आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश

IFTM University, Moradabad, Uttar Pradesh

NAAC ACCREDITED

SCHOOL OF BIOTECHNOLOGY

MASTER OF SCIENCE
(MICROBIOLOGY)

[II YEAR PROGRAM]

CHOICE BASED CREDIT SYSTEM (CBCS)
COURSE STRUCTURE AND SYLLABUS

[Applicable w.e.f. Academic Session: 2022-23]
[*As per CBCS guidelines given by UGC*]

IFTM UNIVERSITY

N.H.-24, Lodhipur Rajput, Delhi Road, Moradabad, Uttar Pradesh-244001
Website: www.iftmuniversity.ac.in

Website: www.iftmuniversity.ac.in

SCHOOL OF BIOTECHNOLOGY

Study and Evaluation Scheme

of

Master of Science

(Microbiology)

Choice Based Credit System (CBCS)

[Applicable w.e.f. Academic Session: 2022-23]
[As per CBCS guidelines given by UGC]

Summary

Programme:	**Master of Science (Microbiology)**
Programme Level:	**Degree (Post Graduation)**
Duration:	**Two years (Four semesters) Fulltime**
Medium of Instruction:	**English**
Minimum Required Attendance:	**75%**
Maximum Credits:	**86**

IFTM UNIVERSITY, MORADABAD
MASTER OF SCIENCE (MICROBIOLOGY)

Preamble

Completion of graduation course in Microbiology simply provides a platform for basic understanding of the subject. Inventions, innovations and technology have revolutionized and enriched the Microbiology subject.

School of Biotechnology, IFTM University offers the M.Sc. (Microbiology) programme with an aim to professionally train students with an undergraduate degree in life science to provide services majorly in educational & research institutions, hospitals, quality control divisions of industries, food processing units and other related settings. These postgraduates are expected to be equipped to pursue research and to contribute to the knowledge building process in the same field.

Considering this, M.Sc. (Microbiology) CBCS (2021-2022) programme is designed to provide through and updated knowledge of the subject which makes easy entry of the students in public private sector. Uniqueness of the course is of having 6 months mandatory dissertation work along with core courses (CC), Generic elective (GE), ability enhancement compulsory course (AECC), discipline specific elective (DSE) and skill enhancement course (SEC).

Programme objectives: The programme aims to achieve the following objectives

- 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.

PROGRAM OUTCOMES (PO):

Following Program Outcomes will be achieved:

PO1- Domain knowledge: Gain and apply knowledge of basic concepts, principles and applications of the microbiology.

PO2- Resource Utilization: Nurture the ability & skills to acquire the appropriate learning resources including library, e-learning resources, ICT tools in order to enhance knowledge base and stay well versed with recent developments and advancements.

PO3- Analytical & Technical skills: Developing the capability and competency to use the appropriate tools, techniques, methods and equipment with the better knowledge and understanding of its Standard Operating Procedures (SOPs) or protocols, safety guidelines and limitations.

PO4- Critical thinking & problem solving: To locate and figure out the relevant & significant problems arising in the relevant science discipline and thereafter its critical analysis using appropriate methods, tools & techniques to find the best solutions.

PO5- Project management: Demonstration of scientific know-how and understanding to bring out the pertinent research problem and thereafter providing best solutions through design of experiments, proper analysis, and use of appropriate techniques within the given constraints of time, skills, budget and other resources.

PO6- Individual and teamwork: Think critically and work in independent manner, and as a member or leader in diverse groups & teams, and also in multidisciplinary settings to attain the solutions & goals.

PO7- Effective Communication: Effective verbal and non-verbal communication (written, social media) with fellows, educators, science community, and with the whole society. Develop the ability to prepare scientific documents like dissertations, reports, and its effective presentation.

PO8- Environment and society: Apply reasoning through the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional scientific practice.

PO9- Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of scientific practice.

PO10- Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of scientific and technological changes for up-to-date research and teaching methods.

1. **Eligibility**

a. **Admission Criteria:** Admission to this course shall be carried out through merit.

b. **Qualifying Examination:** Undergraduate level with any discipline of life Science.

c. Marks 45% aggregate for general and OBC category and 40 % aggregate for SC/ST category.

2. **Curriculum:** M.Sc. courses shall be based on semester system which will be of two years duration, divided into two sessions and four semesters. Each session shall be of two semesters, Session- I shall comprise of two semesters i.e., semester-I and semester-II; Session-II shall comprise of two semesters i.e., semester-III and semester-IV. The academic will follow the pattern as mentioned below:

Academic Calendar	Classes
I and III Semester	August to December
II and IV Semester	January to May
Summer Vacation	June and July

3. **Cancellation of Admission:** If a student at any stage is found to have concealed any information or have furnished false documents or found to be indulged in gross indiscipline/ misconduct, his/ her admission shall be cancelled and fee deposited by the student shall not be refunded in any case.

