आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश

IFTM University, Moradabad, Uttar Pradesh

NAAC ACCREDITED

SCHOOL OF BIOTECHNOLOGY
IFTM UNIVERSITY
www.iftmuniveristy.ac.in

Study & Evaluation Scheme of
Master of Science (Microbiology)
Session 2021-2022

Programme:	Master of Science (Microbiology)
Course Level:	PG Degree
Duration:	Two Years (four semesters) Full Time
Medium of Instruction:	English
Maximum required attendance:	75%
Maximum Credits:	93

Programme Outcomes (POs)

Students completing this programme will be able to:

- Developed broad knowledge in various areas of Microbiology.
- The excellence in educational and technical skills.
- Understand the role of microbes in health, food and value-added product formation – eg. Alcohol, organic acid, amino acid etc.
- Gain theoretical and practical knowledge that enable them to explain about various applications of Microbiology in field of Environment, Industrial, Food, Genetics and Diseased Pathogenicity.
- Design and execute research projects/experiments related to Basic & Applied Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, and Microbial Genetics, and Microbial Pathogenicity.
- Acquire suitable position in academia or industry, and to pursue a career in research.

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
M.Sc. (BIOTECHNOLOGY/MICROBIOLOGY/FOOD TECHNOLOGY)
(Effective from 2021-22)
First Semester

S.N.	Module Code	Module Name	Periods			EVALUATION SCHEME				Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total	End Sem Exam		
THEORY											
1.	MSB-101	Cell Biology	3	1	0	20	10	30	70	100	4
2.	MSB-102	Biochemistry	3	1	0	20	10	30	70	100	4
3.	MSB-103	Microbiology	3	1	0	20	10	30	70	100	4
4.	MSB-104	Bioinstrumentation	3	1	0	20	10	30	70	100	4
5.	MSB-105	Molecular Biology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6	MSB-151	Cell Biology & Biochemistry	0	0	4	20	10	30	70	100	2
7	MSB-152	Microbiology & Bioinstrumentation	0	0	4	20	10	30	70	100	2
		Total Credit	**15**	**5**	8			**210**	**490**	**700**	**24**

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)
(Effective from 2021-22)

MSB-101: CELL BIOLOGY

Objective(s): The objectives of this course:

- Will build on the knowledge of cell structure and function gained in the undergraduate course's students knowledge of how eukaryotic cells work at the molecular level.
- Provide an overview of cell structure and function at the molecular level, including the flow of information from genes to proteins, and regulation of cellular processes, signaling and proliferation in eukaryotic cells.
- Introduce some of the major ideas and experimental approaches in cell and molecular biology.

UNIT I: **(8 Sessions)**

Cell Basics: Discovery of cell; The Cell theory; Ultrastructure and functions of prokaryotic and eukaryotic cells. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structure and functions of Nucleus, with nuclear pore complex, Nucleolus, Endoplasmic reticulum, Golgi complex, Ribosome; Biogenesis of mitochondria and chloroplast.

UNIT II: **(8 Sessions)**

Cytoskeleton, Cell Motility and Cellular Interaction: Microtubules, microfilaments and intermediate elements; Cell motility - Amoeboid, ciliary and flagellar movements. Microvilli, Tight Junction, Desmosome; Connexon; Intercellular communication and Gap Junction.

UNIT III: **(8 Sessions)**

Cell Division and Cell Cycle: Mitosis -Mitotic Apparatus – centromere/kinetochore; Spindle microtubule; Metaphase chromosomal motion; Anaphase chromosomal movement. Meiosis- Meiotic division I and Meiotic division II; Cytokinesis in animal and plant cells; regulation and control of cell cycle.

UNIT IV: **(8 Sessions)**

Cell signaling: Extracellular Messengers & their receptors, G-protein- Coupled receptors their second messengers and signal transduction pathway-Specificity of G-protein coupled responses, Regulation of Glucose levels, Role of GPCRs in sensory perceptions. Protein Tyrosine Kinases- Receptor tyrosine kinases (RTKs), Dimerization, Protein Kinase activation, RTKs activates downstream signaling pathway, signaling by the insulin receptors; Calcium as an intracellular messenger: IP3 and Voltage-Gated Ca^{2+} Channels, Calcium binding Protein (calmodulin); light induced signal transduction (Plant transduction).

UNIT V: **(8 Sessions)**

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, apoptosis.

Course Outcomes:

Upon successful completion of the course, students should be able to:

- Understand and utilize the scientific vocabulary used in communicating information in cell and molecular biology
- Understand and apply general concepts of cell and molecular biology to relevant, specific problems
- Describe and discuss the properties and biological significance of the major classes of molecules found in living organisms and the relationship between molecular structure and biological function
- Represent and illustrate the structural organization of genes and the control of gene expression
- Conceptualize and describe protein structure, folding and sorting
- Explain the structure of membranes and intracellular compartments and relate these to function.
- Summarize the processes of energy transduction in cells and explain their significance.
- Relate how cell movement and cell-cell communication occur and discuss mechanisms of signal transduction
- Outline the processes that control eukaryotic cell cycle and cell death.
- Link the rapid advances in cell and molecular biology to a better understanding of diseases, including cancer.

Suggested Readings:

1. Buchanan et al. Biochemistry & Molecular Biology of plants (2004)
2. Nelson & Cox Lehninger Principles of Biochemistry, (2005)
3. Karp,G. Cell and Molecular Biology; Concepts & Experiments (2004).
4. Cooper,G.M. The Cell: A molecular Approach (2004)
5. De Robertis & df Robertis. Cell & Molecular biology
6. Hughes &Mehnet. Cell proliferation and apoptosis (2003)
7. Albert's et al Molecular Biology of Cells, (2002), 4th Edition
8. Lodish et al. Molecular Cell Biology (2004)

Website Sources:

- https://www.edx.org/learn/cellular-biology
- https://www.coursera.org/courses?query=cell%20biology
- https://bscb.org/learning-resources/softcell-e-learning/
- https://www.mooc-list.com/tags/cell-biology
- https://nptel.ac.in/courses/102/103/102103012/

IFTM University, Moradabad

Master of Science (M.Sc.), Programme

M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)

(Effective from 2021-22)

MSB-102: BIOCHEMISTRY

Objective(s): The objectives of this course:

- Is designed to introduce the students to the study of biological phenomena at the molecular level.
- Aims to make the students understand the fundamental chemical principles that govern complex biological systems.
- Have major focuses on disciplines within biology and chemistry to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis.
- Enable students to acquire a specialized knowledge of the biological molecules and their structure.

UNIT I: (8 Sessions)

Carbohydrates: Composition; basic structure and function of carbohydrates, Mono-, di- ,oligo-saccharides, Glycosidic bonds; glycoproteins (O- linked and N- linked), glycolipids; Polysaccharides- Classification, Homopolysaccharides; Heteropolysaccharides; Metabolism- Glycolysis, TCA cycle, Gluconeogenesis, HMP pathway, Glycogenesis, Glycogenolysis.

UNIT II: (8 Sessions)

Proteins: Primary, Secondary, Tertiary and Quaternary structure of Proteins; Globular protein- Hemoglobin and Myoglobin; Fibrous protein- Collagen and Membrane Protein; ATP synthetase; Protein sequencing; Evolutionary divergence of organisms and its relationship to protein structure and function; Ramachandran plot; Protein folding.

UNIT III: (8 Sessions)

Fatty acids: General formula, nomenclature and chemical properties; Lipid classification- simple, complex; General structure and functions of major lipid subclasses - acyl glycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins & free fatty acids; Fatty acid oxidation (β oxidation of fatty acid); Regulation of fatty acid metabolism; Ketone bodies; Circulating lipids - chylomicrons. LDL, HDL and VLDL.

