



आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश  
**IFTM University, Moradabad, Uttar Pradesh**  
NAAC ACCREDITED

SCHOOL OF BIOTECHNOLOGY  
IFTM UNIVERSITY  
[www.iftmuniversity.ac.in](http://www.iftmuniversity.ac.in)

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

Programme:	Bachelor of Science (Microbiology)
Course Level:	UG Degree
Duration:	Three Years (Six semesters) Full Time
Medium of Instruction:	English
Maximum required attendance:	75%
Maximum Credits:	138

**Programme Outcomes (POs)**

Students completing this programme will be able to:

- They can pursue master degree in life Science & applied discipline
- Understand the role of microbes in health, food and value-added product formation.
- Explain pathogenic microorganisms, their characterization, pathogenesis and control.
- Safeguard themselves & society and can work in pathology and microbial research lab.
- It makes students self-reliance in the industrial application of microbiology and can be established themselves as an entrepreneur.

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

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Sem Exam	AS +AT	Total	End Sem Exam		
			L	T	P						
<b>THEORY</b>											
1.	BSB-101	Principles of Biotechnology	3	1	0	20	10	30	70	100	4
2.	BSB-102	Biodiversity and Systematic	3	1	0	20	10	30	70	100	4
3.	PSD-101	Professional Skill Development I	3	1	0	20	10	30	70	100	4
4.	BCS-104	Fundamentals of Computers	3	1	0	20	10	30	70	100	4
5.	BCH-106	Organic Chemistry	3	1	0	20	10	30	70	100	4
<b>PRACTICALS / PROJECT</b>											
6.	BSB-154	Computer	0	0	2	20	10	30	70	100	1
7.	BSB-156	Organic Chemistry	0	0	2	20	10	30	70	100	1
8.	GP-101	General Proficiency	0	0	0	0	0	100	-	100	1
		<b>Total Credit</b>	15	5	4			310	490	800	<b>23</b>

**IFTM University, Moradabad**  
**Bachelor of Sciences (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology I Year (I Semester)**  
**(Effective from 2021-22)**

**BSB-101: PRINCIPLES OF BIOTECHNOLOGY**

**Objective(s):** The objectives of this course:

- Let the student learn the basics of the biotechnology from the beginning till its advancement.
- Make student understand applications of biotechnology in the different domains of allied sciences
- Introducing students with, biochemistry, genomics, proteomics and molecular markers, microbiology and their role for mankind.
- Make them understand the technical, professional and anthropogenic aspects of this subject area.

**UNIT I: (8 Sessions)**

**Introduction to Biotechnology:** Historical perspectives; Biotechnology and Society; Biotechnology in India and global trends; Application in health, food, medicine and agriculture; Bioethics in biotechnology; GMOs and biosafety issues.

**UNIT I: (8 Sessions)**

**Biomolecules:** Structure and function of biomolecules- Carbohydrates, Proteins, Lipids, Nucleic acids; Classification of Enzymes; Purification and characterization of enzymes from natural sources. Comparison of chemical and enzyme catalysis.

**UNIT III: (8 Sessions)**

**Cell Biology & Microbiology:** Cell theory; Cell Structures (Prokaryotes and eukaryotes); Origin of microbiology; Study of Microbes, Classification of microbes; Microbial Culture Techniques; Application of microbiology.

**UNIT IV: (8 Sessions)**

**Genetic Engineering:** Tools of rDNA Technology; Introduction of Recombinant DNA into host cells, screening techniques for Identification of Recombinants; Polymerase Chain Reaction (PCR); Genome Sequencing Projects (Human Genome Project).

**UNIT V: (8 Sessions)**

**Bioinformatics:** Introduction and application. Biological databases (nucleotide and protein data bases, Structure databases) and data retrieval system (ENTREZ, SRS, DBGET). Sequence and molecular file formats.

**Course Outcomes:**

Students completing this course will be able to:

- Provide education that leads to comprehensive understanding of the principles and practices of biotechnology.
- Empower students with the ability to think and solve problems in the field of biotechnology.
- Ensure students are able to effectively communicate with biotech and other interdisciplinary professionals.

**Suggested Readings:**

1. W. J. Thieman & M. A. Palladino, Introduction to Biotechnology, 2nd Edn., Pearson Education Limited, 2019.
2. H. K. Das, TextBook of Biotechnology, 4th Edn., Wiley India Pvt. Ltd., 2010.
3. B. D. Singh, Biotechnology, Kalyani Publishers, 2008.
4. R. C. Dubey, TextBook of Biotechnology, S. Chand Pvt. Limited, 2006.

**Website Sources:**

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

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**BSB-102: BIODIVERSITY AND SYSTEMATICS**

**Objective(s):** The objectives of this course:

- Provide a comprehensive introduction to all areas of systematic biology, from species description to phylogeny reconstruction.
- Develop understanding for ecosystem, its components, role and importance.
- Develop the concept of biodiversity and conservation of ecosystem.
- Let the learners know the importance of museum sciences, and the role of systematic in conservation biology.
- Define different stages of growth, its affect on society and population density are also described to correlate the biological systems.

**UNIT I: (8 Sessions)**

**Biodiversity & Population Dynamics:** Biodiversity – Concept of diversity, species, ecosystem, genetic; Population Dynamics- Population density & relative abundance, Population age distribution, Growth forms & carrying capacity.

**UNIT II: (8 Sessions)**

**Ecosystem, Biodiversity & Biogeography:** Concept of species, Ecosystem; Habitat & niche, Ecological equivalence, Biological clock, Basic behavioral patterns; Biodiversity & major biomes of world; Biogeography- a comprehensive account of flora and fauna in different bio-geographical region.

**UNIT III: (8 Sessions)**

**Conservation of Biodiversity:** Importance,—Conservation strategies; *in situ* and *ex situ* methods-advantages, limitations and applications; Conservation laws, policies and organizations.

**UNIT IV: (8 Sessions)**

**Threats to Biodiversity:** Natural and anthropogenic threats to biodiversity; Human-Animal conflict with special reference to elephants and tigers; IUCN Threat Categories-Red Data Book; Wildlife exploitation - Species extinctions. Susceptibility for Extinction, Endangered and endemic species of India; Impact of over-harvesting and Climate change on biodiversity; Causes and Impacts of Invasive species to biodiversity.

**UNIT V: (8 Sessions)**

**Biosystematics:** Analysis of Biodiversity- Biodiversity indices, Mathematical modeling for analysis of population variation.

**Course Outcomes:**

Students will be able to understand:

- The concept of biodiversity, population density and age distribution.
- The component part of ecosystem, their habitat and behavioral pattern.
- Tools and techniques to practice biological systematic.
- Analysis of Biodiversity and modeling of population variations.

**Suggested Readings:**

1. Albert E, Radford, Gloria May Cadell, Fundamentals of Plant Systematics, First Ed. Harper & Raw, 1986.
2. Naik, V.N. Taxonomy of Angiosperms. Second Ed Tata McGraw Hill, New Delhi.1984.
3. Thomas M. Smith and Robert Leo Smith. Elements of Ecology, 8<sup>th</sup> Edition. Benjamin Cummings.2012.
4. Freeman & Herron. Evolutionary Analysis, 3<sup>rd</sup> Edition.Pearson.2007.

5. M.P. Singh, B.B. Singh, B.S. Singh and Soma Dey. Plant Biodiversity and Taxonomy, First Ed. Daya Publishing House. 2002.

**Websites Sources:**

- <https://www.environment.gov.au/biodiversity/conservation>
- <https://www.conserve-energy-future.com/biodiversity-conservation-types-importance-methods.php>
- <https://sites.nicholas.duke.edu/ecologyapp/modules/population-dynamics/>
- [http://ib.berkeley.edu/courses/ib200a/ib200a\\_sp2010/lect/ib200a\\_lect16a\\_Lindberg\\_biological\\_systematics.pdf](http://ib.berkeley.edu/courses/ib200a/ib200a_sp2010/lect/ib200a_lect16a_Lindberg_biological_systematics.pdf)

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**(Effective from 2021-22)**

**PSD-101: PROFESSIONAL SKILL DEVELOPMENT-I**

**Course Objectives:** The objectives of this course are:

- To develop knowledge and understanding of grammar.
- To develop abilities to make use of the grammar in own writing English.
- To increase understanding and recall of what is read and listen including facts and main idea.
- To enhance competencies in writing paragraph, gist or abstract/précis of the passage in own words/ language and in writing resume, bio-data, letters and applications of different kinds.
- To develop all the four skills of English language.

**UNIT I:** **(8 Sessions)**

**Basic Applied Grammar and Usage**

**The Sentences:** Parts – Subject and Predicate; Kinds of Sentences and their Transformation. Parts of Speech. **Noun:** Kinds; Gender; Case; Number; Usage. **Pronouns:** Definition; Kinds; Usage. **Adjectives:** Kinds, Degrees of Comparison, Transformation of Degrees. **Determiners:** Kinds: many, many a, a great many; less and fewer; each and every; elder, eldest and older, oldest; much, many; little, a little, the little. **Articles:** Kinds, Articles and Number system, Articles and Gender system, Omission of Articles, Repetition of Articles. **Verbs:** Kinds; Auxiliaries: Principal Auxiliaries; Modal Auxiliaries; Semi-Modals; Usage

**UNIT II:** **(8 Sessions)**

**Basic Applied Grammar Continued**

**Non-Finite Verbs:** Kinds; Infinitives; Gerund; Participle. **Adverbs:** Kinds and Usage. **Prepositions:** Kinds and Usage. **Conjunctions:** Kinds; Usage. **Interjections:** Definition; Usage.

**UNIT III:** **(8 Sessions)**

**Clauses and Phrases, Tenses, Active and Passive Voice, Direct and Indirect Speech**

**UNIT IV:** **(8 Sessions)**

**Précis Writing:** Techniques of Précis Writing; examples. **Paragraph Writing:** Structure of Paragraph, Construction of Paragraphs; Techniques of Paragraph Writing: Unity, Coherence, Emphasis. **Reading Comprehension. Listening Comprehension.**

**UNIT V:** **(8 Sessions)**

**Writing of Resume, Bio-Data. Writing of Letters and Applications:** Formats; Elements; Kinds: Leave Applications, Job Applications, Order Letters, Letters of Claims and Complaints, Letters of Adjustment.

**Course Outcomes:**

Students completing this course will be able to:

- Write paragraph, gist or abstract/précis of the passage in their own words/language, resume, bio-data, letters and applications of different kinds.
- Use targeted grammatical structures meaningfully and appropriately in oral and written production.
- Enhance competence in the four modes of literacy: writing, speaking, reading & listening.
- Understand and recall facts and main idea.

**Suggested Readings:**

1. Remedial English Language by Malti Agarwal, Krishna Publications, Meerut.
2. Professional Communication by Malti Agarwal, Krishna Publications, Meerut.

3. High School English Grammar & Composition by Wren & Martin, S. Chand & Company LTD., New Delhi.

**Website Sources:**

- [www.wikipedia.com](http://www.wikipedia.com)
- [www.englishgrammar.org](http://www.englishgrammar.org)
- [www.usingenglish.com](http://www.usingenglish.com)
- [www.grammarly.com](http://www.grammarly.com)



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**BCS-104: FUNDAMENTAL OF COMPUTERS**

**Objective(s):** The objectives of this course:

- Introduces the concepts of computer basics & programming with particular attention to Engineering examples.
- Make the learners understand about C programming language.
- Understand the fundamental parts of programming language, so that the students will have a basic concept for understanding and using other programming language.

**UNIT I: (8 Sessions)**

**Introduction to Computer:** Definition of computer, characteristics of computer, Applications of computer, Generations of computers, Types of computers, Block diagram of computer, CPU, ALU, Control Unit, Software, Hardware, Operating system, BIOS.

**UNIT II: (8 Sessions)**

**Input-Output devices & Number System:** Keyboard, Mouse, Scanner, touch screen, MICR, OCR, OMR and Barcode Reader; Monitor, Printer, Speaker, and Projector; Binary, Octal, Decimal, Hexa decimal and its conversion. Compliments: 1's compliment, 2's compliment, 9 compliments. BCD. Binary addition, Binary Subtraction

**UNIT III: (8 Sessions)**

**Memory:** Memory Hierarchy, Main Memory, RAM, ROM (PROM, EPROM, EEPROM), Volatile Memory, Non Volatile Memory, Flash Memory, Cache memory, hit, miss, Associate memory Magnetic disk, Magnetic tapes, virtual memory, Bus structure, network topology, Serial communication

**UNIT IV: (8 Sessions)**

**Languages:** High level Language, Low level Language, Compiler, Interpreter, Assembler, Linker, Loader, Flow Chart, Algorithm; Introduction to C-data types, variables, C Libraries, Structure of program, Arithmetic operators, Logical operators, Relational Operators, Unary operators; Conditional Statements-IF, If- Else statement, Nested if statement; Looping Statement- For Loop, Do-While loop, While Loop. Nested loop, Continue and Break Statement.

**UNIT V: (8 Sessions)**

**C Language and Internet:** Array-One dimensional array, multi-dimensional array; Function- call by value, call by reference, nesting of function, recursion, structure; Introduction to internet- Concept of Internet, Basics of E-mail, World Wide Web (WWW), web browsers, Understanding URL, search engine, E-Commerce, Surfing the web

**Course Outcome:**

On completion of the course students will be able to:

- Understanding the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming
- Write, compile and debug programs in C language and use different data types for writing the programs.
- Design programs connecting decision structures, loops and functions.
- Explain the difference between call by value and call by address.
- Understand the dynamic behavior of memory by the use of pointers.
- Use different data structures and create or manipulate basic data files and developing applications for real world problems.

**Suggested Reading:**

1. P. K. Sinha, Fundamentals of Computers, BPB Publications
2. E. Balagurusamy (2008), Computing Fundamentals And C Programming, Tata McGraw-Hill
3. Yashwant Kanitkar, Let Us C, BPB Publications
4. Rajeshree R Khande and Manisha Maddel ; Internet Programming & Industrial Law; Vision Publications, Pune.

**Website Sources:**

- [swayam.gov.in](http://swayam.gov.in)
- [onlinecourses.nptel.ac.in](http://onlinecourses.nptel.ac.in)
- <https://www.geeksforgeeks.org/>
- [https://www.tutorialspoint.com/computer\\_fundamentals/index.htm](https://www.tutorialspoint.com/computer_fundamentals/index.htm)

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**BCH-106: ORGANIC CHEMISTRY**

**Objective(s):** The objectives of this course:

- Impart knowledge of basic principles of organic chemistry, and it will also provide the important topics in Organic chemistry functional groups including (alkanes, cycloalkane compounds, phenols etc.
- Help students to gain experience to predict the functional group transformations, simple reaction mechanisms, and the synthesis of organic molecules by multi-step synthesis strategies.
- Help students to understand the reaction mechanism.