Evaluation of Performance

1. **Programme:** Evaluation of performance of the students in a programme shall be a continuous process based on their performance in the class test, quizzes, assignments and the end semester examinations.

    a. **Theory papers in semester system (Maximum Marks: 100)**

    The evaluation will be done through two class test and one end semester examination. This will be in addition to quizzes, assignments, attendance, etc. Each class test will carry a weightage of 10 marks, and the end semester examination will carry a weightage of 70 marks. The remaining 10 marks will be awarded on the basis of attendance and performance in quizzes and assignments.

    b. **Practical in semester system (Maximum Marks: 100)**

    In each practical, the student will be required to carry out the number of experiments as specified in the syllabus. Each practical conducted will be assessed by the teacher based on the experiment done during the lab, submission of the practical file, and understanding of the experiment done, which will carry a weightage of 30 marks. There shall be an end semester practical examination with or without an external examiner which will carry a weightage of 70 marks.

2. **Project, Dissertation, Seminar etc.:** Project, Seminar, Dissertation, and other learning-oriented activities shall have associated maximum marks and credits, as stated in the syllabus.
3. **Examination:**
    a. The minimum Grade required to pass in each Theory & Practical paper is 'GRADE D'.
    b. A candidate, in order to pass, minimum CGPA of 4.50 is required in a particular academic year inclusive of both semesters of that academic. And maximum number of Carryover paper permissible for promotion to next academic year are 05 theory/ practical / project papers.
    c. In case of audit paper, the minimum Grade required to pass is Grade D. However, the Grade obtained in audit paper shall not be included in SGPA.

Groups of CBCS:

The 07 groups of courses have been identified to provide student comprehensive exposure to a large number of areas, leading to the holistic development of an individual. These groups / clusters are as follows:

1. Core Courses- Theory (CC-T)
2. Core Courses- Practical (CC-P)
3. Discipline Specific Elective (DSE)
4. Generic Elective (GE)
5. Ability Enhancement Compulsory Courses (AECC)
6. Skill Enhancement Courses (SEC)
7. Project/Dissertation/Seminar

1. Core Courses- Theory (CC-T):

Core courses of M.Sc. Program will provide a holistic approach to Microbiology graduates, giving them an overview of the field, a basis to build and specialize upon. These core courses are the strong foundation to establish technical knowledge and provide broad multi-disciplined knowledge can be studied further in depth during the elective phase.

The core courses will provide more practical-based knowledge. It will train the students to analyze, decide, and lead-rather than merely know-while creating a common student experience that can foster deep understanding of the subject. A wide range of core courses provides groundwork in the field of Biochemistry, Microbiology, Immunology etc.

We offer core courses in semester I, II, III during the M.Sc. Microbiology. There will be 4 credits for each core course offered depending upon the course content.

2. Core Courses- Practical (CC-P):

These courses include various laboratories designed to provide the student solid foundation to the domain of Microbiology. These courses are of 1 credit each.

3. Discipline Specific Elective (DSE):

Elective courses may be offered by the main discipline of study is referred to as Discipline Specific Elective. The University offer discipline related Elective courses of interdisciplinary nature like Cell Biology, Microbial Metabolism etc. There will be 4 credits for each Discipline Specific Elective course offered depending upon the course content.

4. Generic Elective (GE):

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. This can be a core course offered in a discipline/subject which may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective. This course includes Biostatistics. This course is of 4 credits.

5. Ability Enhancement Compulsory Course (AECC):

These courses are actually Ability Enhancement Course (AEC) which is designed to develop the ability of students in Bioinstrumentations, Biosafety & IPR and other related courses where they might find it difficult to communicate at a higher level in their prospective job at a later stage due to lack of practice and exposure in the language etc. Students are motivated to learn the theories, fundamentals and technological aspects which can help them develop and sustain in the corporate environment and culture. These courses are of 4 credits each.

6. Skill Enhancement Courses (SEC):

These courses are designed to provide value-based and/or skill-based knowledge. Courses like Molecular Biology, Environmental Microbiology will provide skill based technical knowledge for working in special units in industries and to develop them as entrepreneur. These courses are of 4 credits each.