UNIT IV: (8 Sessions)

Fat soluble and water soluble vitamins: structure and function, Cofactors and coenzymes: structure and function; Coenzymes and their functions - NAD, $NADP^+$, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin; Hormones**:** Classification; site of formation, target organs; Mechanism of action of peptide and steroid hormones: Insulin, Glucagon, Epinephrine, Norepinephrin, Thyroid hormones, Testosterone, Estrogen, Progesterone, Pheromones; Hormonal regulation of metabolism by mineralocorticoids.

UNIT V: (8 Sessions)

Nucleic Acids: Structure of purines, pyrimidines, nucleosides and nucleotides; Physical & biochemical properties of DNA; Types of DNA- A, B and Z DNA, their structure and significance; Physical & biochemical properties of RNA- tRNA, rRNA, mRNA and hnRNA; Primary, secondary, and tertiary structures of RNA; metabolism of Purines and Pyrimidines (*De-novo* and Salvage pathway).

Course Outcomes:

Students completing this course will be able to:

- Demonstrate knowledge and understanding of the molecular machinery of living cells.

- Demonstrate knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition.
- Demonstrate knowledge and understanding of the principles of the basic composition of the genetic material that ultimately leads to the formation of complex system.

Suggested Readings:

1. D. Papachristodoulou, A. Snape, W. H. Elliott, Daphne C. Elliott. Biochemistry and Molecular Biology, V Ed.,Oxford University Press, 2014.
2. K. Trehan. Biochemistry, II Edition, New Age International, 2007.
3. D.L. Nelson, M. M. Cox. Lehninger Principles of Biochemistry, V Ed., CBS Publication, 2016.
4. D. Voet, C. W. Pratt, J.G. Voet, Principles of Biochemistry: International Student Version, IV Ed., Wiley, New York.
5. J.M. Berg, J.L., Tymoczko, L. Stryer. Biochemistry: VII Ed., W.H. Freeman Int. Edition, 2010.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)
(Effective from 2021-22)

MSB-103: MICROBIOLOGY

Objective: The objective of this course:

- Provides knowledge about the microbial world their morphology, difference from other living organisms, distribution and their specific roles in various fields of human life and industry.

UNIT I: **(8 Sessions)**

Introduction to Microbiology: Definition, Historical background & scope; Prokaryotes and eukaryotes, Difference between prokaryotic and eukaryotic organisms; Method of Microbiology- Pure culture techniques, sterilization techniques, Culture media and its types; microbial nutrition; Microbial growth and kinetics.

UNIT II: **(8 Sessions)**

Bacteria: General characteristics; Morphology and structure of bacteria; Gram positive and gram negative bacteria; Basic principle and techniques used in bacterial Classification; Types of vegetative, asexual and sexual reproduction in bacteria.

UNIT III: **(8 Sessions)**

Viruses: General characteristics; Morphology, Classification and structure of plant, animal and bacterial viruses; Cultivation of viruses, a brief account of Adenoviruses, Herpes, Retrovirus, Viroids and prions; Reproductive cycles: lytic and lysogenic.

UNIT IV: **(8 Sessions)**

Control of Microorganism: Antimicrobial Agents; Sulfa drugs, Antibiotics (penicillin and cephalosporin); Broad Spectrum Antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance of antibiotics.

UNIT V: **(8 Sessions)**

Microbial Ecology: Microbial flora of soil; Interaction among soil microorganisms; Nitrogen fixation; Symbiotic association-types, functions and establishment of symbiosis; *A. niger*, yeast, *Pseudomonades putida*.

Course Outcomes:

At the end of this course:

- The students get trained in all aspects of microbiology as it is required in the field of biotechnology, microbiology and food technology.
- The students can recognize and compare the structure and function of microbes.
- Imparts advanced training in microbiology for the students.

Suggested Readings:

1. Pelczar Jr. M.J., Chan E.C.S. and Krieg R., Microbiology, McGraw Hill (1998).
2. Stainer R.Y., Ingraham J.L., Wheelis M.L. and Pamler P.R., General Microbiology, MacMillan (2003).
3. Powar&Dagniwala. Microbiology, Volume 1, Himalaya Publishing House Pvt. Ltd, 2012.
4. Tortora G.J., Funke B.R., and Case C.L., Microbiology, An Introduction, Pearson Education (2009).

5. Madigan, M., Martinko, J., Dunlap, P. and Clark, D., Biology of Microorganisms, Pearson Education (2015).

Website Sources:

- https://www.khanacademy.org/
- https://www.britannica.com/
- https://www.wikipedia.org/
- https://www.researchgate.net

IFTM University, Moradabad

Master of Science (M.Sc.), Programme

M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)

(Effective from 2021-22)

MSB-104: BIOINSTRUMENTATION

Objective(s): The objectives of this course:

- Is to provide principle of the various analytical techniques, which will be helpful in various applications in the field of life science like Molecular Genetics, Cell Biology, Genetic Engineering, Environmental Science and other fields.
- The student will learn to technical aspect of functioning of these bio instruments.

UNIT I: (8 Sessions)

Microscopic Techniques: Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy; Scanning and Transmission Electron Microscopy; Confocal Microscopy; Advances of microscopy.

UNIT II: (8 Sessions)

Chromatography Techniques & Centrifugation Techniques: Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC; Density & Ultra Centrifugation.

UNIT III: (8 Sessions)

Electrophoresis Techniques: Theory and Application of PAGE, Agarose Gel Electrophoresis, Iso-electric Focusing, Immuno diffusion, Southern, Northern and Western Blotting.

UNIT IV: (8 Sessions)

Spectroscopic Techniques: Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, NMR, Atomic Absorption Spectroscopy, Raman Spectroscopy

UNIT V: (8 Sessions)

Radio-isotopic Techniques: Introduction to Radioisotopes and their Biological Applications; Radioactive Decay – Types and Measurement; Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter; Autoradiography, Radiation Dosimetry.

Course Outcomes:

Students completing this course will be able to:

- Define and explain various fundamentals of spectroscopy, qualitative and quantitative analysis.
- Discuss the terms, principle, instrumentation, operation and applications of Molecular spectroscopic techniques.
- Differentiate between principle, instrumentation and operation of Atomic absorption and emission Spectroscopy.
- Explain the various Separation techniques and its instrumentation.

Suggested Readings:

1. Skoog & West Principle of Instrumental Analysis 4th Edn 1992.
2. Freilder. Physical Biochemistry: Application to Biochemistry and Molecular Biology, 2nd Edn 1983.

3. Keith Wilson & John Walker Principles and Techniques of Biochemistry and Molecular Biology:, 7th Edn., Cambridge University Press.
4. S. K. Sawhney & Randhir Singh., Introductory Practical Biochemistry 5th Edn, 2014.
5. G. R. Chatwal & S. K. Anand, Instrumental Methods of Chemical Analysis, Oscar publication, 2015.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)
(Effective from 2021-22)

MSB-105: MOLECULAR BIOLOGY

Objective(s): The objectives of this course:

- Is to provide core principles of molecular biology and to impart knowledge to students about the importance of molecular genetics.
- Will help learners to understand the organization and structure of DNA and its properties.
- Will let the student have an in-depth knowledge on molecular mechanisms like Replication, Transcription, Translation, regulation of genetic expression and cancer biology.

UNIT I: **(8 Sessions)**

Nuclear organization: Nuclear membrane, chromosome structure. Proteins associated with nuclei. nucleosome model. Nuclear DNA content, C-Value paradox, Cot value and its significance in situ hybridization, Structural alteration in chromosome: Deletion, Duplication, Inversion & Translocation, heterozygote. Special types of chromosomes; Salivary gland and Lamp-brush chromosomes. Gene mutation: Types of mutations, Molecular mechanism of mutations. Polyploidy (aneuploids, autopolyploids and allopolyploids).