**UNIT I:** **(8 Sessions)**

**Structure and Bonding:** Hybridizations, Bond lengths and bond angles, bond energy: Localized and delocalized chemical bond, van-der Waals interactions, inclusion compounds, clathrates, charge transfer complex, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

**UNIT II:** **(8 Sessions)**

**Types of Reagents and Reactions:** Electrophiles and nucleophiles. Types of organic reactions. Energy consideration. Reactive intermediates-carbocations, carbanions, free radicals and carbenes. Methods of determination of reaction mechanism.

**UNIT III:** **(8 Sessions)**

**Stereochemistry:** Conformations with respect to ethane, butane and cyclohexane; Interconversion of Wedge Formula; Newman, Sawhorse and Fischer representations; Concept of chirality; Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism; D and L; cis - trans nomenclature; CIP Rules.

**UNIT IV:** **(8 Sessions)**

**Alkanes and Cycloalkanes:** IUPAC nomenclature, classification, isomerism in alkanes, sources, and methods of preparation (with special reference to Wurtz, Kolbe, Coreyhouse, reactions and decarboxylation of carboxylic acids. Physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes. **Cycloalkanes:** Nomenclature, methods of preparations, chemical reactions. Bayer's strain theory and its limitations. ring strain in cyclopropane and cyclobutanes. Theory of stainless rings.

**UNIT V:** **(8 Sessions)**

**Alcohols, Phenols and Ethers:** Alcohols- Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters, Reactions-with sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO<sub>4</sub>, acidic dichromate, conc. HNO<sub>3</sub>). Oppeneauer Oxidation; Diols- Oxidation of diols; Pinacol-Pinacolone rearrangement.

**Course Outcomes:**

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

- Tell fundamental principles of organic chemistry that include chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions and mechanism.
- Understand nucleophile and electrophile groups and their properties.
- Name the functional groups and different class of organic compounds.
- Recognize the basic practical skills for the synthesis and analysis of organic compounds like alcohol, ethers, phenols etc.
- Justify a reasonable mechanism for a chemical reaction.

**Suggested Readings:**

1. R. T. Morrison & R. N. Boyd, Organic Chemistry, 7th Edn, Prentice Hall, 2005.
2. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edn, Longman Publishers, 1998.
3. A. Bahl, Advanced Organic Chemistry, S Chand & Company Limited, 2010.

**Website Sources:**

- <https://ncerthelp.com/>
- <https://ocw.mit.edu/courses/chemistry/>
- <https://www.clearitmedical.com/>  
<https://www.cliffsnotes.com/study-guides/chemistry/>

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
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**(Effective from 2021-22)**  
**Computer (BSB-154)**

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment's and Accessories: Principle and Working	
5.	To create personal letter	Experiment 1
6.	To create simple newsletter:	Experiment 2
7.	To create a resume	Experiment 3
8.	To create a cover page of a project report:	Experiment 4
9.	To create a simple presentation on hardware, software:	Experiment 5
10.	To create a worksheet with 4 columns, enter 10 records and find the sum of all columns:	Experiment 6
11.	To create a report containing the pay details of the employee	Experiment 7
12.	To create a student result sheet	Experiment 8
13.	To create a pie chart for a sample data and give legends	Experiment 9
14.	To create simple table for result processing	Experiment 10

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**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology I Year (I Semester)**  
**(Effective from 2021-22)**  
**Organic Chemistry (BSB-156)**

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment's and Accessories: Principle and Working	
5.	To find out the strength in gms/liter of the given solution of sodium hydroxide with the help of standard oxalic acid solution	Experiment 1
6.	To determine the alkalinity in the given water sample by neutralization titration.	Experiment 2
7.	To determine the melting point of an organic compound containing C, H and O only.	Experiment 3
8.	To determine the melting point of an organic compound containing nitrogen.	Experiment 4
9.	To determine the melting point of an organic compound containing nitrogen and sulphur	Experiment 5
10.	To decolourise and crystallize the given organic compound using Charcoal	Experiment 6
11.	To purify the sample of benzoic acid using water as a solvent by recrystallization method.	Experiment 7

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

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
									End Sem Exam		
			L	T	P	Mid Sem Exam	AS +AT	Total			
<b>THEORY</b>											
1.	BSB-201	Animal Science	3	1	0	20	10	30	70	100	4
2.	BSB-202	Plant Science	3	1	0	20	10	30	70	100	4
3.	BSB-203	Introduction to Microbiology	3	1	0	20	10	30	70	100	4
4.	BSB-204	Environmental Studies	3	1	0	20	10	30	70	100	4
5.	BCH-204	Physical Chemistry	3	1	0	20	10	30	70	100	4
<b>PRACTICALS / PROJECT</b>											
6.	BSB-253	Animal Science & Plant Science	0	0	2	20	10	30	70	100	1
7.	BSB-254	Introduction to Microbiology	0	0	2	20	10	30	70	100	1
8.	GP-201	General Proficiency	0	0	0	0	0	100	-	100	1
		<b>Total Credit</b>	15	5	4			310	490	800	<b>23</b>

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**Bachelor of Science (B.Sc.), Programme**  
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**BSB-201: ANIMAL SCIENCE**

**Objective(s):** The objectives of this course are to:

- Understand the animal kingdom.
- Understand the taxonomic position of Protozoa to Chordates.
- Understand the general characteristics of animals belonging to protozoa to Chordates.
- Understand the body organization, origin and evolutionary relationship of different phylum.
- Understand the morphology and physiology of humans.

**UNIT I:** **(8 Sessions)**

**Taxonomy & Classification:** General principle of taxonomy and animal classification. Salient features and outline classification of invertebrates and vertebrates.

**UNIT II:** **(8 Sessions)**

**Invertebrates:** General characters of protozoa and human disease, type study of *Paramecium caudatum*; Origin of Metazoan metamerism and symmetry; General characters of Porifera; General characters of Coelentrata; General characters of Platyhelminthes, type study of *Taenia* and their parasitic adaptations; General character of phylum Annelids, type study of Leech; General characters of Mollusk, type study of *Pila globosa*; General character of Arthropoda and Echinodermata, external features of star fish.

**UNIT III:** **(8 Sessions)**

**Vertebrates:** Outline classification and characteristic features of phylum Chordata and class Mammalia.

**UNIT IV:** **(8 Sessions)**

**Human Physiology I:** Digestive System, Respiratory system, excretory system, Circulatory system- activity of the heart, Blood- composition and function, blood clotting mechanism; Human reproductive system.

**UNIT V:** **(8 Sessions)**

**Human Physiology II:** Nervous system- Structure of a typical neuron, conduction of nerve impulse, resting potential; Endocrine system, Muscular system-ultrastructure and chemical composition of skeletal muscle, mechanism of muscle contraction.

**Course Outcomes:**

Students completing this course will be able to:

- Understand the world of animals. How few animals cause diseases?
- What are the differences between chordates and non-chordates?
- Understand human physiology and how energy production happens.

**Suggested Readings:**

1. R. L. Kotpal. Modern Textbook of Zoology Invertebrate, 11th Edn., Rastogi Publications, 2014.
2. R. L. Kotpal. Modern Textbook of Zoology Vertebrate. 4th Edn., Rastogi Publications, 2015.
3. Dhama & Dhama, Invertebrate Zoology, 5th Edn., S. Chand Publication, 2006.
4. Dhama & Dhama, Chordata Zoology, R. Chand Publication, 2006.
5. Jordan & Verma, Invertebrate Zoology, S. Chand Publication, 2008.
6. Jordan & Verma, Chordate Zoology, S. Chand Publication, 2007.
7. R. A. Agarwal, Animal Physiology, S. Chand Publication, 2014.



## Website Sources:

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

**IFTM University, Moradabad**  
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**BSB-202: PLANT SCIENCE**

**Objective(s):** The objectives of this course:

- Enables the students to understand the plant structure and physiology.
- Provides the basic knowledge of classification and taxonomy in plant kingdom, distribution, reproduction and their economic importance.

**UNIT I: (8 Sessions)**

**Algae:** General features, classification, distribution, range of thallus organization, reproduction, economic importance of algae, general characters of *Chlamydomonas*, Cyanobacteria- heterocyst, general characters of *Nostoc*.

**UNIT II: (8 Sessions)**

**Fungi:** General features, classification, distribution, range of thallus organization, reproduction, parasexual cycle and economic importance fungi, general characters of *slime mold*, lichens and its types.

**UNIT III: (8 Sessions)**

**Bryophyta:** General features, classification, distribution, range of thallus organization, reproduction, economic importance of bryophyte, general characters of *Riccia*, *Marchantia* and *Anthoceros*.

**UNIT IV: (8 Sessions)**

**Pteridophyta:** General features, classification, structure, reproduction, stellar evolution, heterospory and seed habit, economic importance of Pteridophytes, general characters of *Selaginella*.

**UNIT V: (8 Sessions)**

**Gymnosperms & Angiosperms:** General features, outline classification, structure, reproduction, Alternation of generation, structure of a flower, life cycle of angiosperm and economic importance.

**Course Outcomes:**

The students should be able to:

- Identify the distinguishing anatomical features of various parts of plant.
- Ascertain what taxa commonly seen plants belong to.
- Appreciate the plethora of plant secondary metabolites and its benefits.
- Apply the knowledge in Agri-biotech areas such as - biofertilizers, biopesticide etc.

**Suggested Readings:**

1. V. J. Chapman and D. J. Chapman, The Algae. 2<sup>nd</sup> edition, Palgrave Macmillan; 1973 edition, January 14, 2014.
2. Ganguli and Kar, College Botany Vol. I and II, 6<sup>th</sup> revised edition, New Central Book Agency; 1 January, 2011.
3. V. Singh, P.C. Pande & D.K. Jain. A Text Book of Botany, 4<sup>th</sup> edition, Rastogi Publication, 2008-2009.
4. N.S. Subrahmanyam, Modern Plant Taxonomy, 1<sup>st</sup> edition Vikas Publishing House, 1997.
5. A Text Book of Botany, V. Singh, P.C. Pande & D.K. Jain, Rastogi Publication.
6. H. D. Kumar. Introductory Phycology, 2<sup>nd</sup> edition, Affiliated East-west press Pvt Ltd, 1999.

**Website Sources:**

- [http://www.brainkart.com/subject/Plant-Biology\\_229/](http://www.brainkart.com/subject/Plant-Biology_229/)

- <http://www.plantcell.org/content/teaching-tools-plant-biology>
- <https://www.easybiologyclass.com/plant-physiology-free-lecture-notes-online-tutorials-lecture-notes-ppts-mcqs/>

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**BSB-203: INTRODUCTION TO MICROBIOLOGY**

**Objective(s):** The objectives of this course:

- Give a general introduction to the field of microbiology and investigate the amazing diversity of microbial life.
- Learn about the significant roles that microbes play in health, food, and the environment.
- Describe the key differences between the five groups of microbes.
- Explain how microbes replicate and why environmental conditions affect where they live.

**UNIT I: (8 Sessions)**

**Introduction to Microbiology:** History, scope and development of Microbiology; Applications of Microbiology in human welfare. Development of Microbiology in India & Abroad- Antony van Leeuwenhoek, Alexander Fleming, Edward Jenner, Louis Pasteur, Robert Koch, Selman Waksman, Joseph Lister, M.S. Swaminathan, T.S. Sadasivan and C.V. Subramaniam; Physical and chemical methods of sterilization; Pure Culture Techniques.

**UNIT II: (8 Sessions)**

**Diversity of Microbial World A:** Classification, general characteristics and structure of Bacteria- (eubacteria & archaebacteria), *Cyanobacteria*, *Actinomycetes*, *Mycoplasma*, *Rickettsia* & *Chlamydia* with emphasis on function of each part & components.

**UNIT III: (8 Sessions)**

**Diversity of Microbial World B:** Classification, general characteristics, structure with emphasis on *Mucor*, *Rhizopus*, *Puccinia*, *Cercospora*, *Aspergillus*, *Penicillium* *Alternaria* and *Curvularia*, function of each part & components of cell. Reproduction & economic importance of Fungi.

**UNIT IV: (8 Sessions)**

**Diversity of Microbial World C:** Classification, general characteristics and structure of Viruses (Prions, Virions, Virusoids & Viroids) Virus host, General features of virus reproduction. DNA & RNA Viruses with the example of T4, TMV & Pox Virus.

**UNIT V: (8 Sessions)**

**Growth and growth measurement:** Definition of growth, mathematical expression of growth. Growth curve, Growth yield, Effect of nutrient concentration on growth. Factors affecting growth: nutrients, temperature, oxygen, pH, osmotic pressure. Measurement of growth by measuring cell number, cell mass and cell activity Cell count, direct and indirect method, turbidometric method. Plate count method, membrane filter count method, dry weight and wet weight method by measurement of cellular activity. synchronous culture, continuous culture and batch culture.

**Course Outcomes:**

Students completing this course will be able to:

- Gain knowledge about principle and application of various types of Microscopy.
- Classify and explain the structure and general characteristics of Microorganisms.
- Prepare various Bacteriological, Algal, and Fungal Media.

**Suggested Readings:**

1. M. J. Pelczar, E. C. S. Chan & N. R. Krieg, Microbiology, 5th Edn.; Tata McGraw Hill Publishing, 2003.

2. D. R. Harper, Viruses Biology, Applications, and Control, 3rd Edn., Garland Science Tylor & Fransic Group, 2012.
3. P. D. Sharma, 2nd Edn. Microbiology, Rastogi Publications, 2005.
4. R. C. Dubey & D. K. Maheshwari, A Text Book of Microbiology, 1st Edn.; S. Chand and Company Ltd., 2004.
5. H. C. Dubey, A Textbook of Fungi, Vikas Publishing House, 2005.
6. Vashistha, A Textbook of Fungi, S. Chand and Company Ltd., 2003

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- <https://onlinecourses.nptel.ac.in/>
- <https://www.wikipedia.org/>
- <https://library.nitrkl.ac.in/>
- <https://ecoursesonline.iasri.res.in/>

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

**BSB-204: ENVIRONMENTAL STUDIES**

**Objective(s):** The objectives of this course:

- Develop understanding of how science and the scientific method work to address environmental problems.
- Make the student become familiar with the Earth's major systems (ecosystems and biogeochemical cycles),
- Acknowledge how environment functions and how they are affected by human activity (population growth, air, water and soil pollution, ozone depletion, global warming, and solid waste disposal).
- Let students will learn about the interaction of human society (urban sprawl, energy use/generation, resource consumption and economics) with the Earth's systems.

