M.Sc. Microbiology (CBCS)

effective from Session: 2025-26

Shailendra

Date:_____
Volume No.:_____

Annexure-1

M.Sc. Microbiology

Program Objectives

The aim of this program is to provide a broad overview of microbiology, and thus produce graduates with sufficient knowledge and expertise to apply them in basic biosciences research and teaching.

The program has following specific objectives:

1. To provide an intensive and in-depth knowledge to the students in diverse areas of basic and applied microbiology
2. To impart knowledge and skills necessary to synthesize commercially and therapeutically significant products.
3. To provide bioinformatics skills for biological sequence data mining
4. To train the students to take up wide variety of roles like researchers, scientists, and academicians
5. To provide the students hands on training for the technical review and literature search for designing research problems

Programme Outcome (PO)

PO1: Technical Knowledge: Substantial multidisciplinary knowledge about mathematics, basic sciences, related to specialization for solving various complex scientific problems.

PO2: Development of critical analytical approach in identifying, understanding various problem in the present world, that can be solved with the help of basic scientific knowledge and its applications.

PO3: Ability to contribute towards innovative thinking, scientific approach, and trouble-shooting skills for various problems by utilizing scientific knowledge in accordance with health- environment safety, cultural and social aspects.

PO4: Can independently carry out a complete scientific work process, including the theoretical background, hypotheses generation, collecting and analyzing data as along with the interpretation of results and their presentation

PO5: Critically evaluate appropriate tools and techniques as well as high competency and multidisciplinary experience for obtaining accurate results within limited resources

PO6: Understands the role of Microbiology in society, health related issues, environmental concerns and cultural problems through scientific interventions.

PO7: Assessment of impact specifically on environment and society due to proposed innovation-based solutions and for obtaining sustainable development.

PO8: Should be familiar with the research & professional ethics as well as responsibility taking capability for standard practices.

PO9: has the ability to successfully carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines.

PO10: Empower learner's multiple competencies and adding quality dimension to learner's knowledge for proper documentation, effective report writing and presentations.

PO11: Inculcate managerial skills specifically finance management, team building capacity, individual approach along with existing scientific multidisciplinary knowledge for handling projects and better-quality outcomes

PO12: Aware of recent scientific updates and advanced technologies for quality work and to fulfil the need of the hour throughout life.

Program Specific Outcome (PSO)

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The aim of this program is to prepare students to take up a career in microbiology industry or research. The course curriculum is designed to strengthen the fundamentals in basic subjects and provide hands on practice in all the disciplines of microbiology.

PSO1: Fundamental multidisciplinary knowledge will enable students to design, conduct experiment, analyze and interpret data for investigating problems in microbiology and allied fields.

PSO2: Capability to understand the potentials, and impact of biochemical innovations on environment and their implementation for finding sustainable solution to issues pertaining to environment, health sector, society etc.

PSO3: This course will develop effective communication, managerial and other skills in students to carry out advanced projects and collaborations even across the disciplines.

PSO4: Help to evolve with recent innovations and scientific updates in the technological era in accordance with best scientific temperament, professional and research ethics throughout life.

Post Graduate Diploma in Microbiology

Program Objectives

The aim of this program is to provide a overview of microbiology, and thus produce Post Graduate Diploma with sufficient knowledge and expertise to apply them in basic Microbiology.

The program has following specific objectives:

1. To provide an intensive and in-depth knowledge to the students in diverse areas of basic and applied microbiology
2. To impart knowledge and skills necessary to synthesize commercially and therapeutically significant products.

Programme Outcome (PO)

PO1: Technical Knowledge: Substantial multidisciplinary knowledge about mathematics, basic sciences, related to specialization for solving various complex scientific problems.

PO2: Development of critical analytical approach in identifying, understanding various problem in the present world, that can be solved with the help of basic scientific knowledge and its applications.

PO3: Critically evaluate appropriate tools and techniques as well as high competency and multidisciplinary experience for obtaining accurate results within limited resources

PO4: Understands the role of biochemistry in society, health related issues, environmental concerns and cultural problems through scientific interventions.

Program Specific Outcome (PSO)

The aim of this program is to prepare students to take up a career in microbiology industry or research. The course curriculum is designed to strengthen the fundamentals in basic subjects and provide hands on practice in all the disciplines of microbiology.

PSO1: Fundamental multidisciplinary knowledge will enable students to design, conduct experiment, analyze and interpret data for investigating problems in microbiology and allied fields.

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PSO2: Capability to understand the potentials, and impact of biochemical innovations on environment and their implementation for finding sustainable solution to issues pertaining to environment, health sector, society etc

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M. Sc. Microbiology

Study Evaluation Scheme (Choice Based Credit System)
Effective from the session 2025-26

Annexure II

1-year PG

Curricular Components	PG Programme (one year) for 4-yr UG (Hons. /Hons. With Research)		
	Coursework	**Research thesis/project/Patent**	**Total Credits**
Coursework + Research	20	20	40
Coursework	40	-	40
Research	-	40	40

Note: A 1-year PG in Microbiology is for students who have completed a 4-year Bachelor's programme with Honors or Honors with Research in Biochemistry/Biotechnology/Life Science/ Botany/Zoology/Environmental Science.

2- year PG

Curricular Components		Two-Year PG Programme		
		Coursework	**Research thesis/project/Patent**	**Total Credits**
PG Diploma		42	-	42
1st Year (1st and 2nd Semester)		42		42
Students who exit at the end of 1st year shall be awarded a Post Graduate Diploma in Microbiology				
2nd Year (3rd and 4th Semester)	Coursework + Research	20	20	40
	Coursework	40	-	40
	Research	-	40	40

Note: A 2-year PG in Microbiology is for students who have completed a 3-year bachelor's Programme in Biochemistry/Biotechnology/Life Science/ Botany/Zoology/Environmental Science.

M. Sc. Microbiology

Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

I Year: I Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSM101	General Microbiology	4	0	0	30	70	100	4	Core	Own faculty
2	MSM102	Cell Biology	4	0	0	30	70	100	4	Core	Own faculty
3	MSM103	Bioanalytical Techniques	4	0	0	30	70	100	4	Core	Own faculty
4	MSM104	Biochemistry	4	0	0	30	70	100	4	Minor/ Elective	Own/other faculty
5	MSM121SE	Biostatistics	3	0	0	30	70	100	3	Minor/SEC	Other faculty
Practical											
6	MSM151	Microbiology and Cell Biology Lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSM155SE	Biochemistry and Analytical Techniques Lab	0	0	2	30	70	100	1	Core	Own faculty
8	MSM156SE	Biostatistics Lab	0	0	2	30	70	100	1	Core	Other faculty
Total			19	0	4	210	490	700	22		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AECC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

MOOCs/SVAYAM/NPTEL Courses

MSM101 Descriptive Statistics	https://onlinecourses.nptel.ac.in/noc24_mg133/preview
MSM102 Drug Delivery	https://onlinecourses.nptel.ac.in/noc24_bt62/preview

Note: 1. The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC.

2. In the first semester, every student will be assigned a faculty supervisor who will prepare the student for mini- and major projects.

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M. Sc. Microbiology

Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

I Year: II Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSM201	Medical Microbiology	4	0	0	30	70	100	4	Core	Own faculty
2	MSM202	Industrial Microbiology	4	0	0	30	70	100	4	Core	Own faculty
3	MSM203	Food Microbiology	4	0	0	30	70	100	4	GE-1	Own faculty
4	MSM204	Bioenergetics and Microbial Metabolism	4	0	0	30	70	100	4	Core	Own faculty
5	------	Discipline Specific Elective-1 (DSE-1)	3	0	0	30	70	100	3	DSE-1	Own faculty
Practical											
6	MSM251	Medical and Industrial Microbiology Lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSM252	Food Microbiology and Microbial Metabolism Lab	0	0	2	30	70	100	1	Core	Own faculty
Total			19	0	4	210	490	700	21		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AEC C	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

*There will be no credit and no grading for it.

Discipline Specific Elective-1 (DSE-1)	
Code	**Subject Name**
MSM2101	Drug design and Molecular modelling
MSM2102	Applied Microbiology
MOOCs/SVAYAM/NPTEL Courses	
MSM201 Biomechanics	https://onlinecourses.nptel.ac.in/noc24_me150/preview
MSM 202 Biomedical nanotechnology	https://onlinecourses.nptel.ac.in/noc24_bt72/preview
MSM 203 Bioreactors	https://onlinecourses.nptel.ac.in/noc24_bt39/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC.

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Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

II Year: III Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSM301	Systemic Bacteriology	4	0	0	30	70	100	4	Core	Own faculty
2	MSM302	Environmental and Agricultural Microbiology	3	0	0	30	70	100	3	Core	Own faculty
3	MSM303	Immunology	4	0	0	30	70	100	4	GE-2	Own faculty
4	MSB321SE	Genomics, Proteomics and Bioinformatics	4	0	0	30	70	100	4	SEC	Other faculty
5	------	DSE-2	3	0	0	30	70	100	3	DSE-2	Own faculty
Practical											
6	MSM351	Bacteriology and Environmental Microbiology Lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSM352	Immunology and Bioinformatics Lab	0	0	2	30	70	100	1	Core	Own faculty
8	MSM353	Summer Training/ Internship	0	0	2	30	70	100	1		
Total			18	0	6	240	560	800	21		
OR											
MSB3101PJ		**Dissertation**			40	30	70	100	20		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AECC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

Discipline Specific Elective-2 (DSE-2)	
Code	**Subject Name**
MSM3101	IPR, Bioethics and Biosafety
MSM3102	Environmental Toxicology
MOOCs/SVAYAM/NPTEL Courses	
MSM 301Biomedical Ultrasound	https://onlinecourses.nptel.ac.in/noc24_ge45/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC.

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M. Sc. Microbiology

Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

II Year: IV Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSM401	Research Methodology	4	0	0	30	70	100	4	Core	Own faculty
2	MSM402	Microbial Genetics	4	0	0	30	70	100	4	Core	Own faculty
3	MSM403	Microbial Biotechnology	4	0	0	30	70	100	4	GE-2	Own faculty
4	MSM421SE	Microbial Genetic Manipulation	4	0	0	30	70	100	4	SEC	Other faculty
5	------	DSE -3	3	0	0	30	70	100	3	DSE-2	Own faculty
Practical											
6	MSM451	Microbial Genetic and Biotechnology Lab	0	0	2	30	70	100	1	Core	Own faculty
Total			19	0	2	180	420	600	20		
OR											
	MSB4101PJ	**Dissertation**			40	30	70		20		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AECC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

Discipline Specific Elective-3 (DSE-3)	
Code	**Subject Name**
MSM4101	Quality control in Biochemistry lab
MSM4102	Cancer Biology
MOOCs/SVAYAM/NPTEL Courses	
MSM 401 Circular Dichroism(CD) and Mossbauer Spectroscopy	Circular Dichroism (CD) and Mossbauer Spectroscopy for Chemist - Course (nptel.ac.in)
MSM 402 Computer Aided Drug Design	https://onlinecourses.nptel.ac.in/noc24_bt44/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC.

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Letter Grades and Grade Points

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Computation of SGPA and CGPA

The following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = $\sum(Ci \times Gi) / \sum Ci$

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Example for Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	(Credit x Grade)
1	Course 1	3	A	8	3 x 8 = 24
1	Course 1	4	B +	7	4 x 7 = 28
1	Course 1	3	B	6	3 x 6 = 18
1	Course 1	3	O	10	3 x 10 = 30
1	Course 1	3	C	5	3 x 5 = 15
1	Course 1	4	B	6	4 x 6 = 24
		20			139
SGPA					139/20=6.95

ii. The Cumulative Grade Point Average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = ∑(Ci x Si) / ∑ Ci

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example for Computation of CGPA

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
Credit 20	Credit 20	Credit 20	Credit 20
SGPA 6.9	SGPA 7.8	5.6	6.0
CGPA= (20 x 6.9 + 20 x 7.8 + 20 x 5.6 + 20 x 6.0)/80 = 6.6			

I Year: I Semester (Theory)

Microbiology

Code: MSM101

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. To study the taxonomy, morphology and genetics of bacteria.
2. To study the microbial growth and identification of bacteria.
3. To state microbial genetics and the mechanisms of genetic variations in bacteria.
4. To study the microbial nutrition and control of microorganisms.

Unit-1 Introduction to Microbiology

History of Microbiology, biogenesis vs abiogenesis theory, germ theory of disease, Koch's postulates, contribution of various researchers to the field of Microbiology, scope of Microbiology, distinctive characteristics of eubacteria, blue green algae, mycoplasma, viruses, bacteriophages. The Fungi (Eumycota): Introduction, Importance, Structure, Nutrition and metabolism, reproduction and characteristics of fungal divisions.