UNIT II: **(8 Sessions)**

DNA Replication: Mechanism of DNA replication (Prokaryotic and Eukaryotic), Enzymes involved in DNA replication (Helicases, DNA polymerase, Topoisomerase etc). Type of DNA repair. Regulation of telomere length. DNA recombination; site specific recombination.

UNIT III: **(8 Sessions)**

Transcription: Structure of bacterial RNA polymerase, Transcription events, and sigma factor cycle, Eukaryotic RNA polymerase, Promoter sequences, TATA box, Hogness Box, CAAT box, Enhancers, upstream activating sequences, Initiation and termination of transcription factor, RNA processing in Prokaryotes *Vs* Eukaryotes.

UNIT IV: **(8 Sessions)**

Translation: Prokaryotic and Eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. Post-translational modifications and intracellular proteins transport. Control of gene expression in prokaryotes and eukaryotes, operon model- lac and trp operon, Autogenous regulation, Feedback inhibition, Lytic cascades and lysogenic repression.

UNIT V: **(8 Sessions)**

Genetic disease and diagnostics: Sex linked and autosomal diseases. Molecular Biology of Cancer- causes and genetics of cancer, Tumor suppressor genes and onco genes, anticancer agent (p53 and pRB). Tools in molecular biology- Fluorescent In-situ Hybridisation (FISH), DNA microarrays, Advantages and disadvantages of DNA microarrays.

Course Outcomes:

By the end of this course, students will be able to:

- Describe the nuclear organization of DNA and various models of nuclear organization
- Describe types of mutations and various levels of ploidy

- Explain the different types of molecular mechanisms like Replication, Transcription and translation
- Explain the role of p53 and pRB in the development of cancer and molecular tools like FISH and microarrays.

Suggested Readings:

1. Miglani G.S. Advance Genetics by Narosa Publishing House.
2. S.B. Primrose, R.Twyman. Principles of Gene Manipulation and Genomics, VII Ed., Wiley-Blackwell, 2006.
3. D.L. Nelson, M.M. Cox. LehningerPrinciples of Biochemistry, . V Ed., 2016.
4. J.D. Watson. A Passion for DNA: Genes, Genome &Society, Cold Spring Harbor Laboratory Press, 2000
5. Albert's et al. Molecular Biology of Cells, IVth Edition, 2002.
6. Lewin B. , Genes VII, 7th edition, Oxford University Press; 2000

Website Sources:

- https://ocw.mit.edu/courses/health-sciences-and-technology/
- https://thebiologynotes.com/microbial-genetics/
- https://www.sparknotes.com/biology/
- https://www.cliffsnotes.com/study-guides/biology/biochemistry-i/
- biological-information-flow/the-central-dogma-of-molecular-biology

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)
(Effective from 2021-22)

MSB-151: Cell Biology and Biochemistry

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment and Accessories and Working	
5.	To study of the properties of carbohydrates. Experiment: I A Molish Test Experiment: 1 B. Benedict's Test;	Experiment 1
6.	2A: To estimate given amount of protein by Folin-Lowry method. 2B: To estimate the protein content in the given sample by Biurret methods.	Experiment 2
7.	3A: Qualitative test for the presence of fatty acid by titrametric methods. 3B: Estimation of cholesterol by Liebermann-Buchard reaction.	Experiment 3
8.	To learn technique SDS-PAGE and to separate protein according to their molecular size.	Experiment 4
9.	To understand the process and different stages of mitosis.	Experiment 5
10.	To determine the concentration of cells in a given sample using hemocytometer.	Experiment 6
11.	To detect the presence of amino acid from a given sample by Ninhydrin Test or Xanthoproteic acid Test.	Experiment 7
12.	To stain lignin of the plant section and observe under the microscope.	Experiment 8

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M.Sc. (Biotechnology/Microbiology/Food Technology) I Year (I Semester)
(Effective from 2021-22)

MSB-152: Bioinstrumentation and Microbiology

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment and Accessories and Working	
5.	Working Principle and structural components of simple microscope.	Experiment 1
6.	Working Principle and structural components of compound microscope.	Experiment 2
7.	Basics Working and Principle of Autoclave	Experiment 3
8.	Basics Working and Principle of Biological Safety Cabinet (Laminar Air Flow Chamber)	Experiment 4
9.	Study of Sterilization methods and equipments.	Experiment 5
10.	To prepare and sterilize the nutrient broth media.	Experiment 6
11.	To prepare and sterilize the nutrient agar media (NAM) and to prepare nutrient agar slants.	Experiment 7
12.	To isolate and enumerate microorganisms from soil sample by spread and streak plate methods.	Experiment 8
13.	To isolate and enumerate microorganisms from soil sample by serial dilution method.	Experiment 9
14.	To isolate the microorganisms from mixed culture by sub-culturing technique.	Experiment 10
15.	To stain bacterial cell by simple staining method.	Experiment 11

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
M.Sc. (MICROBIOLOGY)
(Effective from 2021-22)
Second Semester

S.N.	Module Code	Module Name	Periods			EVALUATION SCHEME				Course Total	Credits
									End Sem Exam		
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
1.	MBM-201	Microbial Metabolism	3	1	0	20	10	30	70	100	4
2.	MBM-202	Industrial Microbiology	3	1	0	20	10	30	70	100	4
3.	MBM-203	Environmental Microbiology	3	1	0	20	10	30	70	100	4
4.	MSB-204	Microbial Technology	3	1	0	20	10	30	70	100	4
5.	MSB-205	Advanced Proteomics & Genomics	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	MBM-251	Industrial Microbiology; Environmental Microbiology	0	0	4	20	10	30	70	100	2
7.	MSB-252	Microbial Technology; Advanced Proteomics & Genomics	0	0	4	20	10	30	70	100	2
		Total Credit	**15**	**5**	**8**			**210**	**490**	**700**	**24**

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology I Year (II Semester)
(Effective from 2021-22)

MBM-201: MICROBIAL METABOLISM

Objective(s): The objectives of this course:

- Focuses on the chemical diversity of substrate oxidations and dissimilation reactions (reactions by which substrate molecules are broken down), which normally function in bacteria to generate energy.
- Is to study uptake and utilization of the inorganic or organic compounds required for growth and maintenance of a cellular steady state (assimilation reactions).
- Exergonic (energy-yielding) and endergonic (energy-requiring) reactions are catalyzed within the living bacterial cell by integrated enzyme systems, the end result being self-replication of the cell.

UNIT I: (8 Sessions)

Introduction of Primary metabolism: Glucose Metabolism – Embden- Meyerhof- Parnas (EMP) pathway; Warburg-Dickens or hexose monophosphate (HMP) pathways; Entner-Doudoroff (ED) pathway; TCA cycle,

UNIT II: (8 Sessions)

Respiration: Aerobic respiration in mitochondria (electron transport); Anaerobic respiration; Basic mechanism of ATP synthesis; Reverse and forward electron flow; Chemo-lithotrophic bacteria- Different types, namely, ammonia oxidizers, nitrite oxidizers, hydrogen oxidizers, iron oxidizers and Sulphur oxidizers.

UNIT III: (8 Sessions)

Photosynthesis: Photo pigments; Different types of photosynthetic bacteria- Cyanobacteria, Green and Purple Bacteria; Paths of carbon assimilation and electron flow in bacterial photosynthesis, Classification of bacteria on nutritional basis.

UNIT IV: (8 Sessions)

Biosynthesis and Catabolism: Protein turnover; Flow of nitrogen into biosynthesis and catabolism of amino acids (with reference to representative examples phenylalanine, tyrosine, tryptophan); Central role of glutamine; Metabolism of nucleotides (purines and pyrimidines); Urea cycle and the excretion of nitrogen.

