
III.	**IPR:** Introduction, Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, World Intellectual Property Rights Organization (WIPO). Geographical indication (GI)	**15**
IV	**Types of patent applications and Agreements**: Ordinary, PCT, Conventional, Divisional and Patent of Addition, GATT, TRIPS Agreements;	**15**
TOTAL		**60**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
60Hours	zero	**30 Hours-** Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Reference Books:

1. Indian Patent Act 1970 Acts & Rules, BAREACT, Universal Law Publishing Co. Pvt. Ltd., 2007

2. Genetic Patent Law & Strategy, 1st Edition, Kankanala C., Manupatra Information Solution Pvt. Ltd., 2007

3. N.S. Gopalakrishnan & T.G. Agitha, (2009) Principles of Intellectual Property Eastern Book Company, Lucknow.

4. Kerly's Law of Trade Marks and Trade Names (14th Edition) Thomson, Sweet & Maxweel.

5.B.L.Wadehra (2000) Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India.

Reference book:

1. Cr, K. (2020). Research methodology methods and techniques.

2. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

3. P. Narayanan (2010) Law of Copyright and Industrial Designs; Eastern law House, Delhi

Paper: Microbial Biotechnology		**Subject code:** MIB152N402
Course level-200	**Credit units: 3**	**L-T-P-C-3-0-0-3**

Course Objective:

This course will provide detailed knowledge about Microbial biotechnology its scope and applications in therapeutics, environment, industries, etc. This course is also designed to build a strong foundation in the area of recombinant microbial production processes in pharmaceutical industries, biofuel production, and bioremediation.

Course Outcome: On completion of the course the students will be expected to

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Remember how microbiology is relevant to technological developments for agriculture and the environment.	**BT 1**
CO 2	Understanding how microbiology is relevant to technology. developments for industries related to food and fermentations	**BT 2**
CO 3	Apply the knowledge on how the developments in recombinant DNA technology is juxtaposed with microbially-based technological developments for agriculture, industry, and the environment.	**BT 3**
CO 4	Analysis of the impact of microorganisms on the environment, industries human therapeutics etc.	**BT 4**

Detailed Syllabus:

Modules	**Topics / Course content**	**Periods**
I	Microbial biotechnology: Scope of Microbial biotechnology and applications in therapeutics, Human health, agriculture environmental issues, and food technology. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes' application in industries.	**15**

II	Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine). Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastic.	**15**
III	Microbial-based transformation of steroids and sterols. Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.	**15**
IV	Bioethanol and bio-diesel production: Commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms' role in bioremediation	**15**
Total		**60**

Credit distribution:		
Theory	**Practical**	**Experiential Learning**
60Hours	zero	**30 Hours**- Problem solving, Presentation, Project, Seminar, Internship, Workshop, Field Trip

Textbooks:

1. Richard H. Baltz. Julian E Davies and Arnold L.DemainManual of Industrial Microbiology and Biotechnology. 3rd edition, ASM Press (2010).
2. Daniel Forciniti. Industrial Bioseperation: Principles and practice. 1st edition edition, Wiley-Blackwell (2008).
3. Reed. G. Prescott and Dunn's Industrial Microbiology. CBS Publishers. (1999).
4. Demain, A. L. Industrial Microbiology and Biotechnology. 2nd Edition. (2001).
5. EL Mansi. E.M.T., FermentationMicrobiologyand Biotechnology. 2ndEdition,CRC Taylor&Francis (2007).
6. Waites,M.J.,Morgan, N.L.,Rockey, J.S.andHigton,G.Industrial M i cr o b i o l o g y : An lntroduction. Blackwell SciencePublishers(2002).
7. Casida LE, Industrial Microbiology, J. Wiley, (1968).
8. James Bailey and David Ollis, Fundamentals of Biochemical Engineering, 2nd edition, McGraw-Hill, (1986).
9. Jayanta Kumar Patra Gitishree Das Han-Seung Shin. Microbial Biotechnology. Springer