Unit-2 Structure of Bacterial Cell

Morphological and ultrastructure of microbial cell (Shape, size, arrangement), Gram positive and Gram negative cell wall structure, capsule, cytoplasmic membrane, cytoplasm, nucleoid, mesosomes, ribososmes, fimbriae (pili), flagella, plasmids, endospores. General principle of bacterial classification, polyphasic taxonomy, molecular approaches (16S rDNA sequencing).

Unit-3 Microbial Nutrition and Growth

Basic concepts of Nutrition, Culture media: types of media, natural and synthetic media, chemically defined media, complex media, selective, differential and enrichment media, Pure culture technique. Microbial Growth: growth/ reproduction in bacteria, factors affecting microbial growth, the growth curve, measurement of microbial growth. Microbial control: major physical and chemical methods.

Unit-4 The Fungi (Eumycota)

Introduction, Distribution of fungi, Structure, Nutrition and Metabolism, Reproduction, Characteristics of the fungal divisions.

Unit-5 The Viruses

General Properties of Viruses, Structure, Reproduction, Cultivation of viruses, Virus Purification and Assays, Principles of virus taxonomy, bacterial and archaeal viruses, plant viruses, viruses of fungi and protists, Insect viruses, Viroids, Virusoids, Prions, Bacteriophages.

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Suggested Readings

1. Ananthanarayanan and Paniker's Textbook of Microbiology (R. Ananthanarayan and C. K. Jayaram Paniker)
2. Textbook of Microbiology by C P Baveja.
3. Prescott / Harley Klein's Microbiology (Joanne Willey, Linda Sherwood, Chris Woolverton).

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Study the taxonomy, morphology and genetics of bacteria.
2. Study nutrition required for micro-organisms and introduction of sterilization.
3. State microbial genetics and mechanisms of genetic variation among microorganisms.

Date:_____
Volume No.:_____

I Year: I Semester (Theory)
Cell Biology
Code: MSM102

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. To study and understand structural organization of prokaryotes and eukaryotes.
2. To study the structure and function of intracellular organelles and cell cycle and regulation
3. To understand basic concepts of genome organization and molecular basis of inheritance
4. To have the knowledge in genome mapping and population genetics

Unit-1 Membrane structure and function

Structure of Prokaryotic and Eukaryotic cells; Membrane structure and function-structure of model membrane, lipid bilayer, membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes

Unit-2 Structural organization and function of intracellular organelles:

Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility. Cell junctions, Cell adhesion; Basics of cell signaling- transmembrane, cytosolic and nuclear receptors, integrin and tyrosine kinase signaling, GPCRs role of secondary messengers.

Unit-3 Cell cycle and its regulation in Prokaryotes and Eukaryotes:

Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast and higher organisms. Cell senescence and programmed cell death. Introduction to cell signaling and cell – cell interaction genes. Procaryotic Cell cycle: Binary fission, Chromosome Replication and Partitioning, Cytokinesis. DNA replication in rapidly growing cells. Cell to Cell communication within microbial populations, Quroum Sensing and Biofilm formation.

Unit 4: Gene Structure, Mutations and DNA Repair

DNA as genetic material, the flow of genetic information, Nucleic Acid Structure, Mutations and their chemical basis, types of mutations and effects of mutations- wild, forward, reversion, suppressor, silent, missense, nonsense, Frameshift and conditional mutations. Detection and isolation of mutants, Carcinogenicity test. DNA repair- Excision repair, Direct repair, Mismatch repair, Recombinational repair, and SOS response.

Unit 5: Genetic Variability in Prokaryotes

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Horizontal Gene transfer in Procaryotes, Homologous recombination, site-specific recombination and transposition. Transposable elements. Bacterial Plasmids. Bacterial conjugation, DNA Transformation, Transduction- Generalized and Specialized.

References / Test Book:

1. Molecular Biology of the, Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. Cell (5th Ed.). New York: Garland Science (2008).
2. Lodish et al., Molecular cell Biology, 4th Edition, W.H. Freeman & Company, 2000.
3. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London, 1996.
4. Lewin's Genes XI. Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. Burlington, MA: Jones & Bartlett Learning (2014).
5. Genetics in Medicine, Thompson and Thompson, Saunders, (2004).
6. Genetics: Analysis of genes and genomes, Hartl DA & Jones EW, Jones & Bartlett Publ., (2000).
7. Human Molecular Genetics, Strachan T and Read AP, Garland Science, (2004).

Course Learning Outcomes (CLO)

At the end of the course the student will be able to:

1. Explain structural characterization and function of prokaryotic and eukaryotic cells
2. Understand the genome mapping and population genetics
3. Integrate the various aspects of cell cycle and regulation.

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Date:_____
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I Year: I Semester (Theory)
Bioanalytical Techniques
Code: MSM103

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. The course introduces students to the different types of analytical techniques.
2. To teach basic principle of microscopy and chromatography and their applications.
3. To teach basic principle of cell fractionations, estimation of molecular mass of protein, separations of proteins by different techniques.
4. To comprehend the properties of water, acids, bases, buffers, and solutions.

Unit-1 Microscopy

Microscopy: Resolving powers of different microscopes; Light Microscopy: Basic principles, components and applicationsof Bright field,phase contrast, fluorescence microscopy, Electron microscopy- Principle, preparation of specimens; TEM, SEM and their applications; Confocal microscopy, Microtomy, specific staining of cells and cell organelles, Flowcytometry

Unit-2 Chromatography and Electrophoretic techniques

TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity; Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis

Unit-3 Centrifugation

Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge -Micro centrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods

Unit-4 Spectroscopy Techniques

Electromagnetic radiations, Beer-Lamberts law principles and applications of colorimetry, spectrophotometry. Concept and biological application of UV, Visible, and Raman spectroscopy; fluorimetry, flame photometry; Fluorescence; MS, NMR, PMR, ESR and Plasma Emission spectroscopy. X-ray Diffraction.

Unit-5 Optical Techniques

Principle, Instrument design, methods and application of Fluorescence; Polarising, Flowcytometry and Cytophotometry; Circular dichroism (CD), optical rotatory dispersion (ORD),

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Relation between CD and ORD, application of ORD in conformation and interactions of biomolecules

Texts/References

1. Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman & Company, San Fransisco, 1982.

2. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, 2000.

3. D. Holme & H. Peck, Analytical Biochemistry, 3rd Edition, Longman, 1998.

4. R. Scopes, Protein Purification - Principles & Practices, 3rd Edition, Springer Verlag, 1994. 5. Selected readings from Methods in Enzymology, Academic Press.

Course Learning Outcomes (CLOs):

On completion of this course, the students will have the knowledge about:

1. Understanding physical properties of water, buffers and solutions
2. Remembering and understanding the basics of microscopies and their application. Chromatography techniques and their use in separation of different compounds.
3. Remembering and understanding the mechanisms of centrifugation and electrophoresis of proteins/ nucleic acids.

Date:_____
Volume No.:_____

I Year: I Semester (Theory)
Biochemistry
Code: MSM104

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To study various biomolecules of a cell and their structural characterization.
2. To study various function and interrelationship of biomolecules
3. To elucidate the molecular basis of diseases to enable the development of novel therapies and treatments
4. To study the biochemical basis of inherited disorders and their associated sequelae.

Unit-1 Properties of Water and Buffers

Physical properties and structure of water, ionization of water; Structure of the Atom, Mass number. Acids, Bases and Buffers, buffer action, Henderson–Hasselbalch equation, biological relevance of pH and pKa, determination of pKa of weak acid, and buffer capacity, preparation of buffers. Solutions: Units for expressing strength of solutions: Normality, molarity, molality, mole, ppm, ppb. Calculations with examples

Unit-2Amino acids and Proteins

Amino acids and proteins: Classification, structure and physicochemical properties, Isoelectric point, Zwitter ion; Peptide bonds, peptides of biological importance, therapeutic peptides and biologics, peptides synthesis; Proteins-classification, structure of proteins-primary, secondary (helices, beta sheets, loops, turns) tertiary and quaternary; Myoglobin, hemoglobin; Ramachandran plot, protein-denaturation, protein sequencing, Protein structure and sequence databases.

Unit-3 Carbohydrates

Carbohydrates-classification and structure; structure and functions of mono and Oligosaccharides; Polysaccharides-homo and hetero polysaccharides; starch, glycogen, and cellulose; carbohydrate conjugates; amino sugars, glycoproteins, proteoglycans. Glycomics; Carbohydrate Arrays for Basic Science and as Diagnostic Tools

Unit-4 Lipids

Lipids- classification, structure and properties of fatty acids, phospholipids, sphingolipids, fats, oils and waxes; structure and function of Eicosanoids, Structure and properties of sterols, and steroids. Biogenesis and functions of lipid bodies in animals, plants and microorganisms; Vitamins-chemistry and functions of fat and water soluble vitamins

Unit-5 Nucleic Acids

Date:_____
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Nucleic Acids-Nucleosides, Nucleotides, Chemical synthesis of nucleotides, Structure of DNA and RNA; Different types of DNA and RNA; Different types of small RNAs; Physicochemical properties of nucleic acids; Denaturation and renaturation of nucleic acids. Nucleotide sequencing; nucleotide databases and nucleotide sequence databases.
Nucleosides, Nucleotides and Nucleic Acids as Therapeutics; CRISPR-Cas9, CRISPR-based diagnostics.

Suggested Readings

1. Biochemistry by Voet B and Voet JG, Wiley Publishers, USA
2. Biochemistry 5th Revised edition by LubertStryer, Jeremy M. Berg, John L. Tymoczko, Macmillan Publishers, USA
3. D.L. Nelson and M.M. Cox Lehninger Principles of Biochemistry, Publisher: WH Freeman; 8th ed. NewYork
4. Text Book of Biochemistry for medical students, DM Vasudevan.
5. Biochemistry, U. Satyanarayana, U Chakarapani.

Course Learning Outcomes (CLO)

At the end of the course the student will be able to:

1. Explain various biomolecules of a cell and their structural characterization
2. Understand the function and interrelationship of biomolecules
3. Integrate the various aspects of metabolism, and their regulatory pathways.

Date:_____
Volume No.:_____

I Year: I Semester (Theory)

Biostatistics

Code: MSM121SE

L	T	P	C
3	0	0	3

Course Objectives:

1. To teach the basic of statistics and their applications in biology.
2. Understanding of data and its analysis with the help of computers and interpretation of data analysis.
3. Understanding the basics of computers and computational data analysis which in-turn can be used for interpretation of data analysis.
4. To make awareness about different type of software packages and their use.

Unit 1: Introduction to Biostatistics & Data Handling

- Definition, scope, and significance of biostatistics
- Data and its and measurement scales
- Data collection and classification
- Tabulation and frequency distribution
- Diagrammatical and graphical representation of data- Line, Bar, Pie Chart, Histogram, Frequency Polygon, Ogive

Unit 2: Measures of Central Tendency and Dispersion

- Concepts of statistical measures
- Measures of Central tendency: Mean, Median, Mode
- Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation

Unit 3: Measures of Relationship

- Correlation: Types and interpretation
- Karl Pearson's Coefficient of Correlation
- Spearman's Rank Correlation
- Simple Linear Regression Analysis

Unit 4: Sampling Techniques and Probability Distributions

- Definition of population & sample,
- Sampling criteria, and sample size determination
- sampling & type of sampling technique
- Probability Distributions: Binomial, Poisson, Normal
- Normal Probability Curve, Skewness, Kurtosis

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Unit 5: Hypothesis Testing & Statistical Software

- Basics concept of hypothesis
- Type of hypothesis, critical region, errors (Type I and II), significance level, p-value
  Parametric test & non-Parametric test-
  - Chi-Square Test (χ^2)
  - Student's t-tests (independent, paired)
  - F-test, Z-test, ANOVA
  - Mann-Whitney U test
- Introduction to SPSS and its applications in biostatistics

Suggested Readings

1. Veer Bala Rastogi, "Biostatistics: 3rd Edition", MedTech Science Press, 2022.
2. NSN Rao and NS Murthy, "Applied Statistics in Health Science", 2nd Edition, Jaypee Brothers Medical Publisher (P) LTD, 2010.
3. S.C. Gupta and V.K Kapoor, "Fundamental of Mathematical Statistics", S. Chand & Sons, 11th Edition, 2002.
4. P.K. Sinha and Priti Sinha "Computer Fundamentals: Concepts, System and Applications", 8th Edition, BPB Publication, 2003.
5. Satish Jain, "IT Tools and Business System", Revised 2010 Edition, BPB Publication, 2010.
6. S. Sagman, "Microsoft Office. 2000 for Windows", Second Indian Prim, Pearson Education, 2001.
7. C.R. Kothari, Research Methodology: Methods and Techniques, 2004.

Course Learning Outcomes (CLOs):

On completion of this course, the students will be:

1. Understanding and remembering the knowledge of biostatistics and their use in biological experiments.
2. Remembering and understanding the sampling, collection of data, and test hypothesis during statistical analysis. Measures different tendency and deviations.
3. Remembering and understanding the fundamentals of computers and its parts and handling of different operating systems.
4. Remembering and understanding the use of different software packages in handling of computers.