UNIT V: (8 Sessions)

Biosynthesis of fatty acids and cholesterol: Outline; Oxidation of fatty acids; Ketone bodies; Integration of metabolism and metabolic regulation with reference to metabolic pool; Polyglycans, Poly and hydroxybutyrate, nitrogenous and non-nitrogenous compounds- their synthesis and degradation in bacterial cells.

Course Outcomes:

Upon completing this course students will be able to:

- Understand how microbes generate energy rich molecules like ATP.
- Understand thoroughly the process of photosynthesis in bacteria.
- Understand Flow of nitrogen into biosynthesis and catabolism of amino acids.

Suggested Readings:

1. Lehinger, AL, Principles of Biochemistry, CBS Publisher (India)

2. Doelle H.W. 1969. Bacterial Metabolism.Academic Press.
3. Gottschalk G. 1979. Bacterial Metabolism. Springer Verlag. Moat AG. 1979. Microbial Physiology. John Wiley & Sons.
4. Sokatch JR. 1969. Bacterial Physiology and Metabolism.Academic Press.
5. Moat A G., Foster J W., Spector M P. Microbial Physiology, 4th Ed: Wiley India Pvt Ltd 2009

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
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(Effective from 2021-22)

MBM-202: INDUSTRIAL MICROBIOLOGY

Objective(s): The objectives of this course:

- Is to impart knowledge of various modern tools and techniques used to adapt microorganism for specific needs or opportunities.
- Situations that combine multiple needs and opportunities are common for example; a microorganism may be required to provide sustainable food and healthful nutrition, protection of the environment, and opportunities for jobs and income.
- Finding or developing suitable microorganism is typically a highly complex challenge.

UNIT I: **(8 Sessions)**

Introduction to Industrial Microbiology: Brief History and Developments in Industrial Microbiology, techniques of microbial culture, growth media, sources of nutrition, maintenance of microbial culture and strain preservation.

UNIT II: **(8 Sessions)**

Bioreactors: Components of a Bioreactor, Types of Bioreactors-laboratory, pilot-scale and production; stirred tank reactor, fixed bed and fluidized bed reactor and air-lift reactor.

UNIT III: **(8 Sessions)**

Enzyme Immobilization: Methods of immobilization- adsorption, covalent, cross linking and encapsulation; advantages and disadvantages of different immobilization techniques; application of immobilized enzymes.

UNIT IV: **(8 Sessions)**

Down-stream Processing: Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultra-filtration and drying methods –lyophilisation and spray drying.

UNIT V: **(8 Sessions)**

Microbial production of industrial products: Production of Organic acids, Amino Acids, Biofuels, antibiotics and Biopolymers

Course Outcomes:

Upon completing this course students will be able to:

- Understand how industrially useful strain is preserved, maintained and isolated.
- Explain fermenters and its types and application in industry
- Understand and apply that understanding in several commercially important production process.

Suggested Readings:

1. Murray Moo -Young , Comprehensive Biotechnology, Vol. 1 & III-latest ed. 45
2. Lel and Kotlers Richard J. Mickey Microbes & Fermentation, A., Oriffin Publication
3. Leland, N. Y. Industrial Fermentations-. Chemical Publishers.
4. Prescott and Dunn's- Industrial Microbiology, 4 th, ed.
5. Rehm, Reed &Weinheim, Verlag-Chemie. Biotechnology Series,

6. Aiba, Humphrey & Miller. Biochemical Engg., Academic Press.

Website Sources:

- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology I Year (II Semester)
(Effective from 2021-22)

MBM-203: ENVIRONMENTAL MICROBIOLOGY

Objective(s): The objectives of this course:

- Is designed to introduce the student to the role of microbes in biogeochemical processes in different ecosystems.
- The students will learn the basic microbiological principles, the methods in microbial ecology and their theoretical and practical use.
- The students can get some skills to recognize the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection.
- Learning and understanding these processes allow them to use microorganisms to solve environmental problems.

UNIT I: **(8 Sessions)**

Introduction to environmental microbiology: Microbes and the environment, Classification of microbes: Bacteria, cyanobacteria, fungi, algae; Role of Genetically engineered microbes in environment protection, Scope and application of Microbes.

UNIT II: **(8 Sessions)**

Microbial diversity in natural environment: Terrestrial, Aquatic (Marian & Freshwater), Air and Biological (Plant & Animal) environment. Microbes in the extreme environment and their adaptation.

UNIT III: **(8 Sessions)**

Methods for determination of microbial activity & biomass: Microbial growth assay, quantification of carbon utilization, Radiolabeling of cellular macromolecules, enzyme assay, Nucleic acid assay.

UNIT IV: **(8 Sessions)**

Bioremediation and Pollution Control: Bioremediation and Pollution Control of Heavy metals, recalcitrant organic pollutants (xenobiotics, pesticides), hydrocarbons, desulphurization, natural products (lignocelluloses). Production of methane (methanogenesis), bio-hydrogen.

UNIT V: **(8 Sessions)**

Bioindicators: Bioindicators in the environment, microbial treatment of waste water (sewage and industrial effluents), management of organic solid waste and its microbial treatment, bioleaching and biomining for recovery of resources.

Course Outcomes:

Students completing this course will be able to:

- Understand the role of microorganisms as agents of environmental change.
- Understand microbial processes aimed to solve environmental problems.
- Recognize microorganisms as indicators of alteration of an ecosystem.

Suggested Readings:

1. Maier, RM. Pepper, IL Environmental Microbiology, Acedmic press.2000.

2. Schlegel General Microbiology (seventh edition). Cambridge University Press Publisher.
3. Prescott, LM. Harley, JP. Microbiology, 7th edition. McGraw Hill Publication ,2008.
4. Microbiology (Fifth Edition). Pelczer, MJ. Chan, ECS. Krieg, NR. Tata McGraw Hill Publication.
5. Mohapatra, PK. Text book environmental microbiology. I.K. International Publishing House Pvt. Ltd. 2013
6. Environmental Biotechnology,.Thakur, IS. I.K. International Publishing House Pvt. Ltd. 2006

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- https://www.ncbi.nlm.nih.gov/books
- https://ocw.mit.edu/

IFTM University, Moradabad

Master of Science (M.Sc.), Programme

M.Sc. Biotechnology/Microbiology I Year (II Semester)

(Effective from 2021-22)

MSB-204: MICROBIAL TECHNOLOGY

Objective: The objective of this course:

- Is designed to impart knowledge of various modern tools and techniques used to adapt microorganism for specific needs or opportunities, finding or developing suitable microorganism with highly complex challenge.

UNIT I: **(8 Sessions)**

Microbial Fermentation: Introduction to submerged and solid-state fermentation, Component parts of fermentation processes, Range of fermentation processes, Industrial important microbial product- Primary and secondary metabolites.

UNIT II: **(8 Sessions)**

Fermentation media: Synthetic and complex media; Media components- Carbon sources, Nitrogen sources, Inducers, Minerals, Antifoam; Raw material availability-agricultural and industrial waste; pretreatment of raw materials- physical, chemical and biological.

UNIT III: **(8 Sessions)**

Isolation and preservation of industrially important microbes: Isolation of different types of mutants for production of primary and secondary metabolites- Auxotrophic mutants, resistant mutants, revertant mutants, recombinant microorganisms; preservation techniques- cryopreservation, lyophilization.

UNIT IV: **(8 Sessions)**

Concept of overproduction of metabolites: Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes: Induction, catabolite repression, crab tree effect, feedback inhibition and feedback repression.

UNIT V: **(8 Sessions)**

Production of industrially important products: Ethanol, Citric acid, Penicillin, Baker's yeast, High fructose corn syrup (HFCS).

Course Outcomes:

Upon completing this course students will be able to:

- Understand how industrially useful strain is isolated preserved, maintained and improved.
- Explain fermenters and its types and application in industry
- Understand and apply that understanding in several commercially important production process.