**UNIT I: (8 Sessions)**

**Environmental Sciences:** Introduction, definition, Scope, Importance, Need for Public Awareness; Natural Resources: Renewable and non-renewable resources; Biogeochemical Cycles, Ecological Succession, Ecological pyramids.

**UNIT II: (8 Sessions)**

**Concept of an Ecosystem:** Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Food chains and food webs. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean).

**UNIT III: (8 Sessions)**

**Environmental Pollution:** Pollutants, Causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution; Solid waste management: Causes, effects and control measures of urban and industrial wastes.

**UNIT IV: (8 Sessions)**

**Biodiversity:** Biogeographical classification of India, Hot-spots of biodiversity, Biodiversity at global, national and local levels, Value of biodiversity- consumptive use, productive uses, social, ethical aesthetic and option values, Threats to biodiversity- habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity,

**UNIT V: (8 Sessions)**

**Global Phenomenon & Their Management:** Global warming, acid rains, depletion of ozone layer, population growth, population explosion-family welfare program and human rights, Biofertilizers, Biopesticides, vermicomposting.

**Course Outcomes:**

Students completing this course will be able to:

- Understand the Environment and ecology and its significance for mankind.
- Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- Predict the consequences of human actions on the web of life, global economy and quality of human life.
- Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.

- Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones.
- Understand how nature makes the balance through resistance and resilience.
- Adopt sustainability as a practice in life, society and industry.

### **Suggested Reading:**

1. S. K. Dhameja, Environmental Studies, S. K. Kataria & Sons, 2014.
2. J. Ingram, P. Ericksen, D. Liverman, Food Security and Global Environmental Change, Taylor & Francis, 2012.
3. S. S. Deswal, Environmental Engineering, Dhanpat Rai Publications, 2001.
4. I. S. Thakur, Environmental Biotechnology: Basic Concepts and Applications, I.K. International Publishing House Pvt. Limited, 2011.
5. D. D. Chiras, Environmental Science, 10th Eds., Jones & Bartlett Learning, 2014.

### **Website Sources:**

- <https://www.edx.org/course/subject/environmental-studies>.
- <https://online-learning.harvard.edu/subject/environmental-science>
- <https://www.coursera.org/browse/physical-science-and-engineering/environmental-science-and-sustainability>
- <https://nptel.ac.in/course.html>

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

**BCH-204: PHYSICAL CHEMISTRY**

**Objective(s):** The objectives of this course:

- Familiarize students with modern concepts and tools in physical chemistry that are applied to many areas of chemical research.
- Make students gain an insight into the various concepts related to physical chemistry like types of reactions, dynamics of reactions, chemistry of solutions etc.
- Recognize the Modern techniques that can be imparted to analyze chemical systems.

**UNIT I:** (8 Sessions)

**Introduction:** Reversible and irreversible reactions, chemical equilibrium, law of mass action, Le-Chatelier's principle.

**UNIT II:** (8 Sessions)

**Solution:** Concentration of solution; normality, equivalent weight, molarity, formality, molality, solutions of gases in liquids, mole fraction, colligative properties, abnormal molecular weights, Van't Hoff factor.

**UNIT III:** (8 Sessions)

**Acids & Bases:** Ionization, strong and weak electrolytes, concept of acid and bases, dissociation of acid and base in water, strength of acids and bases, Ionic product of water, the pH scale.

**UNIT IV:** (8 Sessions)

**Laws of Thermodynamics:** First, second and Zeroth law of thermodynamics, entropy, enthalpy, Gibb's free energy. Order of reactions, first, second and zero order reactions, catalysts.

**UNIT V:** (8 Sessions)

**Colloidal & Electrochemistry:** True solution, colloidal solution and suspension, types of colloidal systems, classification of colloids, properties of colloids, coagulation, protective colloids, electrolysis, electrochemical cells, electrode potentials, electrochemical series.

**Course Outcomes:**

After completing this course students will be able to:

- Explain the basic principles of solutions and properties of solutions.
- Identify the strong, weak acids and bases and their pH.
- Explain the processes taking place in solution and at interfaces.
- Describe different orders of chemical reactions and their measurements.
- Experimentally determine certain physical variables.
- Apply calculation in solving physical and chemical problems.

**Suggested Readings:**

1. K. J. Laidler, Chemical Kinetics, Pearson Education Society, 1987
2. P. C. Rakshit, Physical Chemistry, Sarat Book House, 2014.
3. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Company, 2008.
4. P. W. Atkins & J. dePaula, Physical Chemistry, 8th Edn W. H. Freeman Publishing Co., 2006.

**Website Sources:**

- <https://www.askiitians.com/revision-notes/chemistry>



- <https://ocw.mit.edu/courses/chemistry/5-62-physical-chemistry>
- <http://www.colby.edu/chemistry/PChem/Lecture1.html>
- [https://www.internetchemistry.com/chemistry/physical\\_chemistry.htm](https://www.internetchemistry.com/chemistry/physical_chemistry.htm)

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

**BSB-253 Animal Science & Plant Science**

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Identification and study of invertebrate specimens of the following phylum Porifera, Coelentrata, Platyhelminthes, Annelida	Experiment 1
6.	Identification and study of invertebrate specimens of the following phylum Arthropoda, Mollusca, Echinodermata	Experiment 2
7.	Study of prepared slides of <i>Euglena</i> , <i>Paramecium</i> , <i>Vorticella</i> , <i>Trypanosoma</i> & <i>Noctiluca</i>	Experiment 3
8.	Identification and study of vertebrate specimens of the following phylum- Amphibia, Reptilia, Aves and Mammal	Experiment 4
9.	To dissect out the nervous system of <i>Prawn</i> & <i>Scoliodon</i>	Experiment 5
10.	Identification and study of Cyanobacteria- <i>Nostoc</i> .	Experiment 6
11.	Identification and study of some algal forms: <i>Chlamydomonas</i> , <i>Volvox</i>	Experiment 7
12.	Identification and study of fungi- <i>Rhizopus</i> , <i>Agaricus</i>	Experiment 8
13.	Cut the T.S of given plant material ( <i>Riccia/Marchantia</i> , <i>Marselia/Selaginella</i> , <i>Cycas/ Pinus</i> ) and identify it with its morphological and anatomical features.	Experiment 9
14.	Describe given plant in semi-botanical language and also give the floral structure and formulae of it.	Experiment 10

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

**BSB-254 Introduction to Microbiology**

<b>1.</b>	Introduction of Laboratory Practices	
<b>2.</b>	Safety Measures	
<b>3.</b>	Do and Don't	
<b>4.</b>	About Equipments and Accessories: Principle and Working	
<b>5.</b>	Microbiology Good Laboratory Practices and Biosafety.	Experiment 1
<b>6.</b>	To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter, micrometer [ocular and stage], haemocytometer) used in the microbiology laboratory.	Experiment 2
<b>7.</b>	Preparation of culture media (Nutrient Broth and Nutrient Agar) for bacterial cultivation.	Experiment 3
<b>8.</b>	Sterilization of medium and Glass ware using Autoclave and Hot Air Oven and assessment for sterility.	Experiment 4
<b>9.</b>	Sampling and quantification of microorganisms in air, soil and water	Experiment 5
<b>10.</b>	Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution].	Experiment 6
<b>11.</b>	Identification of microorganisms from the habitats [simple staining, differential staining, acid fast staining, capsule staining, spore staining and motility].	Experiment 7
<b>12.</b>	Observation of morphology - shape and arrangement of cells bacteria, phytoplanktons & zooplanktons.	Experiment 8

**IFTM UNIVERSITY, MORADABAD**  
**COURSE STRUCTURE**  
**B.Sc. (MICROBIOLOGY)**  
**(Effective from 2021-22)**  
**Third Semester**

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Sem Exam	AS +AT	Total	End Sem Exam		
			L	T	P						
<b>THEORY</b>											
1.	BSB-301	Modern Analytical Techniques	3	1	0	20	10	30	70	100	4
2.	BSB-302	Enzymology	3	1	0	20	10	30	70	100	4
3.	BSB-304	Basics of Immunology	3	1	0	20	10	30	70	100	4
4.	BMB-301	Microbial Genetics	3	1	0	20	10	30	70	100	4
5.	BMB-302	Microbial Physiology	3	1	0	20	10	30	70	100	4
6.	EHU-301*	Disaster Management* (Audit paper)	3	0	0	20	10	30	70	100	0
<b>PRACTICALS / PROJECT</b>											
7.	BSB-351	Enzymology	0	0	2	20	10	30	70	100	1
8.	BSB-352	Immunology	0	0	2	20	10	30	70	100	1
9.	GP-301	General Proficiency	0	0	0	0	0	100	-	100	1
		<b>Total Credit</b>	<b>18</b>	<b>5</b>	<b>4</b>			<b>310</b>	<b>490</b>	<b>800</b>	<b>23</b>

\*Internal Assessment (Audit Paper not added in total)

**IFTM University, Moradabad**  
**Bachelor of Sciences (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology II Year (III Semester)**  
**(Effective from 2021-22)**

**BSB-301: MODERN ANALYTICAL TECHNIQUES**

**Objective(s):** The objectives of this course:

- Let the student acquire basic concepts, principles, and techniques of modern analytical techniques.
- Empower students with an analytical mind set and the abilities to solve diverse analytical problems in an efficient and quantitative way
- Make student learn the principle behind the basic techniques like chromatography, electrophoresis and their application in diverse fields.

**UNIT I:** **(8 Sessions)**

**Concept of Good Laboratory Practices:** Parts of GLP, Good Manufacturing Practices, Quality assurance and Quality Control, Steps of Analysis, Basic Aspects of Qualitative and Quantitative Analysis. Accuracy and Precision.

**UNIT II:** **(8 Sessions)**

**Microscopy & Spectroscopy:** Simple and Compound microscope; Overview of Electromagnetic spectrum; Beer-Lambert's Law: UV-Vis spectrophotometer, Colorimeter, Raman Effect, IR Spectroscopy- Their Instrumentation, Principle, Working and application

**UNIT III:** **(8 Sessions)**

**Centrifugation:** Theory and Principle of centrifugation, sedimentation, sedimentation rate, sedimentation coefficient. Use and design of different types of rotors, Types of centrifuges, Preparative and analytical centrifugation, Density gradient centrifugation (zonal and isopycnic), differential centrifugation.

**UNIT IV:** **(8 Sessions)**

**Chromatography:** Plate and Rate Theory, Principle of Chromatography, Chromatographic performance parameters, High performance liquid chromatography, adsorption chromatography, partition chromatography, Ion-exchange chromatography, molecular exclusion chromatography, affinity chromatography, normal and reverse phase chromatography.

**UNIT V:** **(8 Sessions)**

**Electrophoresis:** Theory of electrophoresis, General Principle, Native PAGE, SDS PAGE, Agarose gel electrophoresis, Iso-electric focusing, pulse gel electrophoresis, Capillary Electrophoresis.

**Course Outcomes:**

Students completing this course will be able to:

- Develop an understanding and gain knowledge of analytical methods used in biotechnology and allied sciences.
- Establish an appreciation of the role of scientific tools in quantitative analysis
- Develop an understanding of the broad role biochemical techniques in measurement and problem solving for analytical tasks.
- Provide an understanding of techniques employed for elemental and compound analysis.

**Suggested Readings:**

1. K. Wilson & J. Walker, Principles and Techniques of Biochemistry and Molecular Biology, 7th Edn., Cambridge University Press.

2. S. K. Sawhney & R. Singh, Introductory Practical Biochemistry, 2nd Edn., Alpha Science Internatinal, 2005
3. G. R. Chatwal & S. K. Anand, Instrumental Methods of Chemical Analysis, 5th Edn., Himalaya Publishing House, 2019.

**Website Sources:**

- <https://onlinecourses.nptel.ac.in/>
- <https://www.wikipedia.org/>
- <https://library.nitrkl.ac.in/>
- <https://onlinecourses.swayam2.ac.in/>

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology II Year (III Semester)**  
**(Effective from 2021-22)**

**BSB-302: ENZYMOLOGY**

**Objective(s):** The objectives of the course:

- Provide an insight into the fundamentals of enzyme structure, function and kinetics of enzymes.
- Explain how enzymes are able to increase speed of a biochemical reaction in sense of thermodynamics, kinetics and molecular interactions also it deals with current applications and future potential of enzymes.
- This will be helpful in developing concept for fermentation technology and downstream processing.

**UNIT I:** **(8 Sessions)**

**Enzymes as Catalysts:** Overview, historical background; Enzyme characteristics and properties; Coenzyme, Cofactor, Apoenzyme, Holoenzyme, Prosthetic group, Enzyme nomenclature & classification; Enzyme Isolation, Purification and Characterization.

**UNIT II:** **(8 Sessions)**

**Mechanism of Enzyme Kinetics:** Kinetics of single substrate reactions (Michaelis- Menten equation); Enzyme inhibition (Competitive, Non- competitive, Mixed); Two or more than two substrate kinetics.

**UNIT III:** **(8 Sessions)**

**Enzyme Immobilization:** Overview, Types of enzyme immobilization viz adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding - examples; Advantages and disadvantages of different Immobilization techniques; Overview of applications of immobilized enzyme systems

**UNIT IV:** **(8 Sessions)**

**Enzyme Regulation:** Methods of enzyme regulation- covalent modification and zymogen activation, Allosteric regulation Partial Proteolysis; Disulphide reduction.

**UNIT V:** **(8 Sessions)**

**Applications of Enzymes:** Application of enzyme in industries- Food, Beverages, Detergent, Textile, Leather, Agricultural and pharmaceutical.

**Course Outcomes:**

Students will be able to:

- Understand the enzyme kinetics.
- Use catalytic strategies in interpreting mechanisms of enzymatic action.
- Learn about the applications of some industrially used enzymes.

**Suggested Readings:**

1. A. Fersht, Structure and Mechanism in Protein Science, World Scientific, 2017.
2. N. Price & L. Stevens, Fundamentals of Enzymology, 2nd Edn., Oxford University Press, New York, NY.
3. T. Palmer, Understanding Enzymes, 2nd Edn., John Wiley & Sons, New York.
4. D. Voet & J. G. Voet, Biochemistry, John Wiley & Sons, New York, 2011.
5. G. Zubay, Biochemistry, 3rd Edn., Wm. C. Brown, Oxford, 1993.
6. J. M. Berg, J. L. Tymoczko & L. Stryer, Biochemistry, 7th Edn., W.H.Freeman, 2010.