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Date:_____
Volume No.:_____

I Year: I Semester (Practical)

Microbiology and Cell Biology Lab

Code: MSM151

L	T	P	C
0	0	**2**	**1**

Course Objectives (CO)

1. To apply the knowledge to understand the microbial physiology and to identify the microorganisms.
2. To understand the mechanism of microbial staining.
3. To understand the use of microscope and other instruments required in microbiology lab

Practical's

1. Use, Care and working of the Microscope
2. Enumeration and Isolation of bacteria by plate count or serial dilution agar plate technique.
3. Preparation of bacterial smear and simple staining.
4. Gram staining of bacteria
5. Negative staining
6. Endospore staining
7. Hanging drop technique for demonstrating motility of bacteria.
8. Lactophenol cotton blue staining of fungi.
9. Mitosis and the Cell Cycle in Onion Root-Tip Cells
10. Measuring the length and breadth of the cell by using micrometer
11. Cell Counting and viability

Suggested Readings

1. Practical Microbiology by D.K. Maheshwari.
2. Julio. E. Celis (1997). Cell Biology: A Laboratory Handbook
3. 2. K.V. Chaitanya (2013). Cell and Molecular Biology: A Lab Manual

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Make use of conventional techniques/ instruments in Microbiology lab.
2. Analyze and interpret investigative data.
3. Demonstrate the skills of solving clinical problems and decision making
4. Understand the mechanism of microbial staining.

Date:_____
Volume No.:_____

I Year: I Semester (Practical)

Biochemistry and Analytical Techniques Lab

Code: MSM152

L	T	P	C
0	0	**2**	**1**

Course Objectives (CO)

1. To make use of conventional techniques/instruments to perform biochemical analysis relevant to clinical screening and diagnosis biochemistry.
2. To analyze and interpret investigative data
3. To Understand the theory and principles of chromatography, electrophoresis and spectrophotometry.

Practical

1. Qualitative analysis of carbohydrates.
2. Qualitative analysis of amino acids and proteins
3. Qualitative analysis of lipids
4. Qualitative analysis of nucleic acid
5. Estimation of given protein by Biuret test.
6. Seperation of amino acids by chromatographic techniques
    a. Circular paper chromatography
    b. Ascending paper chromatography
7. Seperation and identification of sugars by Thin Layer Chromatography
8. Polyacrylamide gel electrophoresis of proteins

Suggested Readings

1. Plummer, D.T., An Introduction to Practical Biochemistry, 3rd Edition, McGraw Hill Education (India), 2017.
2. Sawhney, S.K. and Randhir Singh, Introductory Practical Biochemistry, Revised Edition, Narosa Publishing House, 2005.

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Make use of conventional techniques/instruments to perform biochemical analysis relevant to clinical screening and diagnosis to biochemistry.
2. Understand the theory and principles of chromatography, electrophoresis and spectrophotometry
3. Analyze and interpret investigative data.

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Date:_____
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I Year: I Semester (Practical)
Biostatistics Lab
Code: MSM156SE

L	T	P	C
0	0	2	1

Course objective:

1. To teach the basic of statistics and data representation, data entry and data analysis in biology.
2. Understanding the basics of different statistical methods such as mean, median, mode, variations, etc.
3. To demonstrate the making computer file in MS office and MS-dos operating systems.
4. To teach the working of office packages.

Experiments

1. Statistical Data Representation and Tabulation
2. Statistical Data entry in computer application software
3. Statistical Data Analysis.
4. Statistical Major Methods: Mean, Median, Mode, Standard Deviation, Correlation and Regression.
5. Computing the Sampling.
6. Graphical representation of data by Histogram, Frequency polygons, frequency curves and
7. Calculation of measures of location & Calculation of measures of dispersion.
8. Calculation of moments, measures of skewness and measures of Kurtosis.
9. Fitting of curves by method of least squares.
10. Determination of regression lines and calculation of correlation coefficient – grouped and ungrouped data.
11. Calculation of correlation ratios and rank correlation coefficients.
12. Calculation of measures of association in contingency tables.
13. Parametric test & non-Parametric test.

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Understand the Representation and Tabulation.
2. Perform the data by Histogram, Frequency polygons, frequency curves
3. Observe and understand the method of various biostatistical software.

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M. Sc. Microbiology

Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

I Year: II Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSM201	Medical Microbiology	4	0	0	30	70	100	4	Core	Own faculty
2	MSM202	Industrial Microbiology	4	0	0	30	70	100	4	Core	Own faculty
3	MSM203	Food Microbiology	4	0	0	30	70	100	4	Core	Own faculty
4	MSM204	Bioenergetics and – Microbial Metabolism	4	0	0	30	70	100	4	GE-1	Own faculty
5	------	Discipline Specific Elective-1 (DSE-1)	3	0	0	30	70	100	3	DSE-1	Own faculty
Practical											
6	MSM251	Medical and Industrial Microbiology Lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSM252	Food Microbiology and Microbial Metabolism Lab	0	0	2	30	70	100	1	Core	Own faculty
Total			19	0	4	210	490	700	21		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AE CC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

*There will be no credit and no grading for it.

Discipline Specific Elective-1 (DSE-1)	
Code	**Subject Name**
MSM2101	Drug design and Molecular modelling
MSM2102	Applied Microbiology
MOOCs/SVAYAM/NPTEL Courses	
MSM201 Biomechanics	https://onlinecourses.nptel.ac.in/noc24_me150/preview
MSM 202 Biomedical nanotechnology	https://onlinecourses.nptel.ac.in/noc24_bt72/preview
MSM 203 Bioreactors	https://onlinecourses.nptel.ac.in/noc24_bt39/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC.

Date:_____

Volume No.:

_____

Date:_____
Volume No.:_____

I Year: II Semester (Theory)
Medical Microbiology
Code: MSM201

L	T	P	C
4	0	**0**	**4**

Course Objectives

1. Develop understanding about immune system, antigen antibody interactions
2. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.

Unit I Host-Pathogen Interaction

Distribution and significance of normal human microbial flora, accidental pathogens, oncogenic viruses. Study of following groups of microbial pathogens (Morphological characters, pathogenesis, diagnosis, epidemiology, prophylaxis and treatment) Bacterial- Enteric pathogens (E. coli, Shigella, Salmonella, Campylobacters, Vibrio), Pneumococci, Pyogenic organisms (Staphylococcus, Streptococcus), Helicobacter pylori, Clostridium spp., Mycobacterium spp.; Viral- HIV, Dengue, Hepatitis, flu; Fungal-Candida, Aspergillus, Cryptococococus, Microsporum; ParasitePlasmodium & Entamoeba.

Unit II Diagnostic Microbiology

General principles of diagnostic microbiology; Collection, transport and processing of clinical samples; Cultural, biochemical, serological and molecular methods for microbial typing; Physical, biochemical and microscopic examination of clinical samples (Blood, urine, stool etc.)

Unit III Mechanisms of Pathogenesis

Transmission, adherence, invasion and colonisation of host cells, E. coli, Salmonella spp., Klebsiella spp., Shigella spp., Staphylococcus, Streptococcus spp. from clinical samples (Blood, urine, stool, etc.), Virulence Factors – Adherence and Colonization Factors, Invasion Factors, Capsules and Other Surface Components, Biofilms, Microbial toxins (exotoxin and endotoxin), Siderophores, Molecular basis of bacterial pathogenicity , cytoskeletal modulation of host cell, virulence genes and pathogenicity islands, – pathogenesis of fungi, structural dimorphism and role of extra cellular products in fungal infection

Unit IV Antibiotics and Chemotherapy

Date:_____
Volume No.:_____

Antimicrobial agents and mode of action, Antimicrobial drug susceptibility testing, Antimicrobial resistance, mechanisms of Antimicrobial resistance, method for the development of antimicrobial drug and vaccine

Unit V Epidemiology and Public Health

Epidemiological principles in prevention and control of diseases; Microbial typing methods, Endemic, epidemic, pandemic and sporadic diseases; Concepts of mortality/ morbidity rates, incidence and prevalence; Communicable and non-communicable diseases; Sources and reservoirs of infection-biotic and abiotic; Modes of transmission of infections; Disease prevention and control measures; Emerging and re-emerging diseases: examples of model bacterial, viral, fungal, and parasite diseases.

Suggested Readings

1. Jawetz, Melnick, & Adelberg's Medical Microbiology by Brooks GF, Butel JS, Morse SA, Melnick JL, Jawetz E, Adelberg EA. 23rd edition. Lange Publication.2004.
2. Cellular Microbiology by Cossart P, Boquet P, Normark S, Rappuoli R eds. 2nd edition. American Society for Microbiology Press. 2005.
3. Bacterial Pathogenesis: A molecular approach by Salyers AA and Whitt DD eds. American Society for Microbiology Press, Washington, DC USA. 2002.
4. Pathogenomics: Genome analysis of pathogenic microbes by Hacker J and Dorbindt U. ed. Wiley- VCH. 2006. 5. Molecular Microbiology: Diagnostic Principles and Practice by Persing DH, Tenover FC, Versalovic J, Tang Y, Unger ER, Relman DA, White TJ eds. American Society for Microbiology Press, 2004.
6. Infectious Disease Epidemiology: Theory and Practice by Nelson KE, Williams CM, Graham NMH eds. An Aspen Publication. 2001.
7. Plant pathology by George N. Agrios: 4th ed., Academic press, New York, 1969.
8. Plant pathology by R.S. Mehrotra: Tata McGraw –Hill publishing company limited. New Delhi.
9. Bacterial plant pathology, cell and molecular aspects by David C. Sigee, Cambridge University Press, 1993. 10. Molecular plant pathology by M. Dickinson: BIOS Scientific Publishers, London,2003.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1 Describe the mechanisms of bacterial invasion of hosts and virulence factors
2 Define various portals of entry and the routes of transmission of the infection
3 Compare and contrast the variety of disease causing mechanisms associated with viral, bacteria, fungal and oomycete pathogens.
4 Critically evaluate the attempts and strategies to control disease
5 Illustrate the basic concepts of epidemiology, application of epidemiological research and concepts of prevalence and incidence in epidemiology

Date:_____
Volume No.:_____

I Year: II Semester (Theory)

Industrial Microbiology

Code: MSM202

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. To impart theoretical knowledge of role of microbes in industrial production of different biochemical/bio-molecules.
2. The theory syllabus covers area such as design of bioreactors, media formulations and factors affecting the industrial production of bio-chemicals along with approaches that can be used for enhanced production.
3. Role of micro-organism in production of organic acids, alcohols, wine, vinegar, enzymes, vitamins, antibiotics, amino-acids and steroids.

Unit I Theory and Principles of Industrial Fermentation

Bioreactors, design and components, various types of bioreactors and their applications. Fermentation- types of fermentation- solid state, submerged fermentation, factors affecting fermentation process. Different substrates used in fermentation and their applications. Culture media- types, components and formulations. Sterilization- batch and continuous. Selection of microbes and growth media for industrial fermentation process.

Unit II Microbial Fermentation

Microbial fermentation processes, upstream and downstream processing, microbial product purification/ bio separation (recovery, control measures and sterilization), physico-chemical basis of bio separation processes, techniques for purification of end products- chromatography, electrophoresis, distillation, crystallization, filtration.

Unit III Microorganisms in industrial fermentation

Role of microbes in industrial fermented products- cheese, yoghurt, dairy products, bread, fermented vegetables and pickles, Alcoholic beverages- Beer, whiskey and wine production and their types. Organic acids- citric acid, acetic acid and lactic acid production. Antibiotics- penicillin and streptomycin, their mode of action, production. Biopolymers production- xanthan gum, PHA and PHB bioplastics production and application.

Unit IV- Bioremediation and Biodegradation

Bioremediation of contaminated sites due to industrial pollution, In situ and ex situ bioremediation techniques, biodegradation of xenobiotic compounds from industrial effluents- pesticides, oil spills, heavy metals, plastics, role of genetically engineered microbes in bioremediation.

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Unit V Industrial Waste Management

Industrial Waste- source and its types, sampling and analysis of various pollution parameters of industrial waste, i.e., BOD, COD, TDS, Total Carbon and Nitrogen, Heavy metals, etc. Waste water treatment, Standards for disposal of Industrial waste, Important Act and Guidelines for environmental protection for industrial waste. The Water (prevention and control of pollution) Rules 1974 and 1975, the Air (prevention and control of pollution) Acts 1981, the Environment (protection) Act, 1986 and The Hazardous waste (Management and Handling) rules, 1989.