Suggested Readings:

1. Cruger and ACruger; A text of Industrial microbiology, Sinaeur Associates, 1990.

2. PF STANBURY, S. Hall, A Whitaker and Stephen J Hall. Principle of Fermentation Technology. Elsevier, 2013
3. Y.H Hui et al.Handbook of Food and Beverages Fermentation Technology, 2003
4. Fermentation Microbiology and Biotechnology, A.R. Allman, Mansi E1-Mansi, C.F.A. Bryce, Arnold L. Demain.
5. Linda Harvey. Practical Fermentation Technology Brain McNeil (Editor), 2008.
6. Greed, Prescott and Dunn's, Industrial Microbilogy, 4th Edition, CBS Publishers, 1987.

Website Sources:

- https://www.wikipedia.org/
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IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Biotechnology/Microbiology I Year (II Semester)
(Effective from 2021-22)

MSB-205 - ADVANCE PROTEOMICS AND GENOMICS

Objective(s): The objectives of this course:

- Is to appraise students with basic concepts of protein structure and function, protein characterization and purification, functional and structural genomics.
- To build up expertise in students with modern techniques of proteomics and genomics so that they can apply it in basic and applied science research.

UNIT I: **(8 Sessions)**

Introduction and scope of proteomics: Site Directed Mutagenesis- Subtilizin, Advance Protein Folding Methods, Molecular Chaperons, Post Translational Modifications, Glycosylation Vs protein confirmation, protein separation techniques; Polyacrylamide gel electrophoresis & isoelectric focusing (IEF); 2D Gel Electrophoresis, PAGE for protein analysis and identification.

UNIT II: **(8 Sessions)**

Gene variation and Genome mapping methods: Physical, genetic and molecular markers in mapping (RFLP, RAPD and AFLP,); single nucleotide polymorphisms (SNPs), Expressed sequence Tags (ESTs): Gene Annotation & Gene disease association.

UNIT III: **(8 Sessions)**

Protein engineering: Protein chips and functional proteomics; clinical and biomedical application of proteomics; proteomics industry, SCP (Single Cell Protein).

UNIT IV: **(8 Sessions)**

General introduction and scope of Genomics: Types of PCRs and its applications, DNA sequence analysis methods: Sanger's Dideoxy method and Fluorescence methods, DNA footprinting and DNA fingerprinting.

UNIT V: **(8 Sessions)**

Gene prediction and annotation: Comparative Genomics; DNA microarrays and DNA chips, DASH, Molecular Becons; Genome databases; Structural Genomics; Principles, tools and applications of gene manipulation for modern food (GM Food) production; Significance of GM foods

Course Outcomes:

Students completing this course will be able to:

- Have an understanding of concepts such as gene expression, proteomics, transcriptomics, metabolomics, and their relationships.
- Describe advanced genomics and proteomics technologies and their application for advancement of research in basic and applied science.
- Explore cellular and molecular targets and able to design research studies for various diseases pathologies.

Suggested Reading:

1 Cantor and Smith, Genomics, john Wiley & Sons, 1999.
2 Introduction to Genomics- Arthur M Lesk, Oxford University Press, 2007.
3 R M Twyman, Principles of Proteomics, BIOS Scientific Publishers, 2004
4 L. Stryer, Biochemistry, W. H. Freeman and Co., New York, 2007
5 NPTEL- Phase-II, Proteomics and Genomics by Dr.Vikas Kumar Dubey, IIT, Guwahati

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology I Year (II Semester)
(Effective from 2021-22)

MBM-251: Industrial Microbiology; Environmental Microbiology

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To understand the characteristics of DO (Dissolved oxygen) contained in drinking and waste water.	Experiment 1
6.	To differentiate between the two major categories of bacteria: Gram positive and Gram negative.	Experiment 2
7.	The test determines the susceptibility of a microbial species against different antibiotic agents.	Experiment 3
8.	To isolate and identification of microorganisms from soil samples by the dilution and agar plate methods using aseptic techniques	Experiment 4
9.	To immobilize microbial cells using sodium- alginate gel entrapment method and production of ethanol.	Experiment 5
10.	To carry out bulk precipitation of protein from yeast cell suspension using of ammonium sulfate salt.	Experiment 6
11.	To produce biopolymer Dextran from *Leuconostoc mesenteroides.*	Experiment 7
12.	To produce citric acid using *Aspergillus niger* and its estimation.	Experiment 8

IFTM University, Moradabad

Master of Science (M.Sc.), Programme

M.Sc. Microbiology, I Year (II Semester)

(Effective from 2021-22)

MSB-252: Microbial Technology; Advanced Proteomics & Genomics

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and Don't	
4	About Equipment and Accessories and Working	
5	To study different growth phases of bacterial population and plot a bacterial growth curve.	Experiment 1
6	To produce ethanol under submerged conditions using *Saccharomyces cerevisiae.*	Experiment 2
7	To purify ethanol produced under submerged conditions.	Experiment 3
8	To immobilize microbial cells using sodium- alginate gel entrapment method.	Experiment 4
9	To produce amylase enzyme under solid state fermentation and submerged state fermentation.	Experiment 5
10	Extraction of protein and estimation of its concentration by Lowry's method	Experiment 6
11	To perform western blotting technique to detect specific protein.	Experiment 7
12	To extract and analyze genomic DNA from leaves by CTAB method.	Experiment 8
13	To perform southern blotting for the detection of a specific DNA fragment.	Experiment 9

IFTM UNIVERSITY, MORADABAD
COURSE STUCTURE
M.Sc. (MICROBIOLOGY)
(Effective from 2021-22)
Third Semester

S.N.	Module Code	Module Name	Periods			EVALUATION SCHEME				Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total	End Sem Exam		
THEORY											
1.	MBM-302	Microbial Genetics	3	1	0	20	10	30	70	100	4
2.	MBM-303	Immunology	3	1	0	20	10	30	70	100	4
3.	MSB-307	Biostatistics	3	1	0	20	10	30	70	100	4
4.	MSB-308	Bioinformatics	3	1	0	20	10	30	70	100	4
5.	MBM-301/304; MSB-305	Departmental Elective	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	MSB-351	Biostatistics and Bioinformatics	0	0	4	20	10	30	70	100	2
7.	MBM-351	Immunology lab	0	0	4	20	10	30	70	100	2
8.	MBM-354	Seminar	0	0	2	-	-	100	-	100	1
		Total Credit	**15**	**5**	**10**			**310**	**490**	**800**	**25**

IFTM UNIVERSITY, MORADABAD
M. Sc. Microbiology
Course Structure
(Effective from 2021-22)
Third Semester

LIST OF DEPARTMENT ELECTIVES		
S.No.	**Course Code**	**Course Name**
1	MBM-301/304; MSB-305	Medical Microbiology/ Clinical & Diagnostic Microbiology; IPR and Biosafety

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. (Biotechnology/Microbiology) II Year (III Semester)
(Effective from 2021-22)

MSB-307: BIOSTATISTICS

Objective(s): The objective of this course:

- Is to study advance statistical science and its application to problems of human health and disease, with the ultimate goal of advancing statistics and analyzing data from research problems.
- It helps to design data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses.

UNIT I: (8 Sessions)

Biostatistics: Definition and applications of Biostatistics, Concept of variables in biological systems, Collection, classification, Tabulation, Graphical and diagrammatic representation of numerical data. Diagrams (Bar & Pie), Histogram, Frequency curve and frequency polygon.

UNIT II: (8 Sessions)

Measures of central tendency: Mean, Median, Mode, Arithmetic, Geometric & Harmonic mean, Measures of dispersion, Variability and changes, Quartile deviation, Mean deviation, Standard deviation, Standard error, Coefficient of variations, Skewness and Kurtosis .