## Website Sources:

- <https://www.omicsonline.org/scholarly/enzyme-technology-journals-articles-ppts-list.php>
- <https://www.britannica.com/science/enzyme>
- <https://www.sciencedirect.com/book/9780444641144/advances-in-enzyme-technology>
- <http://www.biologydiscussion.com/enzymes/enzyme-technology/enzyme-technology-application-and-commercial-production-of-enzymes/10185>
- <http://www.biologymad.com/studentswork/12%20-%20etnotes.pdf>
- <https://www.kth.se/dib/enzyme-technology-1.783173>
- <http://www1.lsbu.ac.uk/water/enztech/whither.html>
- <https://bmcbiotechnol.biomedcentral.com/articles/sections/protein-and-enzyme-technology>
- <http://www.odofin.com/enzyme%20technology.htm>
- <https://www.thesciencenotes.com/enzyme-technology/>
- [https://application.wiley-vch.de/books/sample/3527329897\\_c01.pdf](https://application.wiley-vch.de/books/sample/3527329897_c01.pdf)



**IFTM University, Moradabad**  
**Bachelor of Sciences (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology II Year (III Semester)**  
**(Effective from 2021-22)**

**BSB-304: BASICS OF IMMUNOLOGY**

**Objective(s):** The objectives of this course:

- Includes a detailed description of the immune response made in humans to foreign antigens including microbial pathogens.
- A description of cells involved in the immune response either innate or acquired.
- Is to teach how the immune system recognizes self from non-self and B and T cell maturation and specific responses.
- Other topics covered will include the genetic basis of diversity of immune responses in mammals.

**UNIT I:** **(8 Sessions)**

**Basics of Immunology:** History and scope of Immunology, Types of Immunity- Innate and Acquired immunity (Humoral and Cell Mediated Immunity).

**UNIT II:** **(8 Sessions)**

**Organization of immune system:** Cell and organs of immune system and their functions (Primary and Secondary lymphoid organs); Hematopoiesis; Clonal selection theory.

**UNIT III:** **(8 Sessions)**

**Antigens & Antibody:** Antigen, Epitope, Haptens, Adjuvant, Factors influencing immunogenicity, Antibodies- Structure, types, and functions of immunoglobulins; Antigen Antibody reaction- Precipitation, Immuno-electrophoresis, Haem-agglutination, RIA and ELISA.

**UNIT IV:** **(8 Sessions)**

**Histocompatibility:** Structure of MHC class I & II; Antigen processing and presentation; Complement system: Classical and alternate pathways of complement activation.

**UNIT V:** **(8 Sessions)**

**Vaccines and Immunization:** Passive and Active immunization, Types of Vaccines- Inactivated, Attenuated, Recombinant and Sub Unit Vaccines, Peptide and DNA Vaccines; Hybridoma technology- Production of monoclonal antibodies; Hypersensitivity, Autoimmunity.

**Course outcomes:**

Students completing this course will be able to:

- Compare and contrast innate and adaptive immunity.
- Design a model of Immunoglobulins.
- Describe which cell types and organs present in the immune response.
- Illustrate various mechanisms that regulate immune responses and maintain tolerance
- Exemplify the adverse effect of immune system including Allergy, hypersensitivity and autoimmunity.
- Apply basic techniques for identifying antigen-antibody interactions.
- Explain the stages of transplantation responses
- Recall the success of various transplant procedures.
- Describe the immunological response against tumor and blood transfusion.
- Elucidate the reasons for immunization and aware of different vaccination

### **Suggested Readings:**

1. A. K. Abbas, A. H. H. Lichtman, S. Pillai, Basic Immunology Function and Disorder of Immune System, 6th Edn., Elsevier Publisher, 2019.
2. T. J. Kindt, B. A. Osborne, R. A. Goldsby, Kuby, Immunology, 6th Edn., W. H. Freeman & Co., 2007.
3. P. J. Delves, S. J. Martine, D. R. Burton, I. M. Roitt, Roitt's Immunology, 12<sup>th</sup> Edn. Wiley-Blackwell, 2011.
4. F. H. Khan, The Element of Immunology, Pearson Education, 2009.
5. A. Kumar, Textbook of Immunology, Teri Publishers, 2013.

### **Website Sources:**

- <https://microbenotes.com/what-is-immunology/>
- <http://www.helmberg.at/immunology.pdf>
- <https://ocw.mit.edu/courses/health-sciences-and-technology/hst-176-cellular-and-molecular-immunology-fall-2005/lecture-notes/>
- <http://www.roitt.com/mcqlist.asp>

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

**BMB-301: MICROBIAL GENETICS**

**Objective(s):** The objectives of this course:

- Involves deciphering both the regulatory genes and sites that control individual gene expression and determining coregulation of genes.
- Will help in learning about the same transcriptional unit an operon, regulons.
- With understanding of genetics of microbes and process associated with it so that this understanding can be used for the benefit of mankind.

**UNIT I:** **(8 Sessions)**

**Essentials of Microbial Genetics:** Basics concept of microbial genetics, Bacterial genetic material-structure and properties of nucleic acids, DNA & RNA, Plasmid and their types.

**UNIT II:** **(8 Sessions)**

**Genetics of Bacteriophages:** Structure and classification of bacteriophages, Lytic & Lysogeny cycle of bacteriophages, T4, Lytic &  $\lambda$ , Lysogeny phage. Transduction mechanism, types of transduction in bacteriophages.

**UNIT III:** **(8 Sessions)**

**Molecular Aspects of Gene Expression:** DNA replication in prokaryotes, Mechanism of gene expression in prokaryotes, Genetic code, Codon & Anti-codon- Regulation of gene expression in prokaryotes- Lactose operon and tryptophan operon.

**UNIT IV:** **(8 Sessions)**

**Bacterial recombination and mapping:** Transformation and discovery of transformation, Mechanism of transformation processes in bacteria, Gene mapping by transformation processes, Mutation and mutagenesis, Types of mutations, Identification and selection of bacterial mutants.

**UNIT V:** **(8 Sessions)**

**Recombinant DNA Technology:** Tools and techniques of Gene manipulation, Screening of recombinant molecules, Applications of microbial genetics.

**Course Outcomes:**

Students completing this course will be able:

- Understand Basics concept of genetics of microbes. Like structure of nucleic acid etc.
- Understand how information coded in DNA is translated into protein.
- Understand how microbes exchange their genetic materials.
- Understand, what the basic techniques used for gene manipulation in microbes are.

**Suggested Readings:**

1. M. S. Cronan, & J. E. Freifelder, Microbial Genetics, 2nd Edn., 1994.
2. D. L. Nelson, A. L. Lehninger, M. M. Cox, Lehninger Principles of Biochemistry, 8th Edn., W. H. Freeman, 2017.
3. M. J. Pelczar, E.C.N. Chan & N.R. Kreig, Microbiology, Tata Mc-Graw Hill, 1986.
4. B. Lewin, Genes VII, 7<sup>th</sup> Edn., Oxford University Press; 2000.
5. L Snyder, Molecular Genetics of Bacteria, American Society of Microbiology, 2013.

**Website Sources:**

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

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

**BMB-302: MICROBIAL PHYSIOLOGY**

**Objective(s):** The objectives of this course:

- Is to introduce the student to the major features of growth and metabolism of microorganisms.
- Is to analyze the role of individual components in cells/ microorganisms including determination of growth curve environmental influence on the microbial growth, metabolism and microbial relationships.

**UNIT I:** **(8 Sessions)**

**Introduction:** History and Scope of Microbiology; Spontaneous generation – Biogenesis; Contributions of Louis Pasteur, Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph Lister & Robert Koch. Characterization and classification of microorganism.

**UNIT II:** **(8 Sessions)**

**Salient features of Microorganism:** Salient features of bacteria, fungi, algae, protozoans and viruses. Bacteria- Structure of a typical bacterial cell, Structure and function of cell wall and cytoplasmic membrane; function of cilia, flagella, slime layer, capsule and pili.

**UNIT III:** **(8 Sessions)**

**Microbial Growth:** Definition of Growth, Growth Curve, Specific growth rate, synchronous growth. Effect of temperature and pH on microbial growth.

**UNIT IV:** **(8 Sessions)**

**Microbial Metabolism:** Energy production by Anaerobic Processes – (Glycolysis, Pentose phosphate pathway, Entner Doudoroff pathway). Energy Production by Aerobic Respiration (Tricarboxylic acid cycle, energy yield in aerobic respiration); Energy production in photosynthetic bacteria.

**UNIT V:** **(8 Sessions)**

**Utilization of Energy and biosynthesis:** Utilization of energy in non biosynthetic (Bacterial motility and transport of nutrients by bacteria) and biosynthetic processes (a general concept about photosynthetic fixation of CO<sub>2</sub>, N<sub>2</sub> fixation, synthesis of polysaccharide, nucleotide, lipid and peptidoglycan).

**Course Outcomes:**

Students completing this course will be able to:

- Understand the broad diversity of microorganisms.
- Understand the role of microbes in various industrial processes.
- Explain about the commercial uses of microorganisms.

**Suggested Readings:**

1. M. J. Pelczar, E.C.N. Chan & N.R. Kreig, Microbiology, Tata Mc-Graw Hill, 1986.
2. T. D. Brock, D.W. Smith & M. T. Madigan, Biology of Microorganisms, 4th Edn., Englewood, Cliffs. N.J. Prentice Hall, 1984.

3. R. C. Dubey & D. K. Maheshwari, A text of Microbiology, S. Chand Publisher, 2011.

**Website Sources:**

- <https://onlinecourses.nptel.ac.in/>
- <https://www.ncbi.nlm.nih.gov/books>
- <https://bio.libretexts.org/>
- <https://ocw.mit.edu/>

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology II Year (III Semester)**  
**(Effective from 2021-22)**

**EHU-301: DISASTER MANAGEMENT**

**Objective(s):** The objectives of this course:

- Is to provide students an understanding to the concepts and aspects of disaster and its relationship with development.
- To ensure awareness of Disaster Risk Reduction (DRR) approaches among students.
- To assist students develop ability to respond to their environment with potential response to disaster.

**UNIT I: (8 Sessions)**

**Introduction to Disasters:** Definition- Disaster, Hazard, Vulnerability, Resilience, Risks; Types of disasters – Earthquake, Landslide, Flood, Drought, Fire, campus shooting, bomb threat, terrorist incidence and financial emergency etc.; Causes and Impacts including social, economic, political, environmental, health, psychosocial, etc.; Differential impacts- in terms of caste, class, gender, age, location, disability; Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II: (8 Sessions)**

**Approaches to Disaster Risk Reduction:** Disaster life cycle – its analysis, phases, culture of safety, prevention, mitigation and preparedness; Community based DRR (Disaster Risk Reduction), Structural-nonstructural measures; Roles and responsibilities of community: Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders

**UNIT III: (8 Sessions)**

**Inter-Relationship between Disasters and Development:** Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc.; Climate Change Adaptation-IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources; Role of international cooperation's in Disaster Management

**UNIT IV: (8 Sessions)**

**Disaster Risk Management in India:** Hazard and Vulnerability profile of India. Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management; Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation; Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

**UNIT V: (8 Sessions)**

**Disaster Management: Applications, Case Studies and Field Works:** The project /fieldwork are meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located. A few ideas or suggestions are discussed below:

Several governmental initiatives require Urban Local Bodies (ULBs) and Panchayati Raj Institutions (PRIs) to be proactive in preparing DM plans and community based disaster preparedness plans. Information on these would be available with the district collector or Municipal corporations.

Teachers could ask students to explore and map disaster prone areas, vulnerable sites, vulnerability of people (specific groups) and resources. The students along with teacher could work on ways of addressing these vulnerabilities, preparing plans and consultation with local administration or NGOs.

Students could conduct mock drills in schools, colleges or hospitals. They could also work on school safety, safety of college buildings, training in first aid.

Other examples could be- identifying how a large dam, road/ highway or an embankment or the location of an industry affects local environment and resources or how displacement of large sections of people creates severe vulnerabilities may be mapped by student project work.

The suggested topics for Project work for student could be as follows:

- Monitoring and evaluation plan for disaster response
- Low cost Home based water purification methods
- Planning Nutrition intervention programmes
- Safety tips before during and after earthquake, cyclone, floods and fire accidents.
- Mock Drills
- Major disasters in India
- Disaster Management in India
- Flood affected areas and damages in India
- Heat waves in India
- Earth quakes in India
- Historical Tsunamis in India
- Nuclear emergence
- Traffic accidents in India
- Train Accidents
- Major disease outbreak
- Disaster management structure in India
- Precaution, mitigation of disaster in India
- Warning system in India to prevent disaster
- Bhopal gas tragedy
- Kutch earth quake
- Tsunami (2004)
- Kosi Calamity 2008
- Mayapuri radiation exposure Delhi (2010)
- Mock exercises

**Course Outcome:** The students will be able to:

- Identify the nature and causes of disaster.
- Apply the disaster risk reduction mechanism.

**Suggested Readings:**

1. SatishModh, Introduction to Disaster Management, Macmillan Publisher India Ltd
2. Alexander David, Introduction in 'Confronting Catastrophe', Oxford University Press
3. Blaikie, P, Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards, Peoples' Vulnerability and Disasters, Routledge.
4. Damon P. Coppola, Introduction to International Disaster Management, Butterworth-Heinemann,
5. Singhal J.P. "Disaster Management", Laxmi Publications. ISBN-10: 9380386427 ISBN-13: 978-9380386423
6. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., . ISBN-10: 1259007367, ISBN-13: 978-1259007361]
7. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi
8. KapurAnu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi.
9. Carter, Nick. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manila Philippines.
10. Cuny, F. Development and Disasters, Oxford University Press. Document on World Summit on Sustainable Development.
11. Govt. of India: Disaster Management Act 2005, Government of India, New Delhi. Government of India, 2009.



12. Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi  
Indian Journal of Social Work.
13. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April.