Suggested Readings

1. Bioprocess Engineering principles by Pauline M Doran, Elsevier Science and technologyBooks.
2. Bioprocess Engineering- Basic Concepts by Michael L Shuler and Fikret Kargi, Pearson Education, Inc.
3. Bioprocess Technology: Volume 1 by P T Kalaiselvan and I Arul Pandi MJP publisher.
4. Bioprocess Engineering: Systems, Equipment and Facilities by Bjorn K. Lydersen, Nancy A. D'Elia, Kim L. Nelson, Wiley India Pvt Ltd.
5. Stanbury PF, Hall SJ, Whitaker A (1999). Principles of Fermentation Technology, ButterworthHeinemann, 2nd edition.
6. Creuger and Creuger (2001). Biotechnology- A textbook of Industrial Microbiology, Sinauer Associates, Inc.
7. Waites MJ (2001). Industrial Microbiology: An Introduction, Wiley. 8. Industrial Microbiology, Prescott and Dunn

Course learning outcome (CLO)

At the end of the course, the student should be able to:

1. Learning of different fermentation techniques, bioreactor design, inoculum development for industrial fermentations, Microbial growth and product formation kinetics, media formulation and sterilization, isolation, preservation and improvement of industrially important micro-organisms.
2. Understanding of industrial production and purification of organic acids, alcohols, wine and vinegar with help of different microbes.
3. Understanding of industrial production and purification of antibiotics, enzymes, amino acids and steroids.
4. Understanding of different pathways followed in or by the microbes involved in production of these bio-chemicals. Method of manipulating these pathways to get desired yield.
5. Understanding of application of these bio-molecules in benefit of mankind.

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Date:_____
Volume No.:_____

I Year: II Semester (Theory)
Food Microbiology
Code: MSM203

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. To explain the food sampling techniques and their analysis and help student in applying the knowledge for quality control and food safety
2.To explain the food regulations and standards.
3.To knowledge of microbes and their importance, application in day to day life with special reference to food.
4.To study the various biochemical analysis tests for proteins, fats and oils
5.To determine diverse quality assurance methods for food products.
6.To have the knowledge about the production of food additives

Unit-1 Introduction

Food Regulations and Standards - Sampling methods - Sample preparation for analysis; Statistical evaluation of analytical data - Official Methods of Food Analysis. Moisture in foods - determination by different methods - ash content of foods, wet, dry ashing, microwave ashing methods; Significance of Sulphated Ash, water soluble ash and acid insoluble ash in foods; titratable Acidity in foods, determination of dietary fiber and crude fiber.

Unit-2: Food Spoilage and Food Preservation

Microbial Contamination, Preservation and Spoilage of different foods
Contamination of foods from natural habitat and handling and processing. General principles underlying spoilage: causes of spoilage, classification of food based on spoilage, factors affecting kinds and number of microorganisms in food, factors affecting the growth of microorganisms in food. Chemical changes caused by microorganisms

Unit-3: Microbial Toxins and Food Protection

Microbial toxins (endotoxin and exotoxin) and toxoids, source and chemistry of microbial toxins in contamination of food grains and food products. Protection by food additives: the ideal antimicrobial protection, food additives, added preservatives, developed preservatives, protection by Radiation: Ultra Violet radiation, ionizing radiations, Gamma rays and Cathode rays, Microwave processing. Protection by drying: methods of drying,

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Methods of analysis (Principle, procedure, application) Kjeldahl Method, Biuret method, Lowry method, Bi-cinchoninic Acid method, Ultraviolet (UV) 280nm Absorption, Dye binding method, Bradford method, Ninhydrin method & Turbidimetric method

Unit-4: Food Toxicology and Waste Management

food toxicology: classification, dose, determination toxins in food

Agricultural and industrial contaminants in foods, types of waste generated; non-degradable wastes; food industrial wastes from fruit and vegetable processing, principle of biodegradation, biotransformation of industrial waste, Solid waste storage and disposal methods- l, , incineration, recycling; standards for disposal of wastewater; physical wastewater treatment i.e. screening, racks, adsorption, sedimentation; chemical wastewater treatment i.e. adsorption, chemical precipitation, flocculation, oxidation process; biological wastewater treatment i.e. anaerobic process (Up flow Anaerobic Sludge Blanket (UASB), Fluidized bed reactor (FBR), hybrid reactors), aerobic lagoons, activated sludge process, trickling filter treatment process

Unit-5 Methods for quality assessment

Methods for quality assessment (Sensory, Physical, Chemical & Microbiological) of food materials: fruits, vegetables, cereals, milk & dairy products, meat, poultry, egg and processed food products. Quality Control (QC) System: Importance & functions; Quality Assurance (QA) System: Definition & Importance. Comparison of QC & QA Systems.

Suggested Readings:

1. Wilbur A Gould (1977) Food quality assurance. 1st Edition, AVI Pub. Co, Westport, Conn. (USA)

2. Wilbur A. Gould, Ronald W. Gould (2001) Total quality assurance for the food industries. 3rd Edition, CTI Publication Inc, Maryland, USA

3. Gruenwedel, D.W.; Whitaker, J.R. (editors) (1984): Food Analysis Principles and techniques, Volumes 1 to 8, Marcel Dekker, Inc., New York.

4. Pomeranz, Y. and MeLoan, C.E. (1996): Food Analysis: Theory and Practice; 3rd Edition, CBS Publishers and Distributors, New Delhi.

5. Herschdoerfer, S.M. (ed) (1968 – 1987): Quality Control in the Food Industry, Vols. 1 to 4, Academic Press, London.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Explain about the food regulations and standards.
2. Determine the various biochemical analysis tests for proteins, fats and oils
3. Explain diverse quality assurance methods for food products.
4. Discuss about the production of food additives

Date:_____
Volume No.:_____

I Year: II Semester (Theory)
Bioenergetics and Microbial Metabolism
Code: MSM204

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. To understand the metabolism of biomolecules and their regulation in living cells
2. To have knowledge in basic concepts of bioenergetics
3. To study respiration mechanism and electron transport

Unit-1 Bioenergetics

Bioenergetics: Concept of free energy, standard free energy, determination of ΔG for a reaction; Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions; Biological oxidation-reduction reactions; Redox potentials; Relation between standard reduction potentials & free energy change; High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates alongwith reasons for high ΔG

Unit-2 Metabolism of carbohydrates

Metabolism of Carbohydrates: Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle, its function in energy generation and biosynthesis of energy rich bond; Pentose phosphate pathway and its regulation; Gluconeogenesis, glycogenesis and Glycogenolysis; Glyoxylate and Gamma amino butyrate shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway; Metabolism of disaccharides. Hormonal regulation of carbohydrate metabolism. Energetics of metabolic cycle

Unit-3 Metabolism of lipids and nucleotides

Metabolism of Lipids: Introduction, hydrolysis of tri-acylglycerols, α-, β- oxidation of fatty acids; Fatty acid biosynthesis; Lipid biosynthesis; Metabolism of cholesterol and its regulation. Energetics of fatty acid cycle. Nucleotides metabolism: Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway; Biosynthesis of Vitamins – Ascorbic acid, thiamine, pantothenic acid and Folic acid.

Unit-4 Amino acid metabolism

Amino acid metabolism - Transamination, decarboxylation, Oxidative and non-oxidative deamination of amino acids; metabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines; Urea cycle and its regulation.

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Overview of biosynthetic pathways of amino acids and their regulation; Assimilation of ammonia, biosynthesis of essential and non- essential amino acids, regulation of glutamine synthetase and aspartate family of amino acids.

Unit-5 Respiration and Electron transport

TCA cycle: Central role of TCA cycle in energy generation and biosynthesis of energy rich bond; Integration/regulation of carbohydrate, lipid and protein metabolism Electron Transport Chain in Mitochondria and chloroplast: Organization and role in electron capture Oxidative Phosphorylation: Electron transfer reactions in mitochondria; F1F0 ATPase - Structure and mechanism of action; Chemiosmotic theory; Inhibitors of respiratory chain and oxidative phosphorylation - Uncouplers and ionophores; Regulation of oxidative phosphorylation.

Suggested readings:

1. Lehninger: Principles of Biochemistry, 4th edition, by David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.
2. Fundamentals of Biochemistry, 3rd edition, by Donald Voet and Judith G Voet (2004) , John Wiley & Sons, NY
3. Biochemistry, 2nd edition, by R.H. Garrett and C. M. Grisham (1999). Saunders College Publishing, NY.
4. Biochemistry, 6th edition, by Jeremy M. Berg (2007). W.H. Freeman & Co., NY.
5. Harper's Biochemistry, 26th edition, by R.K. Murray, P.A.Hayes, D.K.Granner, P.A. Mayes and V. W. Rodwell (2003). Prentice Hall International.
6. Biochemistry, 3rd edition, by C.K. Mathews, K.E. vans Holde and K.G. Ahern (2000). Addison-Wesley Publishing Company.
7. Biochemistry (2004) by J. David Rawn, Panima Publishing Corporation, New Delhi.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Understand the pathways associated with the degradation and biosynthesis of biomolecules
2. Analyze the mechanistic basis for the action of selected enzymes, the thermodynamic basis for the folding and assembly of proteins and other macromolecules
3. Learn the fundamentals of respiration and electron transport.

Date:_____
Volume No.:_____

I Year: II Semester (Theory)
Discipline Specific Elective-1 (DSE-1)
Drug Designing and Molecular Modelling
Code: MSM2101

L	T	P	C
3	0	**0**	**3**

Course Objectives (CO)

1. To explain the various stages of drug discovery.
2. To learn lead discoveries and analog based drug design
3. To describe physicochemical properties and the techniques involved in QSAR
4. To explain various structure-based drug design methods (Molecular docking, Denovo drug design) and techniques in Virtual Screening
5. To learn the concept of pharmacophore and modelling techniques.

Unit-I Introduction to Drug Discovery/Development
Drug Discovery, Drug Development, Source of Drugs, Structural effects on drug action, Drugs Derived from Natural Products, Existing Drugs as a Source for New Drug Discovery, Screening for New Drug Leads, Modern "Rational Approach" to Drug Design.

Unit-II Lead discovery and Analog Based Drug Design
Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.
Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

Unit-III Quantitative Structure Activity Relationship (QSAR)
SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

Unit- IV Molecular Modelling and Virtual Screening Techniques
Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening, De novo drug design, Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening.

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Unit--V Bioinformatics and Molecular Modelling

Introduction to Bioinformatics, chemoinformatic, pharmacophore, ADME databases, chemical, biochemical and pharmaceutical databases. Introduction to molecular mechanics and quantum mechanics., Energy Minimization methods and Conformational Analysis, Global Conformational Minima Determination.

Reference Textbooks:

1. Kerns, E.H.; Di, L. Drug-Like Properties: Concepts, Structure Design and Methods: from ADME to Toxicity Optimization, Academic Press, Oxford, 2008
2. BMC – Burger's Medicinal Chemistry and Drug Discovery, 6th Edition, Vol. 1. Principles and Practice, edited by M. E. Wolff, John Wiley & Sons: New York, 2003.
3. PMC – Principles of Medicinal Chemistry, 7th Edition, edited by T.L. Lemke, D. A. Williams, V. F. Roche, and S.W. Zito, Williams and Wilkins: Philadelphia, 2013.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Explain the various stages of drug discovery.
2. Learn lead discoveries and analog based drug design
3. Describe physicochemical properties and the techniques involved in QSAR
4. Explain various structure-based drug design methods (Molecular docking, Denovo drug design) and techniques in Virtual Screening
5. Describe the concept of pharmacophore and modelling techniques.

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Date:_____
Volume No.:_____

I Year: II Semester (Theory)
Discipline Specific Elective-1 (DSE-1)
Applied Microbiology
Code: MSM2102

L	T	P	C
3	0	**0**	**3**

Course Objectives

1. To give an introduction to the various aspects of role of microorganism in environment, food, dairy and agricultural to the students.
2. To explain the industrial aspects of microbiology for the production of various of industrial products of biological origin.
3. The course explains the application of microorganisms and the role of microorganisms in industrial drug discovery

Unit-1 Agricultural Microbiology

Microbial degradation Microbial degradation: Distribution of microorganism in soil. Organic matter decomposition- humus formation, degradation of cellulose, hemicellulose, lignin, pectin and chitin. Role of microbes in the biodegradation of agricultural chemicals. Removal of heavy metals and microbial bioremediation of soil. Role of microbes in soil fertility. Microorganisms of rhizosphere, phyllosphere and spermophere. Microbial interactions and their effect on plant growth. Microorganisms in transformation of phosphorus & sulphur. Mycorrhizal associations. Biofertilizers and their applications. Microbe-plant associations. Soil microbiology: Genetics of Plant disease: Plant diseases:

Unit-2: Environmental Microbiology

Microbes in degradation and mining: Biodegradable and non-biodegradable pollutants. Bioremediation- types and microbes involved. Biodegradation- hydrocarbons, pesticides, herbicides and other important compounds. Bioremediation of contaminated soil and waste lands. Genetically engineered microbes in biodegradation. Bioleaching and its significance copper, uranium, other metals.