UNIT III: (8 Sessions)

Probability and distributions: Random experiment, Events, Sample space, mutually exclusive events, Independent and dependent events; Various definitions of probability, addition and multiplication theorems of probability, Random variables (discrete and continuous), Probability density function and its properties. Binomial, Poisson and Normal distributions.

UNIT IV: (8 Sessions)

Correlation and Regression analysis: Relation between two variables, scatter diagram, definition of correlations, curve fitting, principles of least squares, Two regression lines, Karl Pearson's coefficient of correlation, Rank correlation, Tied ranks.

UNIT V: (8 Sessions)

Introduction to Test of Significance & Hypothesis: Concept of population and sample, random samples, Sampling distribution of mean and standard error, z and t-test, Chi- square test for goodness of fit, independence of attributes, and homogeneity of samples, interrelation between t-test and F-Test & ANOVA.

Course Outcomes:

Students completing this course will be able to:

- Demonstrate knowledge of the properties of parametric, semi-parametric and nonparametric testing procedures in Biostatistics.
- Remember restate the principal concepts about biostatistics and collect data relating to variable which will be examined.
- Understand and interpret the concepts of descriptive statistics from these data.

- Understand and be able to address ethical, regulatory and practical aspects of human subject research including human subjects protections.
- Be capable of self-directed learning of unfamiliar statistical methods and written and oral presentation of results/findings.

Suggested Readings:

1. George W and Willian G., Statistical Methods, IBH Publication
2. Zar, J, Biostatistics, Prenticw Hall, London R. Rangaswami, A Text Book of Agricultural Statistics, New Age International Publication.
3. Methods in *Biostatistics* by B. K. *Mahajan*
4. Fundamentals of Applied *Statistics S.C. GUPTA* & V.K. KAPOOR

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. (Biotechnology/Microbiology) II Year (III Semester)
(Effective from 2021-22)

MSB-308: BIOINFORMATICS

Objective: The objective of this course:

- Is to introduce the field of bioinformatics to study the tools and databases in homology identification, structure visualization and designing new drug molecules**.**

UNIT I: (8 Sessions)

Introduction to Bioinformatics: Introduction and application of bioinformatics, Classification of biological databases, Biological database retrieval system, sequence and molecular file format.

UNIT II: (8 Sessions)

Sequence analysis: Types of sequence alignment, Dot matrix analysis: Dynamic programming algorithm (Needleman Wunsch and Smith Waterman), Heuristic methods (BLAST and FASTA), Scoring matrices-PAM and BLOSUM.

UNIT III: (8 Sessions)

Protein structure prediction: Protein databases, Protein identification and characterization, Primary structure analysis and prediction, Secondary structure analysis and prediction, Microarray Data Analysis.

UNIT IV: (8 Sessions)

Protein modeling and visualization: Method of protein modeling, Homology modeling, Fold recognition, Ab–initio modeling, Protein classification and protein structure visualization databases and tools

UNIT V: (8 Sessions)

Evolutionary analysis and molecular phylogeny: Concept of phylogeny, Types of tree, Distance based methods (UPGMA and NJ algorithm), Character based methods (maximum parsimony and maximum likelihood) phylogenetic software-PHYLIP, PAUP, tree viewing software.

Course Outcomes:

Students completing this course will be able to:

- Bioinformatics databases and tools for molecular structure and function prediction.
- Identify the homologous protein and DNA sequences.
- Visualization and characterization of protein structures.

Suggested Readings:

1. N. Gautham. Bioinformatics databases and Algorithms, Alpha Science Publishers, 2006.
2. A. Lark. Introduction to Bioinformatics, IV Ed., Oxford Press, 2014.
3. Orpita Bosu, Simminder Kaur Thukral,Bioinformatics: Database, Tools, Algorithms,Oxford University Press, 2007

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- https://pubmed.ncbi.nlm.nih.gov/
- www.ncbi.nlm.nig.gov
- http://www.bic.nus.edu.sg/

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology II Year (III Semester)
(Effective from 2021-22)

MBM-301: MEDICAL MICROBIOLOGY

Objective(s): The objectives of this course:

- Is to provide knowledge to students about the significance of microbial association with healthy human body.
- To impart knowledge about the role of various pathogens in causing a variety of diseases in humans like bacterial infections, fungal infections, viral infections etc.

UNIT I: (8 Sessions)

Introduction: Microbial flora of healthy human host, host microbe interaction, process of infection, infection types, stages of infection and systemic infection. Mode of transmission: Entry, spread and tissue damage, aggressins and toxins.

UNIT II: (8 Sessions)

Bacteriology: Pathogenic Bacteria; Morphological characteristics, pathogenesis and laboratory diagnosis of following pathogenic bacteria; *Klebsiella pneumoniae; Proteus vulgaris; Pseudomonas aeruginosa; Crypto sporodium, Vibrio cholerae; Streptococcus pneumonae.* Methicillin resistant *Staphylococcus aureus* (MRSA)*; Bordetella pertusis; Clostridium difficile.*

UNIT III: (8 Sessions)

Mycology: Pathogenic Fungi; Morphological characteristics, pathogenesis and laboratory diagnosis of the following pathogenic fungi:- *Microsporum; Trichophyton; Histoplasma capsulatum; Blastomyces dermatitidis; Candida albicans; Cryptococcus neoformans; Pneumocystis carinii.*

UNIT IV: (8 Sessions)

Parasites: *Entamoeba histolytica; Giardia Lamblia; Plasmodium vivax; Leishmania donovani*. Helminths**:** *Taenia saginata; Taenia soliun; Hymenolepisnana; Schitosoma haematobium.*

UNIT V: (8 Sessions)

Viruses: Classification of viruses, Morphological characteristics, pathogenesis and laboratory diagnosis of the following viruses: *Poxviruses; Herpesviruses; Adenoviruses; Poliovirus; Hepatitis viruses.*

Course Outcomes:

By the end of this course, students will be able to:

- Explain the microflora of healthy human host
- Describe the morphology, cultural characters of bacterial pathogens causing diseases
- Explain the morphology, diagnosis and properties of important fungal infections
- Describe the classification of viruses, diseases caused by viruses and characteristics of important parasitic infections.

Suggested Readings:

1. R. Ananthanarayan, C.K. Jayaram Paniker;Textbook of Microbiology Paperback –Eighth Edition, Universities Press, 2010

2. Satish Gupta, Short Textbook of Medical Microbiology, 10th Edition; Jaypee Publisher, 2010.
3. Ryan Kenneth, George Ray C., Ahmad Nafees, Drew W. Lawrence, James Plorde, Sherris Medical Microbiology, Fifth Edition;McGraw Hill publisher, 2009.
4. Ingraham John L, Ingraham Catherine A.,Introduction to Microbiology,Edition-3,Publisher-Brooks/Cole Publisher,2010.

Website Sources:

- https://www.biologydiscussion.com/
- https://microbeonline.com/colony-morphology-bacteria-describe-bacterial-colonies/
- https://microbenotes.com/cultural-characteristics-of-bacillus-cereus/
- https://courses.lumenlearning.com/boundless-microbiology/chapter/culturing-bacteria/

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology II Year (III Semester)
(Effective from 2021-22)

MBM-302: MICROBIAL GENETICS

Objective(s): The objectives of this course:

- The student will become familiar with methods of transfer of genetic material in bacteria, and will understand the biology of lytic and lysogenic phages.
- The student will be acquainted with the different modes of gene regulation in bacteria, and the importance of bacterial transposition and its applications.

UNIT I: **(8 Sessions)**

Introduction: Identification of Genetic Material-Griffith, Avery and Hershey and Chase Experiments; Gene as a unit of mutation and Recombination, Mutation and mutagenesis- Biochemical basis of Mutation, Spontaneous and induced mutations, Isolation and genetic analysis of mutants.