**Website Sources:**

- [https://www.physio-pedia.com/Disaster\\_Management](https://www.physio-pedia.com/Disaster_Management)
- <http://www.ifrc.org/en/what-we-do/disaster-management>
- <http://www.wcpt.org/disaster-management/what-is-disaster-management>
- [en.wikipedia.org](http://en.wikipedia.org)

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology II Year (III Semester)**  
**(Effective from 2021-22)**

**BSB-351 Enzymology**

<b>1.</b>	Introduction of Laboratory Practices	
<b>2.</b>	Safety Measures	
<b>3.</b>	Do and Don't	
<b>4.</b>	About Equipments and Accessories: Principle and Working	
<b>5.</b>	Introduction to Enzymology Laboratory.	Experiment 1
<b>6.</b>	Extraction of enzyme from plant source.	Experiment 2
<b>7.</b>	To determine the effect of temperature on the rate of enzyme action.	Experiment 3
<b>8.</b>	To determine the effect of pH on the rate of enzyme action.	Experiment 4
<b>9.</b>	To determine the effect of substrate concentration on the rate of enzyme action.	Experiment 5
<b>10.</b>	To determine the effect of enzyme concentration on the rate of enzyme action.	Experiment 6
<b>11.</b>	Extraction of pure amylase enzyme and its mode of action on substrate (starch).	Experiment 7
<b>12.</b>	Immobilization of amylase enzyme.	Experiment 8

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology II Year (III Semester)**  
**(Effective from 2021-22)**

**BSB-352 Immunology**

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipment's and Accessories: Principle and Working	
5.	Identification of blood group by simple agglutination method.	Experiment 1
6.	To collect the serum from Blood.	Experiment 2
7.	To enumerate the total number of RBCs in the blood sample.	Experiment 3
8.	To enumerate the total number of WBCs in the blood sample	Experiment 4
9.	Estimation of specific antibodies present in serum by rapid slide test (WIDAL test)	Experiment 5
10.	<i>In vitro</i> detection of Rheumatoid Factor (RF) in serum by qualitative Slide test.	Experiment 6
11.	To learn the techniques of Radial immunodiffusion – Precipitation Reaction.	Experiment 7
12.	To determine the presence of specific antigen by sandwich ELISA method (Dot ELISA).	Experiment 8

**IFTM UNIVERSITY, MORADABAD**  
**COURSE STRUCTURE**  
**B.Sc. (MICROBIOLOGY)**  
**(Effective from 2021-22)**

**Fourth Semester**

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Sem Exam	AS +AT	Total	End Sem Exam		
			L	T	P						
<b>THEORY</b>											
1.	BSB-401	Introductory Bioinformatics	3	1	0	20	10	30	70	100	4
2.	BSB-405	Biochemistry and Metabolism	3	1	0	20	10	30	70	100	4
3.	BSB-406	Cell & Molecular biology	3	1	0	20	10	30	70	100	4
4.	BMB-401	Industrial Microbiology	3	1	0	20	10	30	70	100	4
5.	BMA-409	Introductory Biostatistics	3	1	0	20	10	30	70	100	4
<b>PRACTICALS / PROJECT</b>											
6.	BSB-451	Bioinformatics	0	0	2	20	10	30	70	100	1
7.	BSB-453	Molecular Biology	0	0	2	20	10	30	70	100	1
8.	GP-401	General Proficiency	0	0	0	0	0	100	-	100	1
		<b>Total Credit</b>	<b>15</b>	<b>5</b>	<b>4</b>			<b>310</b>	<b>490</b>	<b>800</b>	<b>23</b>

**Note:** Industrial training of 4-6 weeks after IV semester which will be evaluated in V semester

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.) Programme**  
**B. Sc. Biotechnology/Microbiology II Year (IV Semester)**  
**(Effective from 2021-22)**

**BSB-401: INTRODUCTORY BIOINFORMATICS**

**Objective:** The main objective of this course:

- To introduce the field of bioinformatics via an array of publically available tools and databases in homology identification, structure visualization and designing new drug molecules.

**UNIT I:** (8 Sessions)

**Introduction of Bioinformatics:** Biological Databases, Primary, secondary and composite databases, Data retrieval with ENTREZ, SRS, DBGET; Sequence and molecular file formats.

**UNIT II:** (8 Sessions)

**Principles of DNA sequencing:** Chemical chain termination, Dideoxy chain termination method, Automatic sequencer; RNA sequencing; Protein sequencing (Edman's degradation method).

**UNIT III:** (8 Sessions)

**Sequence alignment:** Pairwise and multiple, global and local. Database similarity searches (BLAST, FASTA and Types of BLAST).

**UNIT IV:** (8 Sessions)

**Protein structure prediction:** Ramachandran Plot; Secondary (GOR method; Chou Fasman method) and tertiary structures. Homology Modeling, ORF prediction, Profiles and motifs.

**UNIT V:** (8 Sessions)

**Structure visualization methods:** Structure visualization methods- PyMOL, RASMOL, CHIME, Swiss-PDB Viewer, Protein Structure alignment and analysis. Application of Bioinformatics in drug discovery and drug designing.

**Course Outcomes:**

Students will be able to apply:

- Basic bioinformatics tools for the study the gene and protein sequences.
- Identify the homologs of DNA and protein sequences.
- Able to visualize the 3D structure of protein molecules.
- Designing of new drug molecules.

**Suggested Readings:**

1. Bioinformatics by Andreas D Boxevanis (Wiley Interscience)
2. Fundamental concept of bioinformatics by Dan e. krane
3. Introduction to bioinformatics by Attwood and Parry Smith (Pierson education Publication)
4. Instant notes in Bioinformatics by Westhead, parish and Tweman (Bios scientific publishers)
5. Bioinformatics: Principles and applications by Ghosh and Mallick (oxford) university press)

**Website Sources:**

- <https://pubmed.ncbi.nlm.nih.gov/>
- <http://www.bioinform.com/index>
- <http://bioinfo.ernet.in/www.ncbi.nlm.nih.gov>
- <http://www.bic.nus.edu.sg/>

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology II Year (IV Semester)**  
**(Effective from 2021-22)**

**BSB-405: BIOCHEMISTRY AND METABOLISM**

**Objective(s):** The objectives of this course:

- Is to impart knowledge to students about the chemical structures of carbohydrate, and their structural and metabolic role in cellular system.
- Will let the learner appreciate the importance of biochemical reaction in organisms for its survival.
- Will let the students understand the metabolic pathway at cellular level.

**UNIT I: (8 Sessions)**

Introduction: Background and scope of Biochemistry; properties of water, acids, bases and buffers; Covalent and non-covalent interactions in biological systems. Aqueous environment and living organism.

**UNIT II: (8 Sessions)**

Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

**UNIT III: (8 Sessions)**

Carbohydrates: Structure and Function: Structure and properties of Monosaccharides, Oligosaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.

**UNIT IV: (8 Sessions)**

Lipids: Structure and functions – Classification, structures, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids structure and properties of different types of phospholipids, sphingomyelins, glycolipids, cerebrosides, gangliosides, Prostaglandins cholesterol – its structure and biological properties, utilization of cholesterol.

**UNIT V: (8 Sessions)**

**Metabolism:** Glycolysis; Tricarboxylic acid cycle; Glycogenesis and glycogenolysis; Lipid biosynthesis and degradation-Beta oxidation

**Course Outcomes:**

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

- Define the terms related to Biochemistry
- Explain the main biochemical compounds in organism.
- Define the biomolecules and their functions which comprise carbohydrate metabolism.
- Compare the carbohydrate metabolism and regulative mechanisms.
- Explain the structure and functions of nucleotides, DNA and RNA.
- Explain the synthesis of nucleic acids and their metabolism

**Suggested Readings:**

1. D. Voet, J. G. Voet, C. W. Pratt, Voet's Principles of Biochemistry, John Wiley & Sons, 2012.
2. D. L. Nelson, A. L. Lehninger, M. M. Cox, Lehninger Principles of Biochemistry, 8th Edn., W. H. Freeman, 2017.

3. J. M. Berg, J. L. Tymoczko, G. J. Gatto Jr.; L. Stryer, Stryer Biochemistry, 8th Edn, Freeman & Company, W. H., 2015.
4. V. W. Rodwell, D. Bender, K. M. Botham, P. J. Kennelly, P. A. Weil, Harper's Illustrated Biochemistry, 31st Edn., McGraw-Hill Education, 2018.

**Website Sources:**

- <https://www.easybiologyclass.com/topic-biochemistry/>
- <https://www.chem.purdue.edu/courses/chm333/>
- <https://home.apu.edu/~jsimons/Bio101/biochem.htm>
- <https://ocw.mit.edu/courses/chemistry/5-36-biochemistry-laboratory-spring-2009/lecture-notes/>

**IFTM University, Moradabad**  
**Bachelor of Sciences, Programme**  
**B.Sc. Biotechnology/Microbiology II Year (IV Semester)**  
**(Effective from 2021-22)**

**BSB-406: CELL & MOLECULAR BIOLOGY**

**Objective(s):** The objectives of this course:

- Is to impart knowledge to students about the cell and its organelles and the signal mechanisms used to transmit the message across the cell.
- Make students learn the importance of the molecular mechanisms present in the cell which functions to ensure the survival and continuity of the organism like DNA replication, transcription etc.
- Students will also have an introduction about the basic molecular techniques like PCR and Blotting techniques.

**UNIT I:** **(8 Sessions)**

**Cell and its organization:** Eukaryotic and prokaryotic cells; Structure and Function of the Cell and Its Organelles; Cell division- mitosis and meiosis, cell cycle.

**UNIT II:** **(8 Sessions)**

**Membrane receptor and Signal Transduction:** Cytosolic, nuclear and membrane bound receptors, Signal amplification, different models of signal amplifications, role of cyclic AMP in signal transduction. Transport Across Cell Membranes- Passive & active transport, sodium potassium pump, co transport, symport, antiport, endocytosis and exocytosis.

**UNIT III:** **(8 Sessions)**

**DNA Replication and Transcription:** Bacterial DNA replication; Structure of bacterial RNA polymerase; Transcription events, and sigma factor cycle; Eukaryotic RNA polymerase; Promoter sequences; TATA box; Enhancers; Upstream activating sequences: RNA processing.

**UNIT IV:** **(8 Sessions)**

**Translation and Gene regulation:** Prokaryotic and Eukaryotic translation; Mechanisms of initiation; Elongation and termination; Regulation of translation; Post-translational modifications and intracellular proteins transport; Control of gene expression in prokaryotes, Operon model- lac and trp operon.

**UNIT V:** **(8 Sessions)**

**Tools in Molecular Biology:** Purification of nucleic acid; Molecular Probes-labeling of probes, Southern blotting, Northern blotting, Western blotting, DNA fingerprinting.

**Course Outcomes:**

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

- Describe the cell, its components and types of cell division.
- Explain the various signal transduction mechanisms.
- Describe the molecular mechanisms like Replication, Transcription, Translation and regulation of gene expression.
- Explain the various cell culture techniques and molecular tools like PCR and Blotting techniques.

**Suggested Readings:**

1. G. M. Cooper & R. E. Hausman, The Cell: A Molecular Approach, 4th Edn, ASM Press and Sinauer Associates, Inc.,USA, 2007.
2. H. Lodish et al, Molecular Cell Biology, 6th Edn., W. H. Freeman, 2007.
3. T.W. Kimball, Cell Biology, 3rd Edn., Wesley Publishers, 2007.
- J. D. Watson et al, Molecular Biology of the Gene, 7th Edn., Pearson, 2014.



5. De Robertis and De Robertis, Cell and Molecular Biology, 8th Edn., Lippincott Williams, Philadelphia, [B.I Publications Pvt. Ltd. New Delhi], 2005.

**Website Sources:**

- <https://ocw.mit.edu/courses/chemistry/>
- <https://www.easybiologyclass.com/topic-biochemistry/>
- <https://www.cliffsnotes.com/study-guides/biology/biochemisry>
- <https://ocw.mit.edu/courses/health-sciences-and-technology/>

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Microbiology II Year (IV Semester)**  
**(Effective from 2021-22)**

**BMB-401: INDUSTRIAL MICROBIOLOGY**

**Objective:** The main objective of this course:

- Will impart awareness and understanding of microorganisms involved in biotechnological, pharmaceutical and microbiological industries demonstrating a wide range of industrial production of commercially important bio products.

**UNIT I: (8 Sessions)**

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

**UNIT II: (8 Sessions)**

**Improvement of Industrially important microorganisms:** Screening techniques –Detection and assay of fermentation products – Strain improvements – Mutations, protoplast fusion and r-DNA techniques for strain development.

**UNIT III: (8 Sessions)**

**Industrial fermentation:** Basic functions of fermenter – body construction, aeration, agitation, Submerged and solid-state fermentation.

**UNIT IV: (8 Sessions)**

**Down Stream Processing:** General concept of recovery. Recovery process- centrifugation and ultracentrifugation, biomass separation (filtration and centrifugation), cell disruption (chemical and mechanical disruption techniques), liquid- liquid extraction (solvent extraction technique).

**UNIT V: (8 Sessions)**

**Industrial production of Microbial products:** Primary and secondary metabolites; Production of Acids (Citric and lactic acid), Amino Acids (Glutamic acid), Ethanol and Penicillin G. Commercially useful non-microbial products produced through microbes – insulin, Production of SCP- Spirulina and yeast.

**Course Outcome:**

At the end the students will be able to:

- Understand the presence and role of microorganisms present in the biosphere, particularly with respect to industrial applications.
- Correlate the role of various microorganisms in food and fermentation industries.
- Identify the growing importance of the microbes in commercial production of insulin and SCP.
- Understand the role of microorganisms in the production of biopharmaceuticals like antibiotics, proteins and hormones.

**Suggested Readings:**

1. Murray Moo -Young, Comprehensive Biotechnology, Vol. 1 & III-latest ed. 45
2. Prescott and Dunn's- Industrial Microbiology, 4<sup>th</sup>, ed.
3. Biotechnology-A textbook of Industrial Microbiology. II edition.Wulf Crueger and Anneliese Crueger.
4. Industrial Microbiology by L.E Casida, John Wiley and sons INC.
5. Industrial microbiology by A.H.Patel, Macillan India Ltd.
6. Principles of fermentation technology by P.Stanbury & Allan Whitaker, Pergamon.

7. Manual of Industrial Microbiology and Biotechnology, I edition. Arnold L.Demain and Juilan E.Davies.

**Website Sources:**

- <https://www.cliffsnotes.com/study-guides/>
- [https://en.wikipedia.org/wiki/Industrial\\_microbiology](https://en.wikipedia.org/wiki/Industrial_microbiology)
- [https://www.wakenbtech.co.jp/wp/wp-content/uploads/2015/11/nbs\\_fermentation\\_basics.pdf](https://www.wakenbtech.co.jp/wp/wp-content/uploads/2015/11/nbs_fermentation_basics.pdf)
- <https://courses.lumenlearning.com/microbiology/chapter/fermentation/>
- <https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod7.pdf>
- <https://thebiologynotes.com/microbial-growth-and-nutrition/>

**IFTM University, Moradabad**  
**Bachelor of Sciences (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology II Year (IV Semester)**  
**(Effective from 2021-22)**

**BMA-409: INTRODUCTORY BIOSTATISTICS**

**Objective(s):** - The objectives of the course:

- To learn Biostatistics for designing data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses.
- Is to help in learning advance statistical science and its application in problems of human health and disease.
- Is advancing statistics and analyzing data for research problems.