Unit 3 Microbes in food

Principle of food preservation- asepsis, high temperature, low temperature, cryopreservation, drying, chemical preservatives and radiations. Contamination, preservation and spoilage- cereals and cereal products, sugar and sugar products, fruits, vegetables, meat, fish and sea foods, milk and milk products. Microbiology in food sanitation

Unit 4. Microorganisms and human diseases

Koch's postulates for infectious diseases. Normal microbiota in humans. Comparative study of some infectious diseases caused by bacteria, fungi and viruses. Pathogen entering the body

Date:_____
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through the respiratory tract and its infections. Gastrointestinal tract diseases and Urinary tract infections. Food related infections

Unit 5. Antimicrobial Drug

Antibacterial drugs: History and development of antimicrobial drugs. General characteristics of antibacterial drugs. Mechanisms of action of antibacterial drugs that inhibit- cell wall, protein synthesis, nucleic acid and metabolic pathways. Antifungal drugs: General characteristics of antifungal drugs. Mechanisms of action of antifungal drugs- plasma membrane synthesis, cell wall synthesis, cell division and nucleic acid synthesis. Antiviral drugs: General characteristics of antiviral drugs. Mechanisms of action of antiviral drugs- entry inhibitors, viral uncoating, nucleic acid synthesis, integrase inhibitors and assembly and release of viral particles.

Suggested reading

1.Nester's Microbiology: A Human Perspective (8th Edition).
2.Glazer, A.N and Nikaido. H. (1995). Microbial Biotechnology. W.H.Freeman And co. New York.
3. Kumar H.D. Environmental Technology & Biosphere Management. Oxford & IBH Publishing Co. Pvt. Ltd
4.Rangaswami, G and Bagyaraj,D.J.(1996). Agricultural Microbiology 2nd edn. Prentice Hall of India New Delhi.
5. Freeman, J.E.1982. Advances in microbiology. Ed. Subba Rao, (N.S) Oxford and IBH Co. New Delhi.

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I Year: II Semester (Practical)

Medical and Industrial Microbiology Lab

Code: MSM251

L	T	P	C
0	0	**2**	**1**

Course Objectives

1. Program aims to develop students' understanding of medical microbiology with hand on experience in the isolation of the bacteria from different sources.
2. gives the knowledge about the pathogenicity, understanding the biofilm formation in bacteria, role of biofilm in pathogenicity and their antibiotics resistance pattern of pathogenic bacteria (Environmental source, Agricultural part), which is useful for public awareness.
3. Understanding of application of Virus (bacteriophage) in transduction

List of laboratory practicals

1. Isolation and Identification of pathogenic bacteria.
2. Widal Test.
3. Antibiotic susceptibility testing.
4. Determine the minimum inhibitory concentrations (MICs) of antimicrobial agents.
5. Measuring biofilm formation by bacteria.
6. Preparation of wine by fermentation.
7. Preparation of Sauerkraut.
8. To determine the presence of amylase activity
9. Biosurfactant isolation and its characterization.
10. Enzymatic assay of industrially important enzyme- lignolytic enzymes.

Suggested Reading

1. Pathogenomics: Genome analysis of pathogenic microbes by Hacker J and Dorbindt U. ed. Wiley- VCH. 2006
2. Molecular Microbiology: Diagnostic Principles and Practice by Persing DH, Tenover FC, Versalovic J, Tang Y, Unger ER, Relman DA, White TJ eds. American Society for Microbiology Press, 2004
3. Experiments in Microbiology, Plant pathology and Biotechnology, KR Aneja, New Age International Publishers.

Course Learning Outcome

At the end of the course the student will be able to:

1.Properly use aseptic techniques, including sterilization.

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2.Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria.

3.Learning methods for antimicrobial susceptibility testing.

4. Production of industrially important products.

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I Year: II Semester (Practical)

Food Microbiology and Microbial Metabolism Lab

Code: MSM252

L	T	P	C
0	0	**2**	**1**

Course Objective

1. To give hand on experience on isolation and characterization of microbes from different food sources, different spoiled food sources, agricultural (root nodules) and environmental samples (air water and soil).
2.This paper is designed with the objective to impart hand-on experience and laboratory skills to students in area of bioprocess
3. The practical structure is designed so that students are trained to set up different fermentation processes with special emphasis on the downstream processing of bio-molecules purification and characterization.

Practical

1. Microbiological analysis of food.
2. Isolation and enumeration of microorganisms from milk, Fruits, Vegetables and Fruit Juices
3. Isolation of pathogenic bacteria from food.
4. Isolation of spoilage- associated microbes from food.
5. Isolation and characterization of microorganisms from soil, water and air samples.
6. Production of Indole acetic acid, siderophore and Hydrogen cyanide by bacteria.
7. Isolation of Rhizobia from root nodule using Yeast Extract Agar Medium (YEMA)
8. Batch fermentation for production of microbial enzymes.
9. Production and estimation of citric acid (using *Aspergillus niger*) by titrimetric method.
10. Growth curve study.

Book suggesting

1.Bioprocess Engineering principles by Pauline M Doran, Elsevier Science and technologyBooks.
2.D'Elia, Kim L. Nelson, Wiley India Pvt Ltd. 5. Stanbury PF, Hall SJ, Whitaker A (1999).
3.Principles of Fermentation Technology, ButterworthHeinemann, 2nd edition. 6. Creuger and Creuger (2001).
4.Biotechnology- A textbook of Industrial Microbiology, Sinauer Associates, Inc.
5. Waites MJ (2001). Industrial Microbiology: An Introduction, Wiley. 8. Industrial Microbiology, Prescott and Dunn

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Course Learning Outcomes

1. Know General bacteriology and microbial techniques for isolation of pure cultures of microbes from different food, agricultural and environmental sources
2. Solid-state fermentation utilizing different agro-residues and food waste as substrates for production of different bio-molecules viz. citric acid.
3. Submerged fermentation utilizing different agro-residues and food waste as substrates for production of different bio-molecules viz. citric acid.
4. Comparative study of solid state and submerged fermentation with respect to yield and variation in physical parameters.
5. Downstream processing of the bio-molecules and characterization such as stability at different pH and Temperature.

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M. Sc. Microbiology

Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

II Year: III Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSM301	Systemic Bacteriology	4	0	0	30	70	100	4	Core	Own faculty
2	MSM302	Environmental and Agricultural Microbiology	3	0	0	30	70	100	3	Core	Own faculty
3	MSM303	Immunology	4	0	0	30	70	100	4	GE-2	Own faculty
4	MSM321SE	Bioinformatics	4	0	0	30	70	100	4	SEC	Other faculty
5	------	DSE-2	3	0	0	30	70	100	3	DSE-2	Own faculty
Practical											
6	MSM351	Sytemic Bacteriology and Environmental Microbiology Lab	0	0	2	30	70	100	1	Core	Own faculty
7	MSM352	Immunology and Bioinformatics Lab	0	0	2	30	70	100	1	Core	Own faculty
8	MSM353	Summer Training/ Internship	0	0	2	30	70	100	1		
Total			18	0	6	240	560	800	21		
OR											
MSB3101PJ		**Dissertation**			40	30	70	100	20		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AECC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

Discipline Specific Elective-2 (DSE-2)	
Code	**Subject Name**
MSM3101	IPR, Bioethics and Biosafety
MSM3102	Environmental Toxicology
MOOCs/SVAYAM/NPTEL Courses	
MSM 301 Biomedical Ultrasound	https://onlinecourses.nptel.ac.in/noc24_ge45/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC.

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II Year: III Semester (Theory)
Systemic bacteriology
Code: MSM 301

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. To learn about gram positive and gram-negative cocci and their laboratory diagnosis.
2. To study about gram positive and gram-negative bacilli and their laboratory diagnosis.
3. To study about the other pathogenic bacteria causing human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

Unit I: Gram-positive cocci

Introduction, classification, history of GPC

Staphylococcus- *Staphylococcus aureus*- Morphology, culture, biochemical reactions, resistance, antigenic structure, toxins and enzymes, pathogenesis, typing methods, antibiotic sensitivity, epidemiology, laboratory diagnosis, treatment, control, other coagulase positive staphylococci, coagulase negative staphylococci (CONS), micrococci.

Streptococcus and Enterococcus

Classification- alpha haemolyticstreptocpcci, beta haemolytic streptococci, gamma or non-haemolytic streptococci*Streptococcus pyogenes*:- Morphology, culture, biochemical reactions, resistance, antigenic structure, toxins and enzymes, pathogenesis, epidemiology, typing methods, laboratory diagnosis, treatment, prophylaxis, other haemolytic streptococci, enterococcus, viridians streptococci

Pneumococcus- morphology, culture, biochemical reactions, resistance, antigenic structure, variation, toxins and other virulence factors, pathogenesis, epidemiology, laboratory diagnosis, treatment, prophylaxis

Unit II: Gram-negative cocci- ***Neisseria meningitides***

Morphology, culture, biochemical reactions, resistance, antigenic structure, pathogenesis, epidemiology, laboratory diagnosis, treatment, prophylaxis. ***Neisseria gonorrhoeae-*** morphology, culture, biochemical reactions, resistance, antigenic structure, pathogenesis, epidemiology, laboratory diagnosis, treatment, prophylaxisNon-gonococcal (non-specific) urethritis- causative agents, treatmentCommensal neisseriae, Moraxellacatarrhalis;- morphology, culture, biochemical reactions, pathogenesis, Moraxella lacunata- morphology, culture, biochemical reactions, pathogenesis, treatments

Unit III: Gram-positive bacilli

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Corynebacterium diphtheria- Morphology, culture, biochemical reactions, resistance, antigenic structure, toxins, bacteriophage typing pathogenesis, laboratory diagnosis, treatment, prophylaxisother pathogenic corynebacteria, diphtheroids, **Bacillus-** morphology, culture, biochemical reactions, resistance, antigens, toxins, pathogenesis, laboratory diagnosis, treatment, prophylaxis, anthracoid bacilli.*Bacillus cereus*-types of food poisoning, diseases other than food poisoning, pathogenesis, diagnosis, treatment, control. **Clostridium** – classification, general features, **Clostridium perfringens, Clostridium tetani, Clostridium botulinum, Clostridium difficile -**morphology, culture, biochemical reactions, resistance, pathogenesis, laboratory diagnosis, classification, prophylaxis, and treatment.

UNIT IV- Mycobacteria

Introduction, mycobacterium tuberculosis-morphology, culture, resistance, toxins, resistance, biochemical reactions, antigenic structure, mycobacteriophages, pathogenesis, immunity and hypersensitivity, Koch's phenomenon, tuberculin skin test, laboratory diagnosis, drug sensitivity test, prophylaxis, treatment, national tuberculosis elimination programme.

UNIT V- Miscellaneous Gram-positive bacilli

Listeria, Erysipelothrixrhusiopathiae, Tropphery mawhipplei -Morphology, culture, biochemical reactions, various species, pathogenesis, laboratory diagnosis, treatment

Suggested readings

1. Ananthanarayanan and paniker's textbook of microbiology (R. Ananthanarayan and C. K. Jayarampaniker)
2. Textbook of microbiology by C P baveja
3. Prescott / harleyklein's microbiology (joannewilley, lindasherwood, chriswoolverton)
4. Mackie and mccartney practical Medical Microbiology (J. Gerald Collee, Andrew G. Fraser, Barrie P Marmion, Anthony Simmons

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Describe gram positive and gram-negative cocci and their laboratory diagnosis.
2. Describe gram positive and gram-negative bacilli and their laboratory diagnosis.
3. Explain about the other pathogenic bacteria causing human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

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II Year: III Semester (Theory)

Environmental and Agricultural Microbiology

Code: MSM 302

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To understand the role of PGPR in stress management and nitrogen fixation.
2. To understand the applications of Biofertilizer technology.
3. To understand the importance of microorganisms in different ecosystem and bioremediation.

Unit I Plant Growth Promoting Rhizobacteria (PGPR)

Plant growth promoting rhizobacteria (PGPR), Mechanism of action for biotic and abiotic stress managegement, biological nitrogen fixation, biochemistry of nitrogen fixation-nitrogenase, ammonia assimilation and transport, physiological aspects of nitrogen fixation, nodulation- earlt and late events, molecular biology of nitrogenase activity.

Unit II Biofertilizers

Biofertilizers- history of biofertilizers, sources of nitrogen and importance of biofertilizers, description and characteristics of biofertilisers- Rhizobium, Azotobacter, Azospirillum, Blue green algae, Azolla, phosphate solubilizing microbes, VAM. Biofertilizer Production Technology- strain selection, sterilization, growth and fermentation, standards and quality control, biofertlizer application technology, constraints in application of biofertilizer technology.

Unit III Microbes In Different Ecosystems

Microbial services in greenhouse gases mitigation, natural resource management and restoration ecology. Microbial ecology of greenhouse gas (methane) producing and consuming bacteria from different ecosystems. Impact of different environmental drivers on ecologically beneficial microbial community and their biomass. Beneficial microbes in service of wasteland reclamation and restoration of marginal lands.