UNIT II: **(8 Sessions)**

Gene Transfer Mechanisms: Transformation – competent cells, regulation, general process; Transduction - general and specialized; Conjugation - Hfr, Triparental mating, self-transmissible and mobilizable plasmids, pili.

UNIT III: **(8 Sessions)**

Biology of Plasmids: Extrachromosomal heredity - Plasmid- structure, replication, control, partitioning, incompatibility and gene transfer F1, ColE1, pSC101 and Ti plasmids.

UNIT IV: **(8 Sessions)**

Transposable genetic elements and Gene Mapping: Introduction and Discovery, insertion sequences, simple and compound transposons - T10, T5, and retrotransposon. Genetic mapping- *E.coli* Virus T4 phage – using II system.

UNIT V: **(8 Sessions)**

Bacteriophages: Classification, Morphological Groups; The Virulent dsDNA phage, the ssDNA phage, Phage lambda, Temperate and Transposable Phage; Phage Mu, M13; Bacteriophage typing; Phage Therapy; Cyanophages, Mycoviruses; Rhizobiophages.

Course Outcomes:

Upon successful completion of the course, the student:

- Can discuss the importance of mutation analysis, can analyze mutations by complementation and recombination tests, and can design a strategy to create gene replacement in bacteria.
- Is able to explain how plasmid copy number is regulated, can differentiate between Hfr strains and strains carrying F plasmid, and can construct a genetic map of bacterial genome using conjugation-based method
- Is able to compare and contrast generalized versus specialized transduction, knows how to construct genetic linkage maps using two-factor and three factor cross, is able to discuss the basis of natural competence in bacteria.
- Is able to list the events in the lytic and lysogenic phases of lambda phage life cycle and the regulatory factors and events involved.

- Can list the outcomes of transposition events, can design strategies to mutagenize bacteria using transposons, can explain the construction of conditional knockouts
- Can differentiate between positive and negative regulation of gene expression, inducible and repressible systems.
- Can describe the regulation of the lac, trp, gal,ara and tol operons.
- Will have learnt about the model organisms used in biological studies

Suggested Readings:

1. Antony JF, Griffiths, Gilbert WM, Lewontin RC and Miller JH. Modern Genetic Analysis, Integrating Genes and Genomes, 2nd edition, WH Freeman and Company, New York. 2002
2. Blackburn GM, Gait MJNucleic acids in chemistry and biology. Oxford University press. . 1996
3. Malacinski GM and Freifelder D Essentials of Molecular Biology, 3rd edition, John and Bartlett Publishers.
4. Lewin B. (2000). Genes VII. Oxford University press. (1998)
5. Maloy, S. R., J. E. Cronan, and D. Freifelder. "Microbial Genetics 2nd Edition: illustrated." 1994.
6. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. *Lehninger principles of biochemistry*. Macmillan, 2008.
7. Pelczar, Michael J., E. C. N. Chan, and Noel R. Krieg. *Microbiology*. Tata Mc-Graw Hill, 1986.
8. Snyder, Larry, et al. *Molecular genetics of bacteria*. American Society of Microbiology, 2013.

Website Sources:

- https://en.wikipedia.org/wiki/Microbial_genetics
- http://www1.mans.edu.eg/FacMed/dept/microbiology/pdf/genatic/lecture%201.pdf
- https://www.cliffsnotes.com/study-guides/biology/microbiology/microbial-genetics/introduction-to-microbial-genetics
- https://www.slideshare.net/MicrobeDiversityMicrobiology/lecture-7-microbial-genetics
- https://nptel.ac.in/courses/102/103/102103015/

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology II Year (III Semester)
(Effective from 2021-22)

MBM-303: IMMUNOLOGY

Objective(s): The main objective of this course:

- Is to learn the underlying concepts of molecular and cellular mechanisms involved in the development and regulation of the immune response following antigen challenges.
- To understand the cause and mechanism of immune system pathologies and dysfunctions, and to learn the important techniques of Immuno-diagnosis.

UNIT I: (8 Sessions)

Introduction: Brief history of immunology**,** Innate and Acquired immunity, humoral and cell mediated immune response, Hematopoiesis, Cells and organs of the immune system. Characteristic and functions of T&B lymphocytes, lymphocyte trafficking, Inflammation.

UNIT II: (8 Sessions)

Antigenicity and Immunogenicity: Types of antigens & Super antigens, Factors affecting the immunogenicity, Haptens and adjuvant, ABO blood group antigens, Epitopes. Structure, functions and characteristics of different classes of antibodies, Antigenic Determinants on Immunoglobulins.

UNIT III: (8 Sessions)

Major Histocompatibility Complex: Structure and Function of MHC molecules; Antigen processing and presentation, Complement system, Structure, function and application of Cytokines, regulation of immune response, immunological tolerance.

UNIT IV: (8 Sessions)

Antigen and antibody interactions: Cross reactivity, precipitation reactions, agglutination, compliment fixation; serological techniques – ELISA, RIA and western blotting; Production and application of monoclonal antibodies- Hybridoma Technology; Vaccines.

UNIT V: (8 Sessions)

Immune Responses: Cell mediated cytotoxicity: Mechanism of T-cell & NK cells mediated lysis; Immunity against infectious agents-Influenza, Tuberculosis, Malaria; Hyper-sensitivity; Autoimmunity; Tumor Immunology; Immunodeficiency disease – AIDS; Transplantation immunology

Course Outcomes:

Students completing this course will be able to:

- Outline the molecular and cellular mechanisms involved in the development and regulation of the immune response,
- Describe the cause, challenges and treatment for Immune System Pathologies and Dysfunctions.
- To demonstrate a capacity for problem-solving about immune responsiveness.
- To describe the roles of the immune system in both maintaining health and contributing to disease.
- To learn the application of major immunological laboratory techniques and their application to both clinical analysis and experimental research

Suggested Readings:

1. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai, Basic Immunology (Function and Disorder of Immune System), 4th Edition; Elsevier Publisher.
2. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, Kuby Immunology, 6th Edition; Publisher: W H Freeman & Co.
3. Roitt's Immunology, P.J. Delves, S. J. Martine, D.R. Burton, I.M. Roitt, 12th Edition. Wiley-Blackwell.
4. C.Verman Roa, Immunology. II Edition. Narosa Publishing House-2006
5. Fahim Halim Khan. The Element of Immunology. Pearson Eduction. 2009.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.springer.com/gp/biomedical-sciences/immunology
- https://onlinelibrary.wiley.com/doi/book/10.1002/9781119998648

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology II Year (III Semester)
(Effective from 2021-22)

MBM-304: Clinical and Diagnostic Microbiology

Objective: The main objective of this course:

- Is to introduce and acquaint the students with the key aspects of medical microbiology related to the diverse microbial pathogens, their virulence mechanisms, diagnostic methods and brief outline of the functional aspects of antimicrobial chemotherapy.

UNIT I: (8 Sessions)

Microbiota of the human body and introduction to pathogenicity and infection: Microbiota of skin, throat, gastrointestinal tract, urogenital tract. Significance of microbiome. Definitions: Pathogen, infection, invasion, virulence and its determinants, pathogenicity, endotoxins and exotoxins, carriers and their types, opportunistic infections, nosocomial infections. transmission of infection, sepsis and septic shock.

UNIT II: (8 Sessions)

Human diseases caused by pathogens: List of diseases of various organ systems and their causative agents. Symptoms, mode of transmission, prophylaxis and control of the following diseases: Respiratory diseases, Gastrointestinal diseases; viral pathogens- Polio, Ebola, Chikungunya, Japanese Encephalitis, Rota virus, Zika virus - causes, symptoms, diagnosis and treatments; diseases caused by protozoan and fungal pathogens.