7. Project/Dissertation/Seminar:

i. Project with a department faculty or in Government recognized research lab/ Institute(s)/ Research based industry. It is the exploration of a specific topic within a field by a post graduate student that makes an original contribution to the discipline.

ii. The students, who take up experiential projects in companies, where senior executives with a stake in teaching guide them, drive the learning. All students are encouraged to do some live project other than their regular classes.

Summary of Credits

M.Sc. Microbiology: Two Year (4-Semester) CBCS Programme			
Basic Structure: Distribution of Courses			
S. No.	**Type of Course**	**Credit**	**Total Credits**
1.	**Core Course-Theory (CC-T)**	6 Courses of 4 Credits each (Total Credit 6X4)	24
2.	**Core Course-Practical (CC-P)**	6 Courses of 1 Credits each (Total Credit 6X1)	06
3.	**Discipline Specific Elective (DSE)**	3 Courses of 4 Credits each (Total Credit 3X4)	12
4.	**Generic Elective (GE)**	1 Course of 4 Credit (Total Credit 1X4)	04
5.	**Ability Enhancement Compulsory Course (AECC)**	3 Courses of 4 Credits each (Total Credit3X4)	12
6.	**Skill Enhancement Courses (SEC)**	2 Courses of 4 Credits each (Total Credit 2X4)	08
7.	**Project/Dissertation**	1 Course of 20 Credits (Total credit 1x20)	20
TOTAL			**86**

School of Biotechnology
Programme: Master of Science (Microbiology)
CHOICE BASED CREDIT SYSTEM

Course Code	CBCS BASKET	Credits			
Core Courses- Theory (CC-T)		**L**	**T**	**P**	**C**
MSB101T	Biochemistry	3	1	0	4
MSB102T	Microbiology	3	1	0	4
MBM201T	Industrial Microbiology	3	1	0	4
MSB202T	Microbial Technology	3	1	0	4
MBM301T	Immunology	3	1	0	4
MSB302T	Bioinformatics	3	1	0	4
Core Courses-Practical (CC-P)		**L**	**T**	**P**	**C**
MSB101P	Biochemistry Lab	0	0	2	1
MSB102P	Microbiology Lab	0	0	2	1
MBM201P	Industrial Microbiology Lab	0	0	2	1
MSB202P	Microbial Technology Lab	0	0	2	1
MBM301P	Immunology Lab	0	0	2	1
MSB302P	Bioinformatics Lab	0	0	2	1
Discipline Specific Elective (DSE)		**L**	**T**	**P**	**C**
MSB103T	Cell Biology	3	1	0	4
MBM203T	Microbial Metabolism	3	1	0	4
MBM303T	Microbial Genetics	3	1	0	4
Generic Elective (GE)		**L**	**T**	**P**	**C**
MSB304T	Biostatistics	3	1	0	4
Ability Enhancement Compulsory Course (AECC)		**L**	**T**	**P**	**C**
MSB104T	Bioinstrumentation	3	1	0	4
MSB204T	Advanced Proteomics and Genomics	3	1	0	4
Elective	MBM305T MBM306T MSB307T	Medical Microbiology Clinical & Diagnostic Microbiology IPR & Biosafety	3	1	0	4
Skill Enhancement Courses (SEC)		**L**	**T**	**P**	**C**
MSB105T	Molecular Biology	3	1	0	4
MBM205T	Environmental Microbiology	3	1	0	4
Project/Dissertation		**L**	**T**	**P**	**C**
MBM481P	Dissertation	0	0	20	20

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
(CHOICE BASED CREDIT SYSTEM)
M.Sc. (MICROBIOLOGY)

SEMESTER: I

S.No.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	CC-T	MSB101T	Biochemistry	3	1	0	20	10	30	70	100	4
2.	CC-T	MSB102T	Microbiology	3	1	0	20	10	30	70	100	4
3.	DSE	MSB103T	Cell Biology	3	1	0	20	10	30	70	100	4
4.	AECC	MSB104T	Bioinstrumentation	3	1	0	20	10	30	70	100	4
5.	SEC	MSB105T	Molecular Biology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT												
6.	CC-P	MSB101P	Biochemistry Lab	0	0	2	-	-	30	70	100	1
7.	CC-P	MSB102P	Microbiology Lab	0	0	2	-	-	30	70	100	1
TOTAL				**15**	**05**	**04**	**-**	**-**	**210**	**490**	**700**	**22**