Unit IV Microbes and sustainable environment

Influence of land use change (LUC) on ecosystem services and agro-environmental sustainability. Microbial responses to landscape dynamics. Landscape changes on soil N status, climate system, carbon sequestration and GHG problems. Impact of LUC on dynamics of important soil microbiomes. Impact of crop residues burning on soil fertility and agriculturally important microbe.

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Unit V Role of Microbes in Bioremediation

Bioremediation of metals from polluted site, bacteria assisted phytoremediation of POPs, microbial degradation of industrial waste and detection of their metabolic products. Role of nanomaterial for biostimulation of detoxifying enzyme. Quorum sensing mechanism and biofilm formation in bacteria. Role of biosurfactants in bioremediation. Waste water treatment.

Suggested Readings

1. Prescott, Harley and Klein's Microbiology, Seventh Edition, McGraw Hill publications.
2. Brock Biology of Microorganisms, Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, 14th Edition, Pearson Publications.
3. Soil Microbiology (Fourth Edition of Soil Microorganisms and Plant Growth), N. S. Subbarao, Oxford and IBH Publishing Co. Pvt. Ltd.
4. Agricultural Microbiology, Third Edition (1 January 2020), N. S. Subbarao, Medtech Publication.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Understand the role of PGPR in soil and plant health.
2. Understand the applications of Biofertilizer technology.
3. Understand the importance of microorganisms in different ecosystems.

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II Year: III Semester (Theory)
Immunology
Code: MSM303

L	T	P	C
4	0	0	4

Course objective:

1. To compare and contrast the innate versus adaptive immune systems.
2. To compare and contrast humoral versus cell-mediated immune responses.
3. To understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation.

Unit-I: Introduction and definition of Immunology

Introduction- immunity- types-innate, acquired. Ontogeny and Physiology of immune system, Primary and Secondary lymphoid organs, lymphoid tissues. Immunoreactive cells- structure and functions-macrophages, granulocytes, NK cells, T and B lymphocytes – origin, development, differentiation, lymphocyte subpopulation in humans.

Unit-II: Humoral immunity and Cell Mediated Immunity

Antigen-antibody interactions, primary and secondary immune modulation. Affinity and avidity, high and low affinity antibodies, immunoglobulins, classes and structure, complement fixing antibodies and complement cascade.

T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC in antigen processing and presentation, structure of T-cell antigen receptors, TCR, BCR, cell mediated effecter functions.

Unit-III: Major Histocompatibility molecules

Structure functions, classifications and synthesis of immunoglobulins, antigen – antibody reaction, mechanisms and regulation of immune responses. Complement system, hypersensitivity, immune tolerance, immunity to infection, tumor immunity, genetics of immune response, major histocompatibility complex, transplantation, vaccination and immunization strategies, hybridoma technology. Apoptosis, telomeres and telomerase, cytokine network.

Unit-IV: Immunological Disorders

Inflammation, Types of hypersensitivity reactions, autoimmune disorders, their underlying molecular mechanism, etiology, diagnostic, prognostic and prophylactic aspects, immunodeficiency disorders: congenital and acquired, AIDS, immune response during bacterial (tuberculosis), parasitic (malaria), and viral (HIV) infections. Autoimmune disorders

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like systemic Lupus Erythematosus. Organ transplantation: Immunological basic of reaction angraft versus host reaction.

Unit-V: Immunodiagnostic Procedures

Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH. Various types of immunodiffusions and immunoelectrophoretic procedure, Immunoblot, agglutination of pathogenic bacteria, hemagglutination and hemagglutination inhibition, cellular technique.

Suggested Readings

1. Kindt TJ, Osborne BA and Goldsby RA (2007) Immunology, 6 th Edition, WH Freeman and Company, NY.
2. Owen JA, Punt J and Stranford SA (2013) Kuby Immunology, 7th Edition, WH Freeman and Company, NY.
3. Male D., Brostoff J., Roitt I and Roth D (2012) Immunology, WB Saunders Co. USA.
4. Parham P (2012). The Immune System, 3rd Edition, Garland Sciences, London and New York.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Compare and contrast the innate versus adaptive immune systems.
2. Compare and contrast humoral versus cell-mediated immune responses.
3. Discuss the significance of the Major Histocompatibility Complex in terms of immune response and transplantation.
4. Describe the different types of immunological disorder.
5. Discuss about immunodiagnostic procedures to study the immune response.

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II Year: III Semester (Theory)
Genomics, Proteomics and Bioinformatics
Code: MSM321SE

L	T	P	C
4	0	0	4

Course objective:

1. To know the detailed knowledge about genomics of an organism.
2. To analysis of genome sequencing and different diseases. and its applications.
3. To teach analysis total proteins using ultramodern techniques.
4. To know the applications of proteomics.

Unit- I: Genomics:
Genetic and physical maps, physical mapping and map-based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, chromosome microdissection, molecular markers in genome analysis; RAPD and AFLP analysis, molecular markers linked to disease resistant genes, application of RFLP in forensic, disease prognosis, genetic counselling, pedigree, Human genome project.

Unit- II: Genome Sequencing and Application:
Genome sizes, organelle genomes, genomic libraries, strategies for genome sequencing, packaging, transfection and recovery of clones, application of sequence information for identification of defective genes. Pharmacogenetics, genetics of globin triplet repeat disorders, cancer genetics; immunogenetics biochemical genetics; polygenic inheritance, Microarray

Unit- III: Proteomics:
Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Microscale isoelectric focusing in solution, Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; Differential display proteomics, Methods of studying Protein-protein interactions: GST Pull-down assay, Coimmunoprecipitation, Yeast two-hybrid system and structural proteomics

Unit- IV: Basics of Bioinformatic and Tools:
Introduction to Bioinformatics, use of Internet and search engines (WWW, HTML, URLs, Netscape, Explorer, Google, PUBMED), database management system, database browsing, data retrieval, sequence and genome database, databases such as GenBank, EMBL, DDBJ, Swissprot, PIR, TIGR, TAIR BLAST, phylogenetic analysis and detection of open reading frames (ORFs).

Unit-V: Application of Bioinformatics: Molecular evolution and phylogenetic tree, Gene predictions, Introduction to computational structural biology, in-silico methods for structural

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predictions, Homology threading and modeling, ab-initio modelling; Validation of in-silico determined 3D structures of proteins, Computer aided drug design-tools and applications.

Suggested Readings

1. Brown, T.A. Genomes 4, Garland Science, 2018.

2. Lesk, A.M. Introduction to Genomics, Oxford University Press, 2013.

3. Mishra, N.C. Introduction to Proteomics: Principles and Applications, Wiley-Blackwell, 2017.

4. Pennington, S.R. and Dunn, M.J. Proteomics: From Protein Sequence to Function, Viva Books, 2002.

5. Mount, D.W. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2004.

6. Pevsner, J. Bioinformatics and Functional Genomics, Wiley, 2015.

7. Zvelebil, M. and Baum, J.O. Understanding Bioinformatics, Garland Science, 2008.

8. Ewens, W.J. and Grant, G.R. Statistical Methods in Bioinformatics, Springer, 2005.

9. Rastogi, S.C., Mendiratta, N. and Rastogi, P. Bioinformatics: Concepts, Skills & Applications, Tata McGraw-Hill Education, 2008.

10. Attwood, T.K. and Parry-Smith, D.J. Introduction to Bioinformatics, PHI Learning Pvt. Ltd., 2009.

11. Kumar, A. Genomics and Proteomics: Fundamentals and Applications, New India Publishing Agency

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Understanding, remembering of and analysing the different tools of molecular biology used in genome analysis.
2. Remembering, understanding and analysing the basics principles of genome sequence analysis and its applications.
3. Remembering and understanding basics of different techniques involved in proteome analysis.
4. Remembering and understanding the principles and applications of proteomics.
5. Remembering and understanding the principles and applications Bioinformatics in different research fields.

Date:_____
Volume No.:_____

II Year: III Semester (Theory)
Discipline Specific Elective-2 (DSE-2)
IPR, Bioethics and Biosafety
Code: MSM3101

L	T	P	C
3	0	**0**	**3**

Course objective:

1. To provide basic knowledge on intellectual property rights and their implications in biological research and product development.
2. To become familiar with India'sIPR Policy.
3. To learn biosafety and risk assessment of products derived from biotechnology and regulation of such products.
4. To become familiar with ethical issues in biological research.

Course Objectives (CO)

1. To understand about biosafety measures to be taken during trials of biotechnological products.
2. To learn about requirements, steps of patenting.
3. To understand the bioethical guidelines followed during experiments.
4. To understand the safety of transgenic organisms.
5. To get familiarize with major acts and amendments related to IPR

Unit-1: Intellectual Property Rights (IPR)

Intellectual properties, copyrights, trademarks, trade secret, patents, geographical indications, etc. International framework for the protection of IP; IPs of relevance to biological sciences; introduction to GATT, WTO, WIPO and TRIPS.

Unit-2: Biosafety and Risk Management

Biosafety and risk assessment issues, regulatory framework, National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety; Cross border movement of germplasm; Risk management issues-containment.

Unit-3: Bioethics

General principles for the laboratory and environmental biosafety; health aspects; toxicology, allergenicity, antibiotic resistance etc. Impact on the environment; gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of superweeds/super viruses etc.

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Unit-4: Transgenics ant their Safety

Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and non-isotopic procedures; Benefits of transgenics to human health, society and the environment.

Unit-5: Acts and Amendments related to IPR

Indian Patent Act and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

References/ Text Book:

1. Singh BD, 2007. Biotechnology: Expanding Horizons. Kalyani
2. Intellectual Property Rights, Bioethics, Biosafety and Entrepreneurship in Biotechnology, by Sibi G
3. Intellectual Property Rights by Brigitte Anderson, Edward Elgar Publishing.
4. Intellectual Property Rights and the Life Sciences Industries by Graham Dutfield, Ashgate Publishing.
5. WIPO Intellectual Property Handbook.
6. Intellectual Property Rights by William Rodelph Cornish, David Clewelyn
7. IPR, Biosafety & Bioethics, Goel D & Parashar S, Pearson Publishers, 2013.
8. Biological Safety Principles & Practices, 4th Edition, Fleming DO & Hunt DL, ASM Press, 2006.

Course Learning Outcomes (CLOs):

On completion of this course, the students will be:

1. **Remembering** and **understanding** the rationale for and against IPR and especially patents.
2. **Remembering** and **understanding** why India has adopted an IPR Policy and be familiar with broad outline of patent regulations.
3. **Remembering, understanding and analysis the** biosafety and risk assessment of products derived from recombinant DNA research and environmental release of genetically modified.
4. **Remembering, understanding and analysis of** the ethical aspects related to biological, biomedical, health care and biotechnology research.

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Date:_____
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II Year: III Semester (Theory)
Discipline Specific Elective -2 (DSE-2)
Environmental Toxicology
Code: MSM 3102

L	T	P	C
3	0	0	3

Course Objectives (CO)

1. To understand environment, its composition and different types of pollution.
2. To study the chemical toxicity of important environmental pollutants.
3. To study the effect of environmental pollutants on health and some case history.
4. To study the waste disposal and role of bioremediation.

Unit-I: Introduction of Environmental Science

Environmental Pollution: Classification of pollutants, Ecosystem structure and functions, abiotic and biotic component, Energy flow, food chain, food web, Ecological Pyramids-types, biogeochemical cycles. Air, Water, Soil, Noise and Thermal pollution: Their source, Effect and biotechnology-based control measures.

Unit-II: Chemical Toxicology

Biochemical effects of heavy metals (Pb, As, Hg, Cd), pesticides, insecticides, herbicides, weedicides, larvicides. Risk of environmental Geno toxicants such as bisphenols, mycotoxins, combusted carbonaceous fuels as carcinogen.

Unit-III: Effect of Environmental pollutants and case history

Effect of climate change on public health, Ozone depletion, UV-B, Green-house effect, acid rain, CITES etc. Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath

Unit-IV: Waste disposal and Bioremediation

Biomedical waste handling and disposal, nuclear waste handling and disposal, Waste from thermal power plants. Bio feasibility, Bioremediation: Introduction and types of bioremediations, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ & Ex-situ technologies, and phytoremediation.

Unit -IV: Environmental quality Assessment, Monitoring and Environmental Legislations

Biosensors and biochips, Recent environmental legislation and international agreement on environment. Environmental Quality Assessment and Monitoring, Quality of environment for life on earth and man; Deterioration of environmental quality with reference to anthropogenic impact; Methods of assessment of environmental quality, short term studies/surveys, Rapid

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assessment, Continuous short- and long-term monitoring, Environmental Impact Assessment (EIA), Need of EIA, Scope and objectives, Types of environmental impacts, Steps involved in conducting the EIA Studies and its drawback.