**UNIT I:** **(8 Sessions)**

**Introduction to Biostatistics:** Definition, Statistical method biology measurement, Kinds of biological data, Function of statistics and limitation of statistics, Application of biostatistics, Role of biostatistics in modern research, Parametric and non-parametric methods (Tests).

**UNIT II:** **(8 Sessions)**

**Collection of data:** Presentation of data classification and tabulation, Type of representation (graphic-bar diagram, pie-diagram, Curves and basic concept of calculus), Sampling and sampling design.

**UNIT III:** **(8 Sessions)**

**Measures of central tendencies:** Mean, Median, Mode, Geometric mean, Measure of dispersion, Variability and changes, Deviation- Quartile deviation, Mean deviation, Standard deviation, Standard error, Coefficient of variations.

**UNIT IV:** **(8 Sessions)**

**Different Test:** Test of hypothesis, Test of significance, t-test, Chi-square test, F-test and ANOVA with numerical.

**UNIT V:** **(8 Sessions)**

**Probability theory:** Probability theory of random experiment and associated sample space, Events, Definition of probability, Algebra of events, Addition and multiplication theorems on probability (without proof), Probability distribution, Binomial distribution, Poisson distribution and Normal distribution and their applications in biostatistics.

**Course Outcomes:**

The student will be able to:

- Demonstrate knowledge of the properties of parametric, semi-parametric and nonparametric testing procedures in Biostatistics.
- Remember restate the principal concepts about biostatistics and collect data relating to variable which will be examined.
- Understand and interpret the concepts of descriptive statistics from these data.
- Understand and be able to address ethical, regulatory and practical aspects of human subjects research including human subjects protections.
- Be capable of self-directed learning of unfamiliar statistical methods and written and oral presentation of results/findings.

**Suggested Readings:**

1. George W and Willian G., Statistical Methods, IBH Publication
2. Zar J. Biostatistics, Prenticw Hall, London.

3. R. Rangaswami, A Text Book of Agricultural Statistics, New Age International Publication, New Delhi.
4. B. K. Mahajan: Methods in Biostatistics.
5. S.C. Gupta & V.K. Kapoor: Fundamentals of Applied Statistics: Sultan Chand & Sons, New Delhi.

**Website Sources:**

- [www.pdfdrive.com](http://www.pdfdrive.com)
- [www.dmi.gov.in](http://www.dmi.gov.in)
- [www.yourarticlelibrary.com](http://www.yourarticlelibrary.com)
- [onlinecourses.nptel.ac.in](http://onlinecourses.nptel.ac.in)
- [en.wikipedia.org](http://en.wikipedia.org)

**IFTM University, Moradabad**  
**Bachelor of Sciences (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology II Year (IV Semester)**  
**(Effective from 2021-22)**

**BSB – 451: BIOINFORMATICS**

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Introduction to various biological databases.	Experiment 1
6.	To study the various biological databases associated with NCBI databases and tools.	Experiment 2
7.	To introduce Entrez as a biological data retrieval system.	Experiment 3
8.	To study various file formats of NCBI.	Experiment 4
9.	To identify all the possible open reading frames in a sequence.	Experiment 5
10.	To obtain the local alignment of the given sequences using the tool BLAST.	Experiment 6
11.	To obtain the global alignment of the given sequences using the tool Needleman-Wunsch algorithm.	Experiment 7
12.	To compute the various physical and chemical parameters of a protein.	Experiment 8

**IFTM University, Moradabad**  
**Bachelor of Sciences (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology/Food Technology II Year (IV Semester)**  
**(Effective from 2021-22)**

**BSB – 453: MOLECULAR BIOLOGY**

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Preparation of Buffers	Experiment No 1
6.	Genomic DNA isolation from bacteria cells	Experiment No 2
7.	Agarose gel electrophoresis	Experiment No 3
8.	Extraction of specific bands of DNA from agarose gel	Experiment No 4
9.	Isolation and purification of plasmid DNA	Experiment No 5
10.	Restriction digestion	Experiment No 6
11.	Ligation of DNA fragments	Experiment No 7
12.	To estimate the DNA concentration by DPA method	Experiment No 8
13.	To estimate the RNA concentration by orcinol method	Experiment No 9
14.	Transformation of <i>E.coli.</i> cells	Experiment No 10

**IFTM UNIVERSITY, MORADABAD**  
**COURSE STRUCTURE**  
**B.Sc. (MICROBIOLOGY)**  
**(Effective from 2021-22)**  
**Fifth Semester**

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
									Mid Sem Exam		
			L	T	P						
<b>THEORY</b>											
1.	BSB-501	IPR in Biotechnology	3	1	0	20	10	30	70	100	4
2.	BSB-502	Fundamentals of Bioprocess Engineering	3	1	0	20	10	30	70	100	4
3.	BSB-506	Recombinant DNA Technology	3	1	0	20	10	30	70	100	4
4.	BMB-501	Food Microbiology	3	1	0	20	10	30	70	100	4
5.	BMB-502	Microbial Biotechnology	3	1	0	20	10	30	70	100	4
<b>PRACTICALS / PROJECT</b>											
6.	BSB-551	Bioprocess	0	0	2	20	10	30	70	100	1
7.	BMB-552	Industrial Training (Evaluation & Viva Voce)	0	0	2	-	-	100	-	100	1
8.	GP-501	General Proficiency	0	0	0	0	0	100	-	100	1
		<b>Total Credit</b>	<b>15</b>	<b>5</b>	<b>4</b>			<b>380</b>	<b>420</b>	<b>800</b>	<b>23</b>



**IFTM University, Moradabad**  
**Bachelor of Sciences (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology III Year (V Semester)**  
**(Effective from 2021-22)**

**BSB-501: IPR IN BIOTECHNOLOGY**

**Objective:** The main objective of this course:

- To introduce fundamental aspects of IPR to students who are going to play a major role in R&D, management of innovative projects in industries. To aware about current trends in IPR and Govt. steps in fostering IPR

**UNIT I: (8 Sessions)**

**IPR:** Introduction, History and evolution, Various form of IPR: Trade Secret, Patent, Copy right, Trade mark, Industrial Design, Geographical indication, Choice of IPR Protection, Indian Patent Act 1970 (amendment 2000).

**UNIT II: (8 Sessions)**

**International Harmonization of Patent Laws:** Paris convention Treaty, WIPO, European Patent Convention, TRIPs, Protection of Biotechnological Inventions, Plant Breeder's Rights (PBR): Historical, requirement for PBR, The Extent of Protection by PBR, Management of IPR, Benefit and Problem from IPR.

**UNIT III: (8 Sessions)**

**Civil and Criminal Remedies:** Rights/protection, infringement or violation, remedies against infringement-civil and criminal.

**UNIT IV: (8 Sessions)**

**Biosafety:** Introduction, Historical background, Definition, Objective of safety guidelines, Risk Assessment, Containment, Planned introduction of genetically modified organism (GMOs)- Budapest treaty; Biosafety guidelines in India.

**UNIT V: (8 Sessions)**

**Bioethics:** Bioethics in Biotechnological Products- Food and Drugs; Social and ethical implications of biological weapons; patenting of biological material; introduction of NGO for bioethics.

**Course Outcomes:**

Students completing this course will be able to:

- Gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas.
- Devise business strategies by taking account of IPRs.
- Assists in technology upgradation and enhancing competitiveness.
- Adequate knowledge in the use of genetically modified organisms and its effect on human health.
- Gain more insights into the regulatory affairs.

**Suggested Readings:**

1. H. J. Knight, Patent Strategy For Researches & Research Manegers, 3rd Edn., Wiley-Blackwell Publications, 2013.
2. V. Santaniello & R. E. Evenson, Agriculture and Intellectual Property Rights: Economic, Institutional and Implementation Issues in Biotechnology, CABI publishing, 1st Edn., 2000.
3. P. Cullet, Intellectual Property Protection & Sustainable Development, Lexis Nexis Butterworths.

4. J. A. Thomas & R. L. Fuchs, *Biotechnology and Safety Assessment*, 3rd Edn., Academic Publishers, 2002.
5. G. Fuchs, *Biotechnology in Comparative Perspective*, Routledge, 2003.
6. D. Goel, *IPR, Biosafety and Bioethics*, 1st Edn., Pearson, 2013.

**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**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/ Microbiology III Year (V Semester)**  
**(Effective from 2021-22)**

**BSB-502: FUNDAMENTALS OF BIOPROCESS ENGINEERING**

**Objective(s):** The objectives of this course:

- Is to introduce the basic concept of bioprocess/fermentation its role in biotechnology industries.
- Will describe the importance of medium preparation and sterilization.
- Techniques required for fermentation process like pretreatment of raw materials, isolation and preservation of microbes also explained.

**UNIT I:** **(8 Sessions)**

**Introduction to Bioprocess:** Steps in Bioprocess Development: Recombinant DNA products, Inoculum preparation, Media Preparation and formulation.

**UNIT II:** **(8 Sessions)**

**Cultivation system:** Batch, fed batch and Continuous cultivation system- Washout phenomenon, chemostat and turbidostat, Biomass and product yield, yield coefficient.

**UNIT III:** **(8 Sessions)**

**Sterilization:** Sterilization and kinetics of sterilization, Sterilization of media: Batch Sterilization, Continuous Sterilization. Sterilization of air, Air filters and X<sub>90</sub>.

**UNIT IV:** **(8 Sessions)**

**Material Balances:** Material Balance equation, Law of Conservation of Mass, Steady State material balance, Stoichiometric of growth and product formation.

**UNIT V:** **(8 Sessions)**

**Bioreactors:** Bioreactors for microbial or animal cell culture, Aseptic operation of bioreactors, Aeration and Agitation in bioreactor.

**Course Outcomes:**

At the end students will be able to understand:

- Different components of bioprocess engineering to process optimization.
- Aseptic culture and importance of sterilization in microbial growth and product formation.
- Different components of fermentation for example medium components and their role in growth of microbes.
- Different types of bioreactors used in fermentation industries

**Suggested Readings:**

1. P. F. Stanbury, A. Whitaker & S. J. Hal, Principles of Fermentation Technology, Pergamon, 1995.
2. P. M. Doran, Bioprocess Engineering Principles, Academic Press, 2012.
3. H. C. Vogel, Fermentation & Biochemical Engineering Handbook, William Andrews, 2004.

**Website Sources:**

- <https://www.britannica.com/science/fermentation>
- <https://nptel.ac.in/courses/102/105/102105064/>
- <https://www.khanacademy.org>

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/ Microbiology III Year (V Semester)**  
**(Effective from 2021-22)**

**BSB-506: RECOMBINANT DNA TECHNOLOGY**

**Objective(s):** The objectives of this course:

- Is to introduce students to basic molecular biological concepts and techniques used in the fields of biotechnology and genetic engineering.
- Will give students insight into the techniques used to cut up and join together genetic material, especially DNA from different biological species and to introduce the resulting hybrid DNA into an organism in order to form new combinations of heritable genetic material.
- Make the learner understand strategies which help in controlling gene expression, manipulating gene structure and gene containment.

**UNIT I:** **(8 Sessions)**

**Introduction:** Concepts of recombinant DNA technology, Tools of r-DNA technology- Adopters and Linkers, DNA ligase, Modifying enzymes, Restriction enzymes.

**UNIT II:** **(8 Sessions)**

**Vectors in Gene Cloning:** Plasmids- Structure and Genomic organization of pBR 322 and pUC 18, Ti plasmid, Cosmids, Phagemids, shuttle vectors, expression vectors- Yeast Artificial Chromosome (YAC).

**UNIT III:** **(8 Sessions)**

**Gene recombination and Gene Transfer:** Transformation, Bacterial Conjugation, Transduction, Transfection, Microinjection, Electroporation, Shot-gun method.

**UNIT IV:** **(8 Sessions)**

**In-vitro construction of recombinant DNA molecule:** Screening and selection of recombinant host cells; Gene libraries- Genomic DNA and cDNA library.

**UNIT V:** **(8 Sessions)**

**Techniques:** Polymerase chain reaction (PCR), Types of PCR-Nested PCR, Hot-start PCR, Reverse transcriptase PCR, Real time PCR, anchored PCR, Site directed mutagenesis, Application of r-DNA technology.

**Course Outcomes:**

Students completing this course will be able to:

- Understand the concept of gene manipulation.
- Implementing the techniques to make new novel products which can be beneficial for humankind.
- Gain an appreciation and knowledge of how to deal with ethical issues relating to science.

**Suggested Readings:**

1. B. R. Glick, J. J. Pasternak, C. L. Patten, Molecular Biotechnology: Principles and Applications of Recombinant DNA, 2010.
2. T. A. Brown. Gene Cloning and DNA Analysis: An Introduction, 2020.
3. Harvey Lodish, David Baltimore, Arnold Berk. Molecular Cell Biology, W H Freeman & Co (Sd), 2008.
4. Benjamin Lewin – Genes VIII, 2004.

**Website Sources:**

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

**IFTM University, Moradabad**  
**Bachelors of Science (B.Sc.), Programme**  
**B.Sc. Microbiology III Year (V Semester)**  
**(Effective from 2021-22)**

**BMB-501: FOOD MICROBIOLOGY**

**Objective(s):** The objectives of this course:

- To impart knowledge about microorganisms that inhabit, create, or contaminate food are studied in food microbiology.
- To let the learner, know how microbes are being used for the production of foods, food supplements and food ingredients.
- Will make student understand microorganisms are also responsible for food spoilage and food poisoning which result in loss of food products and also cause damage to human and animal health and economic losses.
- Also, to provide insight of effects of microbial contamination is vital to various food safety, production, processing, preservation, and storage aspects.

**UNIT I:** **(8 Sessions)**

**History of microorganism:** History of microorganism in food developments. General characteristics of micro-organisms important in food microbiology- Moulds, Yeasts and yeast-like fungi, Bacteria.

**UNIT II:** **(8 Sessions)**

**General principles of culture maintenance and preparation:** Bacterial cultures, yeast cultures and mold cultures. Factors affecting activity of cultures – Bacteriophages, Antibiotics and Chemicals.

**UNIT III:** **(8 Sessions)**

**Contamination, Spoilage and preservation of food:** Principles underlying spoilage and preservation of foods; Contamination, spoilage and preservation – sugar products, vegetable and fruit products, meat and meat products, fish and sea foods, eggs and poultry products, dairy products.

**UNIT IV:** **(8 Sessions)**

**Bacterial food borne diseases:** *Clostridium perferinges*, *Vibrios*, *E.coli.*, *B.cereus*, *Y.enterocolitica*, *campylobacter*, *Listeria monocystogenes*. Non-bacterial poisonings, infections and intoxications.

**UNIT V:** **(8 Sessions)**

**Food laws and standards:** Codex Alimentarius, HACCP, FSSAI, PFA, BIS, AGMARK, ISO, food sanitation and inspection; microbiological standards of food.