SEMESTER: II

S.No.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	CC-T	MBM201T	Industrial Microbiology	3	1	0	20	10	30	70	100	4
2.	CC-T	MSB202T	Microbial Technology	3	1	0	20	10	30	70	100	4
3.	DSE	MBM203T	Microbial Metabolism	3	1	0	20	10	30	70	100	4
4.	AECC	MSB204T	Advanced Proteomics and Genomics	3	1	0	20	10	30	70	100	4
5.	SEC	MBM205T	Environmental Microbiology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT												
6.	CC-P	MBM201P	Industrial Microbiology Lab	0	0	2	-	-	30	70	100	1
7.	CC-P	MSB202P	Microbial Technology Lab	0	0	2	-	-	30	70	100	1
TOTAL				**15**	**05**	**04**	**-**	**-**	**210**	**490**	**700**	**22**

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
(CHOICE BASED CREDIT SYSTEM)
M.Sc. (MICROBIOLOGY)

SEMESTER: III

S.No.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	CC-T	MBM301T	Immunology	3	1	0	20	10	30	70	100	4
2.	CC-T	MSB302T	Bioinformatics	3	1	0	20	10	30	70	100	4
3.	DSE	MBM303T	Microbial Genetics	3	1	0	20	10	30	70	100	4
4.	GE	MSB304T	Biostatistics	3	1	0	20	10	30	70	100	4
5.	AECC	Departmental Elective*	*Only 01 paper is to be chosen from the basket of the departmental electives having 03 papers, provided by the school	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT												
6.	CC-P	MBM301P	Immunology Lab	0	0	2	-	-	30	70	100	1
7.	CC-P	MSB302P	Bioinformatics Lab	0	0	2	-	-	30	70	100	1
TOTAL				**15**	**05**	**04**	**-**	**-**	**210**	**490**	**700**	**22**

LIST OF DEPARTMENTAL ELECTIVES*		
Sr. no.	**Course Code**	**Course Name**
1.	MBM305T/ MBM306T/ MSB307T	Medical Microbiology/ Clinical & Diagnostic Microbiology/ IPR & Biosafety

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
(CHOICE BASED CREDIT SYSTEM)
M.Sc. (MICROBIOLOGY)

SEMESTER: IV

S.No.	Category	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
							Mid Term Exam			External Exam		
				L	T	P	CT	AS +AT	Total			
THEORY												
1.	CC-P	MBM481P	Dissertation	0	0	20	-	-	150	250	400	20
TOTAL				**0**	**0**	**20**	**-**	**-**	**150**	**250**	**400**	**20**

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

MSB101T 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)**

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).

UNIT V: **(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.

Course Outcomes:

At the end of the course students will be able to:
CO1: Understand in detail the structure and physicochemical properties and metabolism of carbohydrates for skill development, employability and entrepreneurship development.
CO2: Understand in detail the structure, type and classification of protein for skill development and employability.
CO3: Understand the nomenclature and chemical properties of Fatty acids and Lipids along with their metabolic pathways like β oxidation for skill development, employability and entrepreneurship development.
CO4: Understand the structure of Purines and Pyrimidines and their metabolism, types of DNA and properties of RNA for skill development and employability.
CO5: Understand the difference between the water-soluble and fat-soluble vitamins and their key role in metabolism for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	1	2	1	3	2	3
CO2	3	2	3	3	2	2	2	2	2	2
CO3	3	2	3	2	3	3	3	3	2	3
CO4	3	1	2	2	2	1	2	3	3	3
CO5	3	3	2	1	1	2	2	1	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	2
CO3	3	3	3
CO4	3	3	2
CO5	3	3	3

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)

MSB102T 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 the course students will be able to:
CO1: Understand the historical concept of microbiology, various sterilization techniques, microbial nutrition, and microbial growth for skill development and employability.
CO2: Learn about the structure and the classification of bacteria for skill development, employability and entrepreneurship development.
CO3: Learn about the structure and classification of the virus for skill development and employability.
CO4: Understand the mechanism of sterilization, use and mode of action of various antibiotics for skill development, employability and entrepreneurship development.
CO5: Understand the microbial ecology including interaction among soil microbes, symbiosis, and nitrogen fixation for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever

required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	1	3	2	2	2	3	1	3
CO2	3	3	3	2	2	3	2	2	2	3
CO3	3	3	3	3	2	2	2	2	2	2
CO4	2	2	2	3	2	2	2	2	2	3
CO5	1	2	2	2	3	3	2	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	2
CO2	3	3	3
CO3	3	3	3
CO4	3	3	2
CO5	3	3	3

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) I Year (I Semester)

MSB103T 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:

At the end of the course students will be able to:
CO1: Understand Cell structure and functions for skill development, employability and entrepreneurship development.
CO2: Understand the cell junctions maintaining the homeostasis and critical cell processes for skill development and employability.