Suggested Readings

1. Bruce Rittman, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd edition, McGraw-Hill, 2000.
2. Milton Wainwright, An Introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston. Hardbound, 1999.
3. K.G. Mukerji, B.P. Chamola, Rajeev K. Upadhyay, Biotechnological Approaches in Biocontrol of Plant Pathogens, Kluwer Academic/Plenum Publishers. Hardbound, 1999

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Understand environment, its composition and different types of pollution.
2. Discuss the chemical toxicity of important environmental pollutants.
3. Describe the effect of environmental pollutants on health and some case history.
4. Discuss the waste disposal and role of bioremediation.

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II Year: III Semester (Practical)

Systemic Bacteriology and Environmental Microbiology Lab

Code: MSM351

L	T	P	C
0	0	**2**	**1**

Course Objectives

1. To make use of conventional techniques/ instruments to perform biochemical analysis relevant to clinical screening and diagnosis biochemistry.
2. To analyze and interpret investigative data.
3. To demonstrate the skills of solving clinical problems and decision making.

Practicals

1. Microscopic examination of bacteria in living conditions.
2. Isolation and Identification of bacteria from different environmental samples.
3. Identification of unknown bacterial culture (Morphological tests)
4. Identification of unknown bacterial culture (Biochemical tests)
5. Carbohydrate fermentation tests.
6. Identification of unknown fungus (Mold).
7. Antibiotic sensitivity tests- disc diffusion.
8. To test phosphate solubilization by bacteria
9. To test zinc solubilisation by bacteria
10. Isolation of lignocellulosic degrading bacteria
11. Isolation of fluorescent pseudomonds from soil.

Suggested Readings-

1. Human Parasitology, With Notes On Bacteriology, Mycology, Laboratory Diagnosis, Hematology And Serology Hardcover – 26 October 2020, by Damaso Rivas (Author).
2. Lab Manual - Biochemistry.pdf (jru.edu.in)

Course Learning Outcome (CLO)

At the end of the course, the student should be able to

1. Make use of conventional techniques/ instruments to perform biochemical analysis relevant to clinical screening and diagnosis Biochemistry and bacteriology
2. Analyze and interpret investigative data
3. Demonstrate the skills of solving clinical problems and decision making

Date:_____
Volume No.:_____

II Year: III Semester (Practical)

Immunology and Bioinformatics Lab

Code: MSM352

L	T	P	C
0	0	**2**	**1**

Course Objectives

1. To have a knowledge of common immunological disorders and their resultant effects on the human body.
2. To have an understanding of the common haematological disorders and the investigations necessary to diagnose them and determine their prognosis.
3. To perform and interpret in a proper manner the basic clinico-pathological procedures.
4. To know the principles of collection, handling and dispatch of clinical samples from patients in a proper manner.

Practicals

1. Ouchterlony Double Diffusion
2. Rocket Immuno Electrophoresis and Counter Current Immunoelectrophoresis
3. Enzyme Linked Immunosorbent Assay (ELISA) – DOT and Plate.
4. Immunoprecipitation
5. Western Blotting
6. Sputum for AFB and basic of DOT, MycoDot, Mantoux.
7. Immunochromatographic Test Technique (kit method): MPICT, HIV, HBsAg, HCV, Widal test (Typhoid), TOXO (Toxoplasma), Dengue, Chikungunya.
8. Bacterial identification using software based on morphological and biochemical characters.
9. Exploration of online databases: Journal articles – NCBI-Pubmed; Protein and Nucleotide, sequences – NCBI-Protein, NCBI-Nucleotide; EMBL-EBI, DDBJ, OMIM, GEO, ZINC,
10. Sequence retrieval from Databases, Sequence Similarity search - Blast: Blastn, Blastp, Blastx. And Multiple Sequence Alignment (Ex: CLUSTAL-OMEGA, MAFFT, K-ALIGN) and Construction of phylogenetic tree.

Suggested Readings

1. Clinical Immunology and Serology: A Laboratory Perspective Paperback – 23 March 2005, by Christine Dorresteyn Stevens (Author)
2. Manual of Molecular and Clinical Laboratory Immunology, 8th Edition, Barbara Detrick (Editor), John L. Schmitz (Editor),

Course Learning Outcomes

At the end of the course the student will be able to:

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1. Have an understanding of the common immunological and hematological disorders and the investigations necessary to diagnose them and determine their prognosis.
2. Perform and interpret in a proper manner the basic clinico-pathological procedures.
3. Know the principles of collection, handling and dispatch of clinical samples from patients in a proper manner.

Date:_____
Volume No.:_____

II Year: III Semester (Practical)
Summer Training/Internship
Code: MSM353

L	T	P	C
0	0	4	2

Course Objectives

The overall objective of the industrial training is to expose the student to the work environment in the field of biochemistry. In particular, the industrial training program will:

1. Enable the students to gain valuable practical experience, and test the students' career interests.
2. Provide the students with in depth knowledge about career fields.
3. Develop the students' job-related skills.
4. Enhance the students' biochemistry knowledge acquired in class through lab experience.
5. Teach the students on how to deal with the society outside the university.
6. Provide the training organizations with a better assessment of the quality of future human resources, and suggest improvements.

Summer Training /Internship

Summer Training /Internship are an essential part of the academic curriculum. It is a bridge the widen gap between theoretical learning and practical exposure by giving students the first-hand exposure to identify the inputs and outputs for different Industrial operations and processes performed at the workplace.

Course Learning Outcomes

On completion of this course, the students will be able to

1. Analyze the different career prospects available in biochemistry -related establishments
2. Understand the technology implemented in the manufacturing of products in real-world scenario
3. Understand the entrepreneurial skills required to establish biochemistry -related manufacturing units
4. Understand the cost-cutting strategies adopted by manufacturing units

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M. Sc. Microbiology

Study Evaluation Scheme (Choice Based Credit System)

Effective from the session 2025-26

II Year: IV Semester

S No	Course Code	Course	L	T	P	Evaluation Scheme		Total	Credits	Course Type	Faculty
						CIE	ESE				
Theory											
1	MSM401	Research Methodology	4	0	0	30	70	100	4	Core	Own faculty
2	MSM402	Microbial Genetics	4	0	0	30	70	100	4	Core	Own faculty
3	MSM403	Microbial Biotechnology	4	0	0	30	70	100	4	GE-2	Own faculty
4	MSM421SE	Microbial Genetic Manipulation	4	0	0	30	70	100	4	SEC	Other faculty
5	------	DSE -3	3	0	0	30	70	100	3	DSE-2	Own faculty
Practical											
6	MSM451	Microbial Genetic and Biotechnology Lab	0	0	2	30	70	100	1	Core	Own faculty
Total			18	0	2	210	490	700	20		
OR											
	MSB4101PJ	**Dissertation**			40	30	70		20		

L	Lecture
T	Tutorial
P	Practical
CIE	Continuous Internal Evaluation
ESE	End Semester Examination

GE	Generic Elective
AECC	Ability Enhancement Compulsory Course
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

Discipline Specific Elective-3 (DSE-3)	
Code	**Subject Name**
MSM4101	Quality control in Clinical lab
MSM4102	Cancer Biology
MOOCs/SVAYAM/NPTEL Courses	
MSM 401 Circular Dichroism(CD) and Mossbauer Spectroscopy	https://onlinecourses.nptel.ac.in/noc24_cy53/preview
MSM 402 Computer Aided Drug Design	https://onlinecourses.nptel.ac.in/noc24_bt44/preview

Note: The evaluation scheme, promotion scheme, grading system, and CGPA calculation are adopted from the CCFPP given by UGC.

Date:_____
Volume No.: _____

Date:_____
Volume No.:_____

II Year: IV Semester (Theory)
Research Methodology
Code: MSM401

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. To understand a general definition of research design.
2. To know why educational research is undertaken, and the audiences that profit from research studies.
3. To study the methods of data collection, data processing and analysis strategies in research.
4. To gain knowledge on ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.
5. To distinguish a purpose statement, a research question or hypothesis, and a research objective.

Unit- I –Research formulation and Design

Motivation and objectives, Research methods vs. Methodology. Types of research, Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

Unit-II – Data collection and analysis

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

Unit-III – Computer in Research

Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

Unit-IV –Research ethics, IPR and scholarly publishing

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual

Date:_____
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property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Unit-V –Interpretation and Report writing

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports and Conclusions.

Suggested Readings

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Understand a general definition of research design.
2. Describe why educational research is undertaken, and the audiences that profit from research studies.
3. Explain the methods of data collection, data processing and analysis strategies in research.
4. Describe ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.

Date:_____
Volume No.:_____

II Year: IV Semester (Theory)

Microbial Genetics

Code: MSM402

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

To introduces the principles of cell biology and genetics. After completion of this course, students will be able to-

1. To learn different areas of cell biology including the structure and functions of cell, its organelles such as mitochondria, nucleus etc.
2. To understand how genetic information is transmitted in organism
3. To understand the role of cytoskeleton and its remodeling including the diseases associate with improper remodeling.

Unit I: Gene Structure, Replication and Expression

DNA as genetic material, Flow of Genetic Information, Nucleic Acid Structure, DNA replication, Gene Structure, Transcription, The Genetic Code, Translation, Protein folding and molecular chaperones.

Unit II: Regulation of Gene Expression

Levels of regulation of gene expression. Regulation of transcription initiation- Lac Operon, tryptophan operon, arabinose operon, two-component regulatory system. Regulation of transcription elongation- attenuation, riboswitches. Regulation at the level of translation by riboswitches and small RNA molecules. Global Regulatory systems- Catabolite repression, Quorum sensing and Sporulation in *Bacillus subtilis*.

Unit III: Mutations and DNA Repair

Mutations and their chemical basis, types of mutations and effects of mutations- wild, forward, reversion, suppressor, silent, missense, nonsense, Frameshift and conditional mutations. Detection and isolation of mutants, Carcinogenicity test. DNA repair- Excision repair, Direct repair, Mismatch repair, Recombinational repair, and SOS response.

Unit IV Microbial plasmid

Plasmids in prokaryotes and eukaryotes Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids.

Unit V Genetic Variability in Prokaryotes

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Horizontal Gene transfer in Procaryotes, Homologous recombination, site-specific recombination and transposition. Transposable elements. Bacterial Plasmids. Bacterial conjugation, DNA Transformation, Transduction- Generalized and Specialized.

Suggested Reading:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6thEd.). New York: Garland Science.
2. Cooper, G. M., and Hausman, R. E. (2013). The Cell: A Molecular Approach (6th Ed.). Washington: ASM; Sunderland.
3. Karp, G. Cell and Molecular Biology. Concepts and experiments. John Harris, D.,Wiley& sons, New York.
4. Iwasa J., Marshal W. Karp's Cell Biology (2018) (8th edition) Wiley & Sons, NY
5. Iwasa J., Marshal W. Karp's Cell and Molecular Biology. Concepts and experiments. (2015) (8th edition) Wiley & sons, New York
6. Watson, J. D. Baker TA, Bell, SP Gann, A. Levine, M. Losick R. (2008). MolecularBiology of the Gene (5thed.). Pearson.
7. Lodish, H F. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A.Martin, K. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
8. Gupta P.K. Cell and Molecular Biology 2018. 5thedition Rastogi Publication India
9. Verma PS, Agarwal VK. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. (2004). S Chand and Company Ltd.
10. Satyanarayana U (2020). Biotechnology. Books and Allied (P) Ltd.
11. Singh BD. (2015). Biotechnology: Expanding Horizons (4thedition). KalyaniPublishers
12. Dubey RC. (2014) A Textbook of Biotechnology (5thedition) S Chand and CompanyLtd.
13. सिंहबी. डी.(2017)बायोटेक्नोलोजीKalyani Publishers
14. सिंहबी. डी. आनुवंशिकीकेआधार. (2017) Kalyani Publishers
15. सोनीके.सी.स्वरंकारगायत्री. आधुनिककोशिकाविज्ञान, 2018 CBC

Course Learning Outcome (CLO)

1. This course introduces the principles of cell biology and genetics. After completion of this course, students will be able to-

2. Learn different areas of cell biology including the structure and functions of cell, its organelles such as mitochondria, nucleus etc.
3. Understand how genetic information is transmitted in organism
4. Understand the role of cytoskeleton and its remodeling including the diseases associate with improper remodeling.

Date:_____
Volume No.:_____

II Year: IV Semester (Theory)

Microbial Biotechnology

Code: MSM403

L	T	P	C
4	0	0	4

Course Objectives (CO)

1. To get knowledge of microbial biotechnology and their applications in different fields.
2. To study the industrial production using microbial biotechnology.
3. To study the role of microbial biotechnology in biodegradation and bioremediation.
4. To study the composting and vermicomposting techniques and their applications in organic farming and solid waste management.

Unit I Microbial Biotechnology

Microbial Biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhiza), environmental and food technology, use of prokaryotic and eukaryotic microorganisms in biotechnological applications, genetically engineered microbes for industrial applications.