UNIT III: (8 Sessions)

Routine and Special tests: Examination of Urine, Stool, Sputum, Semen, CSF, Pleural Fluid, Pericardial Fluid, Synovial Fluid, Ascetic Fluid, Various methods of detecting HCG levels, Cytochemistry of Leukemic cells, Amniocentesis, Laboratory control of Anticoagulant , Thrombotic and platelet therapy, Collection and handling of Blood.

UNIT IV: (8 Sessions)

Antimicrobial agents: General characteristics and mode of action: Antibacterial agents: five modes of action with one example each: inhibitor of nucleic acid synthesis, inhibitor of cell wall synthesis, inhibitor of cell membrane function, inhibitor of protein synthesis, inhibitor of metabolism. Antifungal agents: mechanism of action of amphotericin B. Antiviral agents: mechanism of action of acyclovir, azidothymidine.

UNIT V: (8 Sessions)

Current approaches to diagnosis: Collection, transport and culturing of clinical samples. Principles of different diagnostic tests: ELISA (rapid diagnostic kits) and agglutination-based tests (Widal test). Specific approaches to diagnose pathogens that are difficult to detec/culture by routine methods: Plasmid fingerprinting (creation of database for a wide collection of circulating strains of bacterial pathogens); indirect immunofluorescence test for syphilis; monoclonal antibody based detection kits; immunoblotting for HIV, radio-immunoassays and its applications in cardiology, blood banking, diagnosis of allergies and endocrinology; diagnostic use of microarrays.

Course Outcomes:

Students completing this course will be able to:

- Understand the diverse nature of the normal microflora of the body and its significance as well.

- Acquaint themselves with the terminology and scientific nomenclature used in describing disease causation and pathogenic features of microbial agents of disease.
- Gain an in-depth knowledge about the spectrum of diseases caused by bacterial pathogens, and an understanding of the course of disease development and accompanying symptoms. Will become familiar with the methods of transmission, epidemiological aspects as well as prevention and control methods.
- Learn basic concepts of handling clinical specimens and approaches used to aid in detection/diagnosis of diseases using immunological and molecular biology based methods. Will also understand the mode of action of different antimicrobial agents and concept of antimicrobial resistance.

Suggested Readings:

1. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGraw Hill Higher Education, USA. 2019.
2. Brock Biology of Microorganisms by M.T. Madigan, K.S. Bender, D.H. Buckley, W.M. Sattley and D.A. Stahl. 15th edition. Pearson Education, USA. 2019.
3. Textbook of Microbiology by R. Ananthanarayan and C.K.J. Paniker. 10th edition. Universities Press, India. 2017.
4. Jawetz, Melnick and Adelberg's Medical Microbiology by K.C. Carroll, S.A. Morse, T.A. Mietzner and S. Miller. 27th edition. McGraw Hill Education. 2016.
5. Microbiology: An Introduction by G.J. Tortora, B.R. Funke and C.L. Case. 9th edition. Pearson Education, USA. 2007

Website Sources:

- http://catdir.loc.gov/catdir/toc/ecip0817/2008020047.html
- http://ecoursesonline.iasri.res.in/course/view.php?id=108
- https://www.microbiologyresearch.org/content/journal/jmm
- https://www.cdc.gov/labtraining/training-courses/basic-microbiology/index.html

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology II Year (III Semester)
(Effective from 2021-22)

MSB-305: IPR and Biosafety

Objective(s): The objectives of this course:

- Concentrates on technology, knowledge and business management aspect of intellectual property, including patenting aspect.
- Provide knowledge on biosafety and risk assessment of products, ethical issues in biological research.

UNIT I: **(8 Sessions)**

Introduction: Introduction to Intellectual Property; Types of IP; Importance of IPR; Patents- Patent file procedure, Patentable and Non-Patentable items Trademarks, Copyright and Related rights, Industrial Design; Geographical indications; Protection of biotechnological inventions; Patent file procedure.

UNIT II: **(8 Sessions)**

Agreement and Treaties: TRIPS, World Intellectual Property Rights Organization (WIPO). GATT, Patent cooperation treaty, WTO- Objective- Structural format of WTO - Economic Impact of WTO - Benefits of WTO; Compulsory licensing.

UNIT III: **(8 Sessions)**

Rights and Protection: Infringement or violation, remedies against infringement- civil and criminal; Indian Patent Law (1970); Various laws in India- licensing and technology transfer.

UNIT IV: **(8 Sessions)**

Bioethics: Ethical aspects of Genetic Engineering: Genetically modified food and crops,; Stem cell research: Hematopoietic stem cell and Embryonic stem cell; NGO for bioethics; Ethical issues and biosafety.

UNIT V: **(8 Sessions)**

Biosafety: Good laboratory practices (GLP); Biosafety guideline and regulation; Roles of institutional biosafety committee, RCGM, GEAC etc.; Biosafety levels, Cartegena protocol;

Course Outcome:

Students completing this course will be able to:

- Understanding of the fundamentals of IPR and Bioethics and key principles of it.
- Awareness of its major application.
- Ability to use or apply IPR related guidelines.

Suggested Readings:

1. Bioethics and Biosafety: M K Satheesh
2. Biotechnology and Patent Protection: Beier FK, Crespi RS and Straus
3. Intellectual Property Rights on Biotechnology: Singh K
4. Regulatory Framework for GMOs in India: Ministry of Environment and Forest, Govt. of India

5. Cartagena Protocol on Biosafety: Ministry of Environment and Forest, Govt. of Inida
6. Bioethics: Shaleesha A Stanley

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/
- https://www.researchgate.net
- https://www.wipo.int/

IFTM University, Moradabad
Masters of Science (M.Sc.), Programme
M.Sc. (Biotechnology/Microbiology)
(Effective from 2021-22)

MSB-351: Biostatistics and Bioinformatics

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and Don't	
4	About Equipment and Accessories and Working	
5	To calculate Mean, Median and mode using excel software.	Experiment 1
6	To calculate Standard deviation using excel software.	Experiment 2
7	To perform two sample student's t-test assuming equal variance using excel software	Experiment 3
8	To perform one-way ANOVA.	Experiment 4
9	Introduction to various biological databases.	Experiment 5
10	To identify the 10- homologues sequences of P68871 of various origins. Find the conserved region existing between them comment on the same	Experiment 6
11	To perform blast of given sequences.	Experiment 7
12	Comment on the evolutionary relationship between the sequences	Experiment 8

IFTM University, Moradabad
Masters of Science (M.Sc.), Programme
M.Sc. Microbiology II Year (III Semester)
(Effective from 2021-22)

MBM-351: Immunology

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To enumerate the total number of WBCs and RBCs in the blood sample	Experiment 1
6.	To Perform Ouchterlony double diffusion technique for precipitation reaction	Experiment 2
7.	To perform the precipitation technique by single radial immunodiffusion.	Experiment 3
8.	To perform Sandwich ELISA by using microtiter plate reader.	Experiment 4
9.	To perform Counter current Immunoelectrophoresis.	Experiment 5
10.	To perform the technique of Immunoprecipitation to precipitate of the antigen-antibody complex by using Protein A beads.	Experiment 6
11.	To isolate the peripheral blood mononuclear cells from whole blood by density gradient centrifugation method and determine the viability of cells by Trypan blue exclusion assay.	Experiment 7
12.	To Extract genomic DNA from Blood lymphocytes	Experiment 8

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
M.Sc. (MICROBIOLOGY)
(Effective from 2021-22)
Fourth Semester

S.N.	Module Code	Module Name	Periods			EVALUATION SCHEME				Course Total	Credits
			L	T	P	Mid Sem Exam	AS +AT	Total	End Sem Exam		
PRACTICAL											
1.	MBM-482	Dissertation	0	0	0	-	-	150	250	400	20
		Total Credit						**150**	**250**	**400**	**20**

Note: The student has to complete his/her dissertation preferably in Industry or Research Institute. In some exceptional cases he/she may apply to pursue his/her dissertation on campus. The student must have internal supervisor.