CO3: Understand the different stages of the cell cycle and cell division for skill development, employability and entrepreneurship development.
CO4: Know the different cell signaling pathways for skill development, employability and entrepreneurship development.
CO5: Understand cancer-related cell reproduction for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	2	2	3	2	2	3
CO2	3	3	2	2	2	2	2	1	3	3
CO3	3	3	3	3	3	2	2	3	2	2
CO4	1	3	2	2	3	3	3	2	3	3
CO5	3	3	3	3	2	2	3	3	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

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)

MSB104T 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:

At the end of the course students will be able to:
CO1: Understand the principle and working of microscope for skill development, employability and entrepreneurship development.
CO2: Understand the concept of ultracentrifugation and its application for skill development, employability and entrepreneurship development.
CO3: Acquire knowledge of the various applications of electrophoresis for skill development, employability and entrepreneurship development.
CO4: Explain the principle, instrumentation, and application of spectroscopic instruments for skill development and employability.
CO5: Understand the various radio-isotopic techniques and their application in biology and medicine for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	3	2	2	3	3
CO2	3	3	1	2	2	3	2	2	3	2
CO3	3	3	1	2	2	3	2	2	3	3
CO4	3	3	3	2	2	3	3	2	3	3
CO5	3	3	3	3	3	3	2	3	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	2
CO5	3	3	3

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) I Year (I Semester)

MSB105T 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:

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

CO1: Describe the structural components of Nuclear membrane, chromosomal structure, DNA packaging, C-value and Cot value, Mutations involving chromosomal and gene mutations, Salivary and Lamp brush chromosomes for skill development, employability and entrepreneurship development.
CO2: Describe the mechanism of bacterial replication, Enzymes involved in DNA replication, Telomeric replication, Recombination and its mechanism and types of DNA repair mechanisms for skill development, employability and entrepreneurship development.
CO3: Explain the structure of prokaryotic and eukaryotic RNA Polymerase, mechanism of transcription in prokaryotes and eukaryotes, significance of promoter sequences and RNA processing for skill development and employability.
CO4: Describe the molecular mechanisms of translation in prokaryotes and eukaryotes, regulation of translation, post-translational modifications of proteins, and mechanisms of regulation of gene expression in prokaryotes lac operon and trp operon, mechanisms of regulation of gene expression in eukaryotes, lytic cascades, and lysogenic repression for skill development, employability and entrepreneurship development.
CO5: Describe the genetic diseases-autosomal and sex-linked diseases, causes and genetics of cancer, the role of p53 and pRB in cancer, Tools in molecular biology- Fluorescent In-situ Hybridisation (FISH), DNA microarrays for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	3	3	2	3	2
CO2	3	2	3	3	3	3	2	2	2	2
CO3	2	3	2	2	1	2	3	3	2	3
CO4	2	2	2	1	2	2	2	2	2	3
CO5	3	3	3	3	3	3	3	2	2	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

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)

MSB101P BIOCHEMISTRY LAB

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.	Estimation of total carbohydrates by Anthrone's methods.	Experiment 5
10.	To detect whether given sample is protein or non-protein.	Experiment 6
11.	To detect the presence of amino acid from a given sample by Ninhydrin Test or Xanthoproteic acid Test.	Experiment 7
12.	Test to distinguish ketoses from aldoses sugars (Seliwanoff's test)	Experiment 8

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

MSB102P MICROBIOLOGY LAB

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
Master of Science (M.Sc.), Programme
M.Sc. Microbiology I Year (II Semester)

MBM201T 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 Vitamins, Enzymes and Amino Acids: Production of Vitamin B12, Amylases, Cellulases, Proteases, Tryptophan and antibiotics.

Course Outcomes:

At the end of the course students will able to:
CO1: Understand the history and developments of Industrial microbiology. Learn the techniques to culture and maintenance of microbes for skill development, employability and entrepreneurship development.
CO2: Describe the components and various types of bioreactor for skill development, employability and entrepreneurship development.
CO3: Describe the methods, advantages and application of enzyme immobilization for skill development, employability and entrepreneurship development.
CO4: Learn the methods of downstream processing for skill development, employability and entrepreneurship development.
CO5: Understand the microbial production of vitamin, enzymes and amino acids for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	3	2	2	3	2	3	3
CO2	3	3	1	3	3	2	3	3	3	1
CO3	3	2	2	2	2	3	3	3	3	2
CO4	3	1	3	2	2	3	1	2	3	2
CO5	3	2	2	3	2	2	2	3	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

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. Biotechnology/Microbiology I Year (II Semester)

MSB202T 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:

At the end of the course students will be able to:
CO1: Develop an understanding of fermentation and its types -solid and submerged fermentation for skill development, employability and entrepreneurship development.
CO2: Know the raw materials for industrial fermentation and the pretreatment process for skill development, employability and entrepreneurship development.
CO3: Isolate and preserve the industrially important microbes for skill development, employability and entrepreneurship development.
CO4: Understand the metabolic pathways and their role in product formation for skill development, employability and entrepreneurship development.