**Course Outcomes:**

Students completing this course will be able to:

- Understand the basic characteristics of microbes that are important in food industry.
- Understand methods of preservation of food.
- Understand several food borne diseases.

**Suggested Readings:**

1. B. Sivasankar, Food Preservation and processing, PHI Publication. 2009
2. W. S. Frazier, D. C. Westhoff, Food Microbiology. Tata McGraw Hill publications, 2008
3. W.K. Joklik, H.P. Willet, D. B. Amos & W. C.M. Zinssers, Microbiology, 19th Edn. Prentice-Hall International Inc. 1988

4. P. J. Vandemark, B. L. Batzingth, Microbes, The Benjamin/cummings publishing company. Inc, 1987.
5. L. M. Prescott, J. P. Harley, D. A. Kleein, Microbiology, 3rd Edn., Broen publishers, 2010.

**Website Sources:**

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

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Microbiology III Year (V Semester)**  
**(Effective from 2021-22)**

**BMB-502: MICROBIAL BIOTECHNOLOGY**

**Objective(s):** The objectives of this course:

- To provide the awareness about use of microbes to generate useful products or to degrade wastes (bioremediation).
- Also is to deal with involvement of microbes in food industries and geochemical mining and the development of microbial strains that are highly efficient at catabolising natural organic compounds or synthetic chemical compounds.
- To let learner come across the concept of microbial biotechnology overlaps with the recently developing field of designer bacteria, the so-called “artificial microbiology”.

**UNIT I: (8 Sessions)**

**Microorganisms in Agriculture:** Bacteria and fungi as biopesticides; Genetically modified crops containing insecticidal genes; Biofertilizers- Nitrogen fixers, PSB and Mycorrhiza.; Fuel from microorganisms- Biogas technology, Microbial hydrogen production, Concept of gasohol.

**UNIT II: (8 Sessions)**

**Geomicrobiology:** Microbial leaching of copper and uranium ores; Bio-recovery of petroleum- MEOR; Bioremediation and Biodeterioration- leather, textile and paper.

**UNIT III: (8 Sessions)**

**Pharmaceutical Biotechnology:** Genetically engineered microorganisms; Production of heterologous proteins- Insulin, Growth hormones, Interleukins and T- plasminogen activator; Recombinant vaccines.

**UNIT IV: (8 Sessions)**

**Food from Microbes:** Dairy products- Cheese, Butter, Yogurt; Microorganisms as food- SCP, Spirulina and Mushroom; Indian and Oriental fermented foods.

**UNIT V: (8 Sessions)**

**Advanced Microbiology:** Biosensors and Biopolymers; Biochips, Biofilms and Bioplastics; Microorganisms as bioindicators

**Course Outcomes:**

A student passing this module will be able to:

- Critically evaluate the role of micro-organisms in specific biotechnological processes.
- Explain the complex processes behind the development of genetically manipulated organisms.
- Demonstrate a clear understanding of how biochemical pathways relate to biotechnological applications.
- Conduct a comprehensive search for original research literature pertinent to a selected area of microbiology and biotechnology.
- Judge the relative support for different perspectives in potentially controversial issues based on a critical and objective analysis of published research.
- Communicate complex scientific principles and ideas effectively

**Suggested Readings:**

1. J. M. Willey, L. Sherwood, C. J. Woolverton, L. M. Prescott, Microbiology. New York: McGraw-Hill Higher Education, 2008
2. M. Frobisher, Fundamentals of Microbiology, 9th Edn., W.B. Saunders Company, 1974.



3. E.C.S. Chan, M. J. Pelczar, N. R. Krieg. Microbiology, 5th Edn, Tata McGraw-Hill Education Pvt. Ltd, 1998.
4. R.Y. Stanier & M. Doudoroff. General Microbiology, Paperback Publisher, 1970
5. H. A. Modi, Introductory Food Microbiology, Pointer Publishers, 2007
6. Powar & Dagainawal. General Microbiology, 1st Edn., Himalaya Publishing House Pvt. Ltd. 2012.

**Website Sources:**

- <https://nptel.ac.in/courses/102/103/102103015/>
- <https://www.futurelearn.com/courses/introduction-to-microbiology>
- [http://mdurohtak.ac.in/pdf/Syllabus\\_pdf/CBCS\\_microbial%20Biotech\\_Final\\_17.7.15.pdf](http://mdurohtak.ac.in/pdf/Syllabus_pdf/CBCS_microbial%20Biotech_Final_17.7.15.pdf)

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology III Year (V Semester)**  
**(Effective from 2021-22)**

**BSB-551: BIOPROCESS LAB**

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Isolation of microbes from soil using serial dilution method.	Experiment 1
6.	To prepare the broth media for growth of micro-organisms.	Experiment 2
7.	To study the Growth Curve of Bacteria.	Experiment 3
8.	To study the effect of osmotic pressure on bacterial growth.	Experiment 4
9.	Production of ethanol from <i>Sacchromyces cerevisiae</i> under submerged fermentation.	Experiment 5
10.	To purify ethanol produced under submerged condition.	Experiment 6
11.	To optimize the fermentative condition for the production of bacterial cellulose by bacterial strain.	Experiment 7
12.	To immobilization cells using gel entrapment.	Experiment 8

**IFTM UNIVERSITY, MORADABAD**  
**COURSE STRUCTURE**  
**B.Sc. (MICROBIOLOGY)**  
**(Effective from 2021-22)**

**Sixth Semester**

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
									Mid Sem Exam		
			L	T	P						
<b>THEORY</b>											
1.	BSB-601	Fermentation Technology	3	1	0	20	10	30	70	100	4
2.	BSB-602	Introductory Bioenergetics	3	1	0	20	10	30	70	100	4
3.	BMB-601	Advanced Virology	3	1	0	20	10	30	70	100	4
4.	BMB-603	Dairy Microbiology	3	1	0	20	10	30	70	100	4
5.	BMB-602/604/605	Departmental Elective	3	1	0	20	10	30	70	100	4
<b>PRACTICALS / PROJECT</b>											
6.	BSB-651	Fermentation Technology	0	0	2	20	10	30	70	100	1
7.	BMB-651	Dairy Microbiology	0	0	2	20	10	30	70	100	1
8.	GP-501	General Proficiency	0	0	0	0	0	100	-	100	1
		<b>Total Credit</b>	<b>15</b>	<b>5</b>	<b>4</b>			<b>310</b>	<b>490</b>	<b>800</b>	<b>23</b>

**IFTM UNIVERSITY, MORADABAD**

**B. Sc. Microbiology**

**Course Structure**

**(Effective from 2021-22)**

**Sixth Semester**

**LIST OF DEPARTMENT ELECTIVES**

<b>S. No.</b>	<b>Course Code</b>	<b>Course Name</b>
1	BMB-602/604/605	Clinical Parasitology/ Microbial quality control in Food and pharmaceutical industries/ Microbial diagnosis in health clinic

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology III Year (VI Semester)**  
**(Effective from 2021-22)**

**BSB-601: FERMENTATION TECHNOLOGY**

**Objective(s):** The main objectives of this course:

- Is to introduce the basic concept of fermentation its role in industries.
- It describes the importance of medium preparation and sterilization.
- Techniques required for fermentation process like pretreatment of raw materials, isolation and preservation of microbes also explained.

**UNIT I:** **(8 Sessions)**

**Introduction:** History, scope and development of fermentation technology, Isolation and screening of industrially important micro-organisms- primary and secondary screening; maintenance of strain; strain improvement-mutant selection and rDNA technology.

**UNIT II:** **(8 Sessions)**

**Fermentation media:** Basic component of media (carbon source, nitrogen source, vitamins, minerals, inducers and antifoaming agents); Natural and synthetic media; Raw materials from agriculture and industrial waste, Pretreatment of raw materials-physical, chemical and biological.

**UNIT III:** **(8 Sessions)**

**Fermenter design:** Basic design of fermenter; Culture vessel, aerators, agitators; characteristics feature of bioreactors; Type of bioreactor-STR, bubble column, air-lift and packed-bed; online monitoring and computer control of fermentation process.

**UNIT IV:** **(8 Sessions)**

**Fermentation Products:** Fermentation process in dairy and other food products. Production of Organic Acid- Acetic Acid, Amino acid- L-lysine, Production of alcoholic beverages-ethanol production.

**UNIT V:** **(8 Sessions)**

**Production of Antibiotics and Vitamins:** Synthesis of antibiotics- Tetracycline, Streptomycin, Penicillin, Vitamins.

**Course Outcomes:**

At the end students will be able to understand:

- Design and operation of fermenter used in biotechnology industries.
- Isolation and preservation of microbes of industrial importance.
- Different components of fermentation for example medium components and their role in growth of microbes.
- Industrial scale production of ethanol, citric acid, amino acid and antibiotics.

**Suggested Readings:**

1. A. Cruger & A Cruger; A textbook of Industrial microbiology, 2nd Edn., Sinaeur Associates, 1990.
2. P. F. Stanbury, A. Whitaker & S. J. Hal ,Principles of Fermentation Technology, Second ed., Pergamon, 1995.
3. Y. H Hui et al., Handbook of Food and Beverages Fermentation Technology, 1st Edn., CRC Press, 2004.
4. A. R. Allman & M. E. Mansi, C. F. A. Bryce, A. L. Demain, Fermentation Microbiology and Biotechnology, 3rd Edn., CRC press, 2012.
5. B. McNeil & L. Harvey, Practical Fermentation Technology, Wiley-Blackwell, 2008.

6. Greed, Prescott and Dunn's, Industrial Microbiology, 4th Edn., CBS Publishers, 2004.

**Website Sources:**

- <https://www.britannica.com/science/fermentation>
- <https://nptel.ac.in/courses/102/105/102105058/>
- <https://www.masterclass.com>
- <https://www.khanacademy.org>

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Biotechnology/Microbiology III Year (VI Semester)**  
**(Effective from 2021-22)**

**BSB-602: INTRODUCTORY BIOENERGETICS**

**Objective(s):** The objectives of this course:

- To introduce the concept of energy flow through living systems as an active area of biological research since life is dependent on energy transformations.
- To give the insight about how a cell functions, how signaling occur and how a cell actually exists.

**UNIT I: (8 Sessions)**

**Metabolic Energy:** Energy, energy flow cycle, energy conversion, Structure and properties of ATP, High energy compounds, Thermodynamic considerations, coupling reactions of ATP and NDP (nucleotide diphosphate).

**UNIT II: (8 Sessions)**

**Biological membrane:** Structure, permeability, properties, passive transport and active transport, facilitated transport, energy requirement, mechanism of Na<sup>+</sup>/ K<sup>+</sup> ATPase pump, glucose and amino acid transport, Organization of transport activity in cell, Active potentials, Role of transport in signal transduction process.

**UNIT III: (8 Sessions)**

**Metabolism and bioenergetics:** Generation and utilization of ATP, Metabolism of Nitrogen containing compounds- amino acids (biodegradation, deamination, decarboxylation, biosynthesis) and nucleotides.

**UNIT IV: (8 Sessions)**

**Energetic pathways and their regulation:** Glycolytic pathway and its regulation, glycogen breakdown, Citric acid cycle and its cycle, gluconeogenesis, pentose phosphate pathway, glyoxylate pathway.

**UNIT V: (8 Sessions)**

**Phosphorylation:** Sites of Phosphorylation, Substrate level and oxidative phosphorylation- Mechanism and control, ATP synthetase.

**Course Outcomes:**

Students completing this course will be able to:

- Understand how energy flows in cell.
- Structural composition of living cells and how transport occurs across it.
- Understand the role of ATP and reduced cofactors in shuttling energy and electrons around within cells.
- Know how substrate level phosphorylation and oxidative phosphorylation synthesizes large amount of ATP.
- Students can do research about a living organism go into detail to its cellular level with other fields and study about them be it for making a medicine or antibiotics.

**Suggested Readings:**

1. E. Conn & P. Stumpf, Outlines of Biochemistry, 5th Edn, John Wiley & Sons, 2009.
2. D. L. Nelson, A. L. Lehninger, M. M. Cox, Lehninger Principles of Biochemistry, 8th Edn., W. H. Freeman, 2017.
3. J. M. Berg, J. L. Tymoczko, G. J. Gatto Jr.; L. Stryer, Stryer Biochemistry, 8th Edn, Freeman & Company, W. H., 2015.
4. R C Srivastava, Subit K., S K. Jain & A. K. Jain, Thermodynamics: A Core Course, 3rd Edn., PHI Learning Private Limited New Delhi, 2010.

## **Website Sources:**

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



**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Microbiology III Year (VI Semester)**  
**(Effective from 2021-22)**

**BMB-601: ADVANCED VIROLOGY**

**Objective(s):** The objectives of this course:

- To allow students to learn the biology and pathogenesis of medically important viruses at the cellular and molecular level.
- Will also help how viruses can be used in the biotechnology industry and in agriculture and gene based therapeutic approaches to treat disease.
- Will also focus on the technology used in the modern diagnostic virology laboratory and recent advances in pathogen detection and disease epidemiology.
- Will also deals with viruses from a public health perspective including preventing transmission and control of disease outbreaks, including vaccination and pharmacological intervention strategies.

**UNIT I:** **(8 Sessions)**

**History of Virology:** Origin of Virus, Morphology- Shape, Size, Structure, types of envelope, their composition; Classification of Virus- LHT System, Baltimore Classification; Viroids and Prions; Isolation & Cultivation of Virus.

**UNIT II:** **(8 Sessions)**

**History of Plant Virology:** Classification of plant viruses, life cycle and pathogenicity of important viruses. Tobamovirus Group: Symptoms, Virus structure, Genome Organization, Multiplication. Potex Virus Group: Symptoms, Virus structure, Genome Organization. Ptyvirus Group: Symptoms, Virus structure, Genome Organization. Tymovirus Group: Symptoms, Virus structure, Genome Organization

**UNIT III:** **(8 Sessions)**

**Plant Viruses:** Tomato Spotted Wilt Virus, Cauliflower Mosaic Virus: Symptoms, Virus structure, Genome Organization. Potato Leaf Roll Virus: Symptoms, Virus structure, Genome Organization. Rice Tungro Virus. Mosaic Disease of Sugarcane. Transmission of Plant Virus, Effect of Viruses on Plants: External and Internal symptoms. Serological Tests for Diagnosis of Plant Virus

**UNIT IV:** **(8 Sessions)**

**Classification of animal viruses:** Life cycle and pathogenicity of important viruses, genome organization and replication of DNA viruses; Papovavirus, SV40, Poxviruses, Adenovirus, Herpesviruses. RNA containing Viruses; Picornavirus, Togaviruses, HIV, Working of Immune System in presence of HIV.