Unit II Recombinant Microbial Production

Recombinant Microbial Production processes in pharmaceutical industries- streptokinase, recombinant vaccines (Hepatitis B vaccine), Microbial polysaccharides and polyesters, microbial production of bio-pesticides, microbial biosensors, biostimulant.

Unit III Microbes and Biodegradation

Degradation of Xenobiotics, Biomining-mineraal recovery, removal of heavy metals from effluents, biodegradation of recalcitrant compounds, microbial based accumulation, microbes as decomposers, prebiotics and probiotics, Single cell protein (SCP), Mushroom cultivation.

Unit IV Biofuel Production

Microbial enhanced oil recovery, bio-ethanol and bio-diesel production- commercial production from lingo-cellulosic waste, algal biomass for fuel. Biogas production- methane and hydrogen production using microbial culture. Bioinoculant.

Unit V Biocomposting

Production of compost from different solid waste, preparation of composting, assessing the quality parameters of matured compost, different techniques in composting, nutritional enrichment of mature compost, i.e., micro/macro nutrients. Introduction to vermiculture,

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history, economic importance, their value in maintainence of soil structure, role as four R's of recycling, reduce, reuse, restore. Vermiwash and vermicomposting techniques.

Suggested Readings

1. Brock Biology of Microorganisms, Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, 14th Edition, Pearson Publications.
2. Soil Microbiology (Fourth Edition of Soil Microorganisms and Plant Growth), N. S. Subbarao, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Agricultural Microbiology, Third Edition (1 January 2020), N. S. Subbarao, Medtech Publication

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Describe the role of microbial biotechnology in industrial production.
2. Discuss the methods of bio-composting and vermicomposting.
3. Describe the process of bioremediation and biodegradation with the help of microbial biotechnology.

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Date:_____
Volume No.:_____

II Year: IV Semester (Theory)
Code: MSM421SE
Microbial Genetic Manipulation

L	T	P	C
4	0	**0**	**4**

Course Objectives (CO)

1. To Understanding microbial genes, genomes, and gene expression is essential for understanding the biology and evolution of microorganisms and their interactions with the environment
2. To learn the biology and microbial genetics are now in an exciting era of "genomics" and "post-genomics." Complete genome sequences (genetic blueprints).
3. To learn the structure, function, expression, and evolution of microbial genes and methods for their study and manipulation
4. To learn microbial genomes and their evolution; gene discovery, identification, and mapping; mutation; DNA repair; gene transfer among organisms; plasmids; transposable elements; genetic recombination; and gene regulation.
5. To understand the gene cloning, polymerase chain reaction (PCR) and quantitative PCR, hybridization techniques, microarrays, 'proteomics,' 'metabolomics,' uses of gene expression, directed mutagenesis, gene fusions, 'reporters,' probes, and emerging technologies such as 'Next Generation' DNA sequencing strategies.

Unit-I: Genomic Analysis

Structure and replication of DNA, the basis for molecular genetics: DNA duplexes, melting, reannealing, & the activity of enzymes that bind DNA. Review of molecular genetic techniques: restriction analysis, gel electrophoresis, DNA & RNA hybridizations, melting curves, cutting & joining DNA, & gene cloning strategies, RNA, transcription, translation, protein folding, & membrane proteins.

Unit-II: Post Genomic Analysis

Post-genomic' analyses: global gene expression studies via microarrays, Spotted vs. oligonucleotide synthesis and 'tiling' arrays, Emerging technologies: Global gene expression studies via 'deep mRNA sequencing',Real-Time, quantitative PCR (qPCR) & reverse transcriptase quantitative PCR (RT-qPCR) for gene expression studies

Unit-III: Mutation, DNA repair, and evolution

Types of mutation & DNA repair • Mutagenesis • Mechanisms of genome and microbial evolution, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, Extra-chromosomal and moveable elements: Plasmids: gene cloning and in vitro mutagenesi

Unit-IV: Gene Transfer

Date:_____
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Gene Transfer methods, Impact on microbial evolution & basis for classical mapping and mutation analysis, Conjugation and conjugative plasmid**,** Gene Transfer, Transformation: physiological and artificial, Transduction and bacteriophage, Moveable genetic elements, Transposons, 'illegitimate' recombination, & site-specific recombination, Plasmids and transposons as tools, Microbial introns, retrons, and inteins

Unit-V: Regulation of gene expression & responses to changing environments

Operons, repressors, activators, & paradigms of gene regulation, Global regulatory mechanisms, Regulatory cascades, two component sensors, sensor-kinases & response regulators, enhancers & silencers, Regulatory RNAs, Global gene expression studies, further discussion of microarrays, proteomics & new technologies, Genetic analysis of bacteria, strain construction, gene fusions & genetic reporters. Synthetic genes & genomes, in vitro genetic manipulations,

Suggested Readings

1. McMillan, V. E. 2006. Writing Papers in the Biological Sciences, 4th edition, Bedford/St. Martin's.
2. Bushman, F. 2002. Lateral Gene Transfer, Cold Spring Harbor Laboratory Press.
3. Kaper, J. B. and Hacker, J. 1999. Pathogenicity Islands and Other Mobile Virulence Elements, ASM
Press, Washington, D.C.
4. Ptashne, M. 2002. Genes and Signals, Cold Spring Harbor Laboratory Press.
5. Miller, J.R. 1992. A Short Course in Bacterial Genetics: Lab Manual, Cold Spring Harbor Laboratory Press.

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Learn the structure & properties prokaryotes genome and its structural elements.
2. Learn the role of different proteins in replication, nature of DNA replication and the structure of DNA polymerase in microbes.
3. Learn microbial genes, genomes, and gene expression and evolution of microorganisms and their interactions with the environment.
6. Learn the microbial genomes and their evolution; gene discovery, identification, and mapping
4. Understand the molecular biology techniques and their application in microbial genetic manipulation and medical field.

Date:_____
Volume No.:_____

II Year: IV Semester (Theory)
Discipline Specific Elective-3 (DSE-3)
Quality Control in Clinical Lab
Code: MSM4101

L	T	P	C
3	0	**0**	**3**

Course Objectives (CO)

1. To study the quality control in the clinical laboratory for improvement in the efficiency and effectiveness its services.
2. To know how to comply with safety and security policies and procedures.
3. To demonstrate how to follow emergency procedures.
4. To Know the ISO Policy for medical laboratory.
5. To get knowledge about safety and bio-medical waste management.

Unit-I: Introduction to Quality

Quality control, accuracy, precision, specificity, sensitivity and limitation of errors allowable in the laboratory, LJ Chart, Health literacy, Report distribution system, Error in reporting system, responding to adverse events, Investigation of error/ Root cause analysis, Medical Error, The science of safety

Unit-II: EHS rules in GMP/GLP controlled lab area

Recall the guidelines and procedures for hazards, accidents, safety signs and signals, and Heinrich pyramid used in a lab, Describe the importance of the gowning, medical assistance and emergency services, explain health, safety, and accident reporting procedures, Discuss the procedures for evacuation for employees, contract staff, and visitors in controlled areas, Discuss the types of safety gears and procedure to use them, Explain the importance of material segregation and 5S system. Internal quality control, EQAS,

Unit-III: ISO Policy for Clinical Laboratory

Team work and communication, Leadership, Quality control policy, Major development and evaluation in diagnostic division, Clinical establishment act policy, National accreditation board of laboratory, ISO Policy for medical laboratory, Fire and safety policy for medical laboratory.

Unit-IV: Bio-Medical Waste Management

Personal protective equipment in the laboratory, AIDS and laboratory safety, Safety protection in lab in STD and other infectious disease., Biomedical waste management, Patient care in medical laboratory, Patient rights, Counselling of patient during phlebotomy, First aid in medical laboratory service.

Date:_____
Volume No.:_____

Suggested Readings

1. Total Quality Management: Key Concepts and Case Studies, by D.R. Kiran.
2. Fundamentals of quality control and improvement by Amitava Mitra
3. Quality Control by Dale H. Besterfield

Course Learning Outcomes (CLO)

At the end of the course, the student should be able to:

1. Explain the quality control in the clinical laboratory for improvement in the efficiency and effectiveness its services.
2. Describe how to comply with safety and security policies and procedures in clinical laboratories.
3. Discuss how to follow emergency procedures.
4. Discuss the ISO Policy for medical laboratory.
5. Explain about safety and bio-medical waste management.

Date:_____
Volume No.:_____

II Year: IV Semester (Theory)
Discipline Specific Elective-3 (DSE-3)
Cancer Biology
Code: MSM4102

L	T	P	C
3	0	0	3

Course Objectives:

1. To acquire basic knowledge about cancer formation and progression
2. To gain glimpses of current progress in basic concepts of cell cycle related cancer research.
3. To gain insights about stems cells and their role in cancer.

Unit-1 Introduction to cancer

Definition and classification of cancer, Hallmarks of cancer: Basic hallmarks and emerging hallmarks with enabling characteristics. Global impact and prevalence of cancer: causative factors such as environmental, environment, reproductive life, diet, alcohol and smoking. Carcinogenic agents-radiation, chemicals, biological agents, and endogenous reactions.

Unit-2 Cell cycle and regulation

Overview of cell cycle, check - points in cell cycle regulation. S-phase, mitotic phase and cytokinesis, control of cell division and cell growth. Programmed cell death or Apoptosis; mechanism, regulation, pro-apoptotic factors, Pro-apoptotic regulators. Benign and malignant tumors.

Unit-3 Cancer transformation and types of cancers

Cancer transformation, Metastatic tumor cells - Alteration in cell - cell interaction -blood vessel formation - Tumor micro environment influence cancer development - Isolation of DNA from tumor cells - Transformation of normal cultured cells. Types of cancer cells and their morphological architecture.

Unit-4 Molecular oncology

Carcinogenesis: Aberrant metabolism in cancer, paraneoplastic syndrome. Tumor markers, stages in chemical carcinogenesis; Initiation, promotion and progression. Oncogenes, proto - oncogenes and viral oncogenes - mechanism of oncogene activation. Growth factors – EGF, TNFα and TNFβ and growth factor receptors. Tumor suppressor genes: Loss of heterozygosity, Over expression of glycoproteins, P53 & Bcl2 role in carcinogenesis, Retinoblastoma.

Unit-5 Stem cells

Date:_____
Volume No.:_____

Stem cells: Types and self-renewal mechanism, cancer stem cell models: Hierarchal and stochastic model, Cancer stem cell pathways: Wnt and Hedgehog pathways.

Suggested readings:

1. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics, 5th Edition (2021), Pecorino L, Oxford University Press; ISBN: 9780198833024

2. Lecture Notes: Oncology, 2nd Edition (2011), Bower M and Waxman J, WileyBlackwell; ISBN: 9781118293003

3. The Biology of Cancer, 3rd edition (2023), Robert A Weinberg, W W Norton & Co.; ISBN: 978-0393887662

4. The Biology of Cancer, 2nd Edition (2007), Janice Gabriel (Editor), Wiley; ISBN: 9780470057599

Course Learning Outcomes:

At the end of the course, the student should be able to:

1. Acquire basic knowledge about cancer formation and progression
2. Gain glimpses of current progress in basic concepts of cell cycle related cancer research.
3. Gain insights about stems cells and their role in cancer.

Date:_____
Volume No.:_____

II Year: IV Semester (Practical)

Microbial Genetics and Biotechnology Lab

Code: MSM451

L	T	P	C
0	0	2	1

Course objective:

1. To acquire the skill for identification of microbes.
2. To acquire the knowledge of microbes to environment interaction
3. To teach different conjugating methods.
4. To teach different techniques for microbial genetic manipulation.

Practical

1. Isolation of antibiotic resistant bacterial population by gradient-plate method.
2. isolation of antibiotic resistant mutants by replica plating technique
3. Demonstration of genetic recombination in bacteria by conjugation
4. Isolation of plasmids from bacteria.
5. Isolation of DNA from bacteria.
6. UV induced auxtotrophic mutants production and isolation of mutants by replica plating technique
7. The Ames test: for detecting potential carcinogens
8. Sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) of proteins.

Book suggesting

1.Molecular Genetics of Bacteria, 2013, 4th Ed, L. Snyder, J. E. Peters, T. M. Henkin, W. Champness Wiley ISBN: 9781555816278)
2. Microbial Genetics, 1994, 2nd Ed, by S.R. Maloy, J.E. Cronan & D. Freifelder; Jones and Bartlett Pub.
3. An Introduction to Genetic Analysis, (all editions) by A.J.F. Griffiths, J.H. Miller, D.T. Suzuki, R.C. Lewontin & W.M. Gelbart; W.H. Freeman & Co. Pub.

Course Learning Outcomes (CLO):

On completion of this course, the students will be able to:
1.To acquire the skill for identification of microbes.
2.To acquire the knowledge of microbes to environment interaction
3.To teach different conjugating methods.
4.To teach different techniques for microbial genetic manipulation

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Date:_____
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