CO5: Understand the techniques of production of industrially important products-ethanol, citric acid, penicillin, etc. for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	2	2	3	2
CO2	3	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	1	2	2	2	2
CO4	3	3	3	3	3	2	2	2	3	3
CO5	3	3	3	3	3	3	1	3	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	2

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

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology I Year (II Semester)

MBM203T 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:

At the end of the course students will be able to:
CO1: Understand the basic concepts of primary metabolism used within cells to break down the molecules to generate the energy such as Embden- Meyerhof- Parnas (EMP) pathway and TCA cycle for skill development, employability and entrepreneurship development.
CO2: Understand the principles of cellular respiration in aerobic and anaerobic organisms, familiarize the concept of ATP synthesis and electron flow, describe metabolism in chemoheterotrophic bacteria for skill development, employability and entrepreneurship development.

CO3: Understand thoroughly the process of photosynthesis in bacteria uptake and utilization of the inorganic or organic compounds required for growth and maintenance of a cellular steady-state (assimilation reactions) for skill development, employability and entrepreneurship development.
CO4: Understand the flow of nitrogen into biosynthesis and catabolism of amino acids for skill development, employability and entrepreneurship development.
CO5: Define the biosynthesis and oxidation of fatty acids and ketone bodies. To understand the metabolism of nitrogenous and non-nitrogenous compounds in bacterial cells for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	3	2	2	3	2	2	3
CO2	3	3	3	3	3	2	3	3	2	3
CO3	3	3	3	2	2	3	2	2	1	2
CO4	2	3	2	2	2	2	3	2	3	3
CO5	3	3	3	2	3	3	2	3	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

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

MSB204T 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:

At the end of the course students will be able to:
CO1: Understand the scope of proteomics, protein folding, gel electrophoresis, and post-translation modification for skill development, employability and entrepreneurship development.
CO2: Construct physical and genomic mapping, the role of SNPs and ESTs in gene identification for skill development.
CO3: Know biomedical application of proteomics and principle and design of protein chip for skill development and employability.
CO4: Produce multiple copies of genes using PCR, and develop the concept of DNA foot printing and fingerprinting for skill development.

CO5: Compare and predict gene, Principle, and construction of DNA microarray and tools used for gene manipulation for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	2	2	2	2	2	2
CO2	3	3	3	2	3	3	2	2	1	2
CO3	3	3	3	2	2	3	3	1	2	3
CO4	3	3	3	2	3	3	3	2	2	2
CO5	2	3	3	2	3	3	2	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	2	2
CO3	3	3	2
CO4	3	2	2
CO5	3	3	3

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)

MBM205T 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 (Marine & 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:

At the end of the course students will be able to:
CO1: Understand the role of microorganisms as agents of environmental change for skill development, employability and entrepreneurship development.
CO2: Recognize microorganisms as indicators of alteration of an ecosystem for skill development, employability and entrepreneurship development.
CO3: Understands the emerging needs of Biofuels, Biofertilizers, and Biopesticides for skill development and employability.
CO4: Understand bioremediation, its application, and its limitations for skill development, employability and entrepreneurship development.

CO5: Understand the environmental issues including Primary, Secondary, and tertiary wastewater and industrial effluents treatment for skill development and employability.

Mapping Course Outcomes leading for the achievement of Programme Outcomes. Please write 3,2,1 wherever required. (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	1	2	3	2	2
CO2	3	2	2	2	2	3	2	3	2	2
CO3	3	3	3	2	2	3	2	3	2	3
CO4	3	2	2	3	2	2	2	3	2	1
CO5	2	2	2	3	2	3	3	3	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	2
CO3	3	3	3
CO4	3	3	2
CO5	3	3	3

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

Website Sources:

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

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology I Year (II Semester)

MBM201P INDUSTRIAL MICROBIOLOGY LAB

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)

MSB202P MICROBIAL TECHNOLOGY LAB

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
Master of Science (M.Sc.), Programme
M.Sc. Microbiology II Year (III Semester)

MBM301T 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; Mechanism of T-cell & NK cells mediated lysis; 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; FACS; Production and application of monoclonal antibodies- Hybridoma Technology; Vaccines.