**UNIT V:** **(8 Sessions)**

**Bacteriophages:** Classification, Morphological Groups, The Virulent dsDNA phage, the ssDNA phage, Phage lambda, Temperate and Transposable Phage; Phage Mu: M 13; Bacteriophage typing; Phage Therapy; Cyanophages, Mycoviruses; Rhizobiophages.

**Course Outcome:**

Student will be able to:

- Student will know plant viruses, important viral diseases of crops, sign and symptoms and management of viral diseases.
- Be able to comprehensively explain in detail how virus structure and replication relates to the pathogenesis of medically important viruses.
- Be able to explain the design of and use of appropriate molecular techniques for the diagnosis for viral disease.
- Be able to describe the pathology of virus infections with particular reference to immunodeficiency diseases, latent and reactivation diseases, malignancies and development of new drugs and vaccines for their treatment.

- Be able to critically interpret the safety issues associated with the use of viruses for gene therapy.

### **Suggested Readings:**

1. R. H. Matthew, Matthews' Plant Virology, 4th Edn., ASM Press, Washington DC, 2008.
2. N. J. Dimmock, S. B. Primrose, Introduction to Modern Virology, 4<sup>th</sup> Edn., Blackwell scientific Publications, Oxford, 1994
3. C. Morag & M. C. Embury, Medical Virology, 10<sup>th</sup> Edn., Churchil Livingstone, London, 1994.
4. S. J. Flint *et al.*, Principles of Virology Vol I: Molecular Biology, Vol. II: Pathogenesis and Control, 3rd Edn, ASM Press, 2015.

### **Website Sources:**

- <http://virology.net/Tutorials.html>
- [https://academic.oup.com/ofid/article/4/suppl\\_1/S445/4294639](https://academic.oup.com/ofid/article/4/suppl_1/S445/4294639)
- <https://aoac-india.org/e-learning/>
- <https://nptel.ac.in/courses/102/103/102103039/>

**IFTM University, Moradabad**  
**Bachelor of Science (B. Sc.), Programme**  
**B.Sc. Microbiology III Year (VI Semester)**  
**(Effective from 2021-22)**

**BMB- 602: CLINICAL PARASITOLOGY**

**Objective:** The main objective of the course:

- Aims to determine the presence and identification of human parasites and fungal forms. It also demonstrates an understanding of the life cycle and pathogenicity of parasites and fungi.

**UNIT I: (8 Sessions)**

**Infection:** Introduction to infection, types of infection, host-parasite relationship, toxicogenecity, exotoxin-AB toxin, specific host site exotoxins, membrane disrupting exotoxin, roles of exotoxin in disease, endotoxin.

**UNIT II: (8 Sessions)**

**Introduction to parasitology:** Terminologies and definition; Transmission of Parasites- vector boron transmission, air born transmission, water born transmission, food born transmission, vehicle transmission.

**UNIT III: (8 Sessions)**

**Protozoa:** Morphology, life cycle, pathogenesis, symptoms, laboratory diagnosis, prevention and control of the following parasite-I) *Plasmodium*, II) *Entamoebahistolytica*, III) *Leishmaniadonovani*.

**UNIT IV: (8 Sessions)**

**Cestodes:** Morphology, life cycle, pathogenesis, symptoms, laboratory diagnosis, prevention and control of the following parasite- I) *Taeniasolium*, II) *Echinococcusgranulosus*, III) *Taeniasagenata*

**UNIT V: (8 Sessions)**

**Helminths:** Morphology, life cycle, pathogenesis, symptoms, laboratory diagnosis, prevention and control of the following parasite-I) *Ankylostomaduodenale*, II) *Ascarislumbricularis*, III) *Enterobiusvermicularis*

**Course Outcomes:**

At the end the students will be able to understand:

- The role of parasites in infected persons who have acquired the parasitic infections.
- Able to identify the difference between the terms like parasite, host, intermediate host, reservoir host, vector, mutualism, commensalism, and parasitism.
- Able to describe the means of transmission of parasites and the factor that influence disease diffusion.
- Explain the importance of correct parasite identification and methods of identification.
- Articulate the major aspects of controlling parasites and treating parasitic diseases.

**Suggested Readings:**

1. J. M. Willey, L. M. Sherwood, C. J. Woolverton. Prescott, Harley and Klein Microbiology, Mc Graw Hill Publication.
2. Pawar & Dagainawal, General Microbiology. I. Himalaya Publishing House Pvt. Ltd., 2012.
3. E.C.S. Chan, M. J. Pelczar, Jr., N. R. Krieg, Microbiology, 5th Edn., Published by Tata McGraw-Hill Education Pvt. Ltd, 1998.
4. M. Frobisher. Fundamentals of Microbiology 9th Edn., W. B. Saunders Company, June 1974.
5. H. W. Brown, F. A. Neva, Basic Clinical Parasitology, 4th Edn, .Appleton & Lange, U.S., 1975.

**Website Sources:**

- <https://www.britannica.com/science/fermentation>

- <https://nptel.ac.in/courses/102/105/102105064/>
- <https://www.khanacademy.org>

**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
**B.Sc. Microbiology III Year (VI Semester)**  
**(Effective from 2021-22)**

**BMB-603: DAIRY MICROBIOLOGY**

**Objective:** The main objective of this course:

- To familiarize the students with the importance of various microorganisms responsible for the spoilage of dairy products and the methods employed for the preservation of dairy products, starter organisms and applications of starters in the production of dairy products.

**UNIT I:** (8 Sessions)

**Milk:** Definition, Uses, Sources, types of milk and chemical composition of milk; Fermented dairy products- Yogurt, Kefir, cultured cream, Bulgarian buttermilk, Cheese.

**UNIT II:** (8 Sessions)

**Microbial analysis of milk:** Microflora of raw milk, Total Bacterial count, Dry reduction test, Brucella ring test, Test for mastitis; Factors affecting the microbial growth in milk; temperature response of bacteria.

**UNIT III:** (8 Sessions)

**Contamination of Milk and Milk Products:** Spoilage of – milk, cream, condensed milk, dry milk products, frozen desserts and butter; Defects-Colour, flavor, Sweet curdling and ropiness.

**UNIT IV:** (8 Sessions)

**Processing of different milk products:** Processing of different milk products for control of microorganism- Cream, Butter, condensed milk, evaporated milk and whole milk powder.

**UNIT V:** (8 Sessions)

**Preservation of milk and milk products:** Asepsis, Removal of microorganisms by use of heat (Pasteurization, UHT, LHT, HTST), Use of low temperature, Drying, Use of preservatives.

**Course Outcomes:**

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

- Explain the types of milk, significance of milk, chemical composition and different dairy products.
- Describe the different microorganisms present in milk and milk products and factors responsible for the growth of microorganisms.
- Explain the spoilage of milk products by microorganisms like cream, condensed and dry milk products etc.
- Describe the methods for controlling microorganisms in cream, butter, evaporated milk and other dairy products.
- Describe the various methods employed for the preservation of milk products.

**Suggested Readings:**

1. Richard K. Robinson-Dairy Microbiology Handbook: The microbiology of Milk and Milk Products.
2. Elmer H. Marth, James L. Steele. Applied Dairy Microbiology. Taylor & Francis, 1998
3. William C. Frazier, Dennis C. Westhoff. Food Microbiology. Tata McGraw-Hill Publishing Company, 1978
4. Manish Srivasatva. Handbook of Milk Microbiology. Daya Books, 2002

**Website Sources:**

- <https://microbenotes.com/milk-pasteurization-methods-steps-significance/>
- <https://www.uoguelph.ca/foodscience/>

- <https://dairyprocessinghandbook.tetrapak.com/chapter/microbiology>
- <https://www.groupe-esa.com/>

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**BMB-604: MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES**

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

- To provide an opportunity to learn quality assurance and management system in food and pharmaceuticals.
- To learn national and international laws and quality standards.
- To learn risk assessment, management and guidelines of drug safety.

**UNIT I: (8 Sessions)**

**Introduction to quality management:** Definition, quality concepts, quality, quality perception, quality attributes, safety, health, sensory, shelf life, convenience, extrinsic attributes, factors affecting food behavior. Quality policy, quality objectives, strategic planning and implementation, McKinsey 7s model, competitive analysis.

**UNIT II: (8 Sessions)**

**Quality risk management in Pharmaceuticals:** Introduction, risk assessment, risk control, risk review, risk management tools, HACCP, risk ranking and filtering according to ICH Q9 guidelines; process development and stability testing drug substances and drug products as ICH Q8 guidelines.

**UNIT III: (8 Sessions)**

**Pharmaceutical Quality System:** Change management/ change control, deviations, out of specifications (OOS), out of trend (OOT). Complaints: Evaluation and handling, investigation and determination of root cause, corrective and preventive actions (CAPA), returns and recalls, vendor qualification, annual product reviews, batch review and batch release.

**UNIT IV: (8 Sessions)**

**Food contamination and additives:** Contamination in Food- Physical, chemical (heavy metals, pesticide residues, antibiotics, veterinary drug residues, dioxins, environmental pollutants, radionuclides, solvent residues, chemicals); Risk assessment studies- Safety and quality evaluation of additives and contaminants; Antioxidants mechanism of action, natural and synthetic anti-oxidants,

**UNIT V: (8 Sessions)**

**Food Laws, standards and regulations:** History, National and International laws & Regulations: FSSAI, USFDA, EU, Codex alimentarius, ISO Series, World Trade Organization- (Sanitary and Phyto Sanitary agreement (SPS), Technical Barriers in Trade(TBT); Standards of Identity, Standards of Quality, Standards of fill of the container.

**Course Outcomes:**

Students will be able to:

- Understand the need of quality management and assurance system.
- Understand regulations like WTO, FSSAI, ISO and its application.
- Understand the national and international laws to make the process and product safe.

**Suggested Readings:**

1. Antony J., and Preece D., Understanding, Managing and Implementing Quality: Frameworks, Techniques and Cases, Routledge, Taylor and Francis Group, New York.
2. Lawler E.E., Mohrman S.A., Benson G., Organizing for High Performance: Employee Involvement, TQM, Reengineering, and Knowledge Management in the Fortune 1000, Jossey-Bass, New Jersey.

3. Pie P.A. Luning, W.J. Marcelis, Food Quality Management Technological and Managerial principles and practices, Wageningen, 2002.
4. H.J Heinz, D.A. Shapton, Principles and Practices for the safe processing of Foods, Butterworth-Heinemann, 2002.
5. Ternel A, Luning, Willem J. Marcelis, Food Quality Management Technological and Managerial principles and practices, Wageningen, 2009.

**Website Sources:**

- <https://www.fda.gov/inspections-compliance-enforcement-and-criminal-investigations/inspection-guides/pharmaceutical-quality-control-labs-793>
- <https://www.pharmaguideline.com/p/quality-control.html>
- <http://www.fao.org/3/a-t0396e.pdf>



**IFTM University, Moradabad**  
**Bachelor of Science (B.Sc.), Programme**  
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**BMB-605 MICROBIAL DIAGNOSIS IN HEALTH CLINICS**

**Objective:** The main objective of this course:

- To introduce the students to the importance of diagnosis of pathogens in controlling diseases.
- The student will become familiar with various approaches used for diagnosis along with their advantages and limitations.
- The importance of antimicrobial resistance and methods to determine it are also covered in this course.

**UNIT I: (8 Sessions)**

**General principles of diagnosis and collection of clinical samples:** Importance of diagnosis of infectious diseases; Challenges in diagnosis (Interference from normal microflora, mixed infections, specificity and sensitivity issues); Choice of clinical samples for diagnosis of infectious diseases; Methods for collection of clinical samples (Blood, CSF, Urine, Faeces); Sample collection from oral cavity, throat and skin, biopsies); Methods of transport of clinical samples to laboratory and their storage.

**UNIT II: (8 Sessions)**

**Approaches for identification of pathogens:** Microscopic examination-Examination of clinical sample by microscopy, Ziehl-Neelson staining of sputum sample for detection of tuberculosis, Giemsa staining of blood film for detection of malaria; Cultural Methods- Enrichment Culture, Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, TCBS agar, Salmonella Shigella agar; Microbial detection using chromogenic media; Distinct colony properties of various bacterial pathogens on relevant culture media (Streptococcus pyogenes, Mycobacterium tuberculosis, Salmonella, Shigella, E. coli, Vibrio); Biochemical Methods- Sugar fermentation profiling, TSI, IMViC. Serological and Molecular methods: Serological Methods – Agglutination, ELISA, Western blot, Immunofluorescence, Lateral flow Immunoassays, Nucleic acid based methods – PCR; Real Time and Multiplex, Nucleic acid probes; Dot Blot and Colony Hybridization.

**UNIT III: (8 Sessions)**

**Rapid Detection of bacterial pathogens and antibiotic sensitivity of bacteria:** Laboratory guidance and diagnostic testing for rapid detection of pathogens; Typhoid, Dengue and HIV, Swine flu, Zika virus; Testing for Antibiotic sensitivity in Bacteria; Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method.

**UNIT IV: (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 and VDRL test); Specific approaches to diagnose pathogens that are difficult to detect/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; PCR-ELISA test to detect specific serotypes of rotavirus; flow cytometry for analysing heterogeneous microbial populations and for diagnosis of Legionella pneumophila.

**UNIT V: (8 Sessions)**

**Anti-microbial chemotherapy:** 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, Griseofulvin; Antiviral agents- Mechanism of action of Amantadine, Tamiflu, Azidothymidine. Antimicrobial resistance: MDR, XDR, TDR. NDM-1; National immunization schedule and other current vaccines.

### **Course Outcomes:**

Students completing this course will be able to:

- Understand the importance and challenges in detecting pathogens.
- Acquainted with the principles of various classical and newer approaches for the identification of microbial pathogens such as microscopy, culturing, biochemical tests, serological and molecular methods.

### **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 and J.M. Martinko. 15th edition. Prentice Hall International Inc., USA. 2017.
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: A Laboratory Manual by J. Cappucino and N. Sherman. 10th edition. Pearson Education, India. 2014.

### **Website Sources:**

- <https://nptel.ac.in/courses/102/103/102103015/>
- <https://www.futurelearn.com/courses/introduction-to-microbiology>
- [http://mdurohtak.ac.in/pdf/Syllabus\\_pdf/CBCS\\_microbial%20Biotech\\_Final\\_17.7.15.pdf](http://mdurohtak.ac.in/pdf/Syllabus_pdf/CBCS_microbial%20Biotech_Final_17.7.15.pdf)

**IFTM University, Moradabad**  
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**BSB-651: Fermentation Technology**

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To produce ethanol under