UNIT V: **(8 Sessions)**

Immunity to Microbes and diseases: Immunity against infectious agents-Influenza, Mycobacterium tuberculosis, Plasmodium falciparum; Hyper-sensitivity; Autoimmunity; Tumor Immunology; Immunodeficiency disease – AIDS; Transplantation immunology

Course Outcomes:

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

CO1: Understand the outline of the key mechanisms and cellular players of innate and adaptive immunity, as well as inflammation. Describe the characteristics and roles of different types of T cells & B cells in the adaptive immune response for skill development.
CO2: Describe in detail the properties of antigens, haptens, and adjuvants. Explain the structure, properties, and functions of antibodies for skill development, employability and entrepreneurship development.
CO3: Learn the outline of key events and cellular players in antigen processing & presentation, pathways of complement protein activation, mechanisms that regulate immune responses and maintain tolerance for skill

development, employability and entrepreneurship development.
CO4: Apply basic techniques for identifying antigen-antibody interactions. Understand the principles of vaccination & types of vaccines; production and application of monoclonal antibodies for skill development, employability and entrepreneurship development.
CO5: Understand the mechanisms of cell-mediated cytotoxicity and immune response against infectious diseases. Explain the basis of hypersensitivity, autoimmunity, transplantation tumour immunology for skill development.

Mapping Course Outcomes leading for the achievement of Program Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	3	3	2	2	3
CO2	3	3	2	3	2	3	1	2	3	2
CO3	2	3	2	2	3	3	3	2	3	3
CO4	2	3	3	2	2	3	3	2	2	2
CO5	3	3	3	3	2	2	1	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	2
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

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. (Biotechnology/Microbiology) II Year (III Semester)

MSB302T 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:

At the end of the course students will be able to:
CO1: Gain knowledge of various biological databases and sequence formats for skill development.
CO2: Identify the homologous protein and DNA sequences for skill development, employability and entrepreneurship development.
CO3: Study various protein modelling methods for skill development, employability and entrepreneurship development.
CO4: Understand the visualization and characterization of protein structures for skill development.
CO5: Establish the phylogenetic relationship between DNA and protein sequence for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Program Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	3	2	2	2	3
CO2	3	2	2	2	2	2	2	2	2	1
CO3	3	3	2	3	2	2	2	2	2	3
CO4	3	2	2	2	2	2	3	2	2	2
CO5	3	2	2	2	2	3	1	3	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	2
CO2	3	3	3
CO3	3	3	3
CO4	3	2	2
CO5	3	3	3

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

Website Sources:

- 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)

MBM303T 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:

At the end of the course students will be able to:
CO1: Understand the importance of mutation analysis, can analyze mutations by complementation and recombination tests and can design a strategy to create gene replacement in bacteria for skill development.
CO2: 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 for skill development, employability and entrepreneurship development.
CO3: Understand the structure, replication, control, partitioning, and replication of explained plasmid for skill development and employability.
CO4: Construct a genetic map of the bacterial genome using the conjugation-based method for skill development, employability and entrepreneurship development.

CO5: List the events in the lytic and lysogenic phases of the lambda phage life cycle and the regulatory factors and events involved for skill development and employability.

Mapping Course Outcomes leading for the achievement of Program Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	3	1	2	2	3	3	2
CO2	3	3	2	3	2	3	2	3	3	2
CO3	3	2	3	3	3	2	2	3	3	1
CO4	3	2	2	3	2	2	2	3	2	3
CO5	3	3	3	3	3	3	3	3	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	3
CO2	3	3	3
CO3	3	3	2
CO4	3	2	3
CO5	3	3	2

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. (Biotechnology/Microbiology) II Year (III Semester)

MSB304T 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:

CO1: Demonstrate knowledge of the properties of parametric, semi-parametric and nonparametric testing procedures in Biostatistics for skill development.
CO2: Remember restate the principal concepts about biostatistics and collect data relating to variable which will be examined for skill development.
CO3: Understand and interpret the concepts of descriptive statistics from these data for skill development.
CO4: Understand and be able to address ethical, regulatory and practical aspects of human subject research including human subject's protections for skill development.

CO5: Be capable of self-directed learning of unfamiliar statistical methods and written and oral presentation of results/findings for skill development and employability.

Mapping Course Outcomes leading for the achievement of Program Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	3	2	2	2	2	2
CO2	3	2	2	2	3	1	2	2	2	2
CO3	3	2	2	2	3	2	2	3	3	3
CO4	3	2	1	2	3	2	2	3	3	3
CO5	3	2	2	2	3	2	2	3	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	2	2
CO2	3	2	2
CO3	3	2	1
CO4	3	2	2
CO5	3	3	2

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
- en.wikipedia.org

IFTM University, Moradabad
Master of Science (M.Sc.), Programme
M.Sc. Microbiology II Year (III Semester)

MBM305T 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:

At the end of the course students will be able to:
CO1: Describe the microflora of a healthy human host, host-microbe interaction, infection types and stages, Transmission of diseases, and tissue damage for skill development, employability and entrepreneurship development.
CO2: Explain the morphological characteristics, pathogenesis, and lab diagnosis of important bacterial pathogens like Klebsiella pneumonia; Proteus Vulgaris; Pseudomonas aeruginosa; Crypto sporodium, Vibrio cholerae; Streptococcus pneumonia, etc for skill development and employability.
CO3: Elaborate the morphological characteristics, pathogenesis, and Lab diagnosis of important fungal pathogens like Microsporum; Trichophyton; Histoplasma capsulatum; Blastomyces dermatitidis; Candida albicans, etc. for skill development and employability.

CO4: Describe the protozoan infections caused by Entamoeba histolytica; Giardia Lamblia; Plasmodium vivax; Leishmania donovani and helminthic infections like Taenia saginata; Taenia solium; Hymenolepisnana for skill development and employability.
CO5: Explain the morphological characteristics, pathogenesis, and Lab diagnosis of viral infections caused by Poxviruses; Herpesviruses; Adenoviruses; Poliovirus; Hepatitis viruses damage for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Program Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	2	2	2	2	2	3	3	3
CO2	3	3	2	2	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	2	3
CO4	3	3	3	2	2	2	3	2	3	2
CO5	2	3	3	3	3	3	3	2	3	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3

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)

MBM306T 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:

At the end of the course students will be able to:
CO1: Understand the diverse nature of the normal microflora of the body, its significance and key concepts related to host-pathogen interaction as well for skill development, employability and entrepreneurship development.
CO2: To introduce and acquaint the students with the key aspects of medical microbiology related to the diverse microbial pathogens, their virulence mechanisms, symptoms and their mode of transmission for skill development, employability and entrepreneurship development.
CO3: Learn basic concepts of handling clinical specimens and approaches used to aid in the detection/diagnosis of diseases using immunological and molecular biology-based methods for skill development and employability.
CO4: Understand the general characteristics and mode of action of commonly employed antibacterial agents and the concept of antimicrobial resistance for skill development and employability.
CO5: Learn the technique of collection, transport and culturing of clinical samples. Learn the principles of different diagnostic tests such as ELISA, agglutination-based tests and specific approaches to diagnose pathogens that are difficult to detect/culture by routine methods for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Program Outcomes
Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	2	3	3	2
CO2	3	3	2	2	2	2	3	2	3	3
CO3	3	3	3	3	2	3	2	2	2	2
CO4	3	2	2	2	2	3	3	3	3	3
CO5	2	3	3	2	2	3	2	2	3	2

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3

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. (Biotechnology/Microbiology) II Year (III Semester)

MSB307T IPR & 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:

At the end of the course students will be able to:
CO1: Understand the concept of IPR and its types in detail for skill development, employability and entrepreneurship development.
CO2: Describe the agreements and treaties related to IP for skill development, employability and entrepreneurship development.
CO3: Explain the rights and protection of IP for skill development, employability and entrepreneurship development.
CO4: Understand the ethical issues and ethical aspects of genetic engineering for skill development and employability.
CO5: Learn the role, different committees and guidelines for biosafety for skill development, employability and entrepreneurship development.

Mapping Course Outcomes leading for the achievement of Program Outcomes

Please write 3,2,1 wherever required
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	2	2	2	2	2	3
CO2	3	2	1	2	2	2	2	2	2	3
CO3	2	2	3	3	2	3	1	2	2	3
CO4	2	2	2	2	2	2	2	3	2	3
CO5	3	3	3	3	2	2	2	2	2	3

CO-Curriculum Enrichment Mapping (Please write 3,2,1 wherever required)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	2
CO5	3	3	3

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. Microbiology II Year (III Semester)

MBM301P IMMUNOLOGY LAB

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 Immuno electrophoresis.	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

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MSB302P BIOINFORMATICS LAB

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and Don't	
4	About Equipment and Accessories and Working	
5	Introduction to various biological databases.	Experiment 1
6	To study various file formats of NCBI.	Experiment 2
7	To Identify all the possible open reading frames in a sequence.	Experiment 3
8	To compute the various physical and chemical parameters of a protein.	Experiment 4
9	To learn how to retrieve structural data of a protein using PDB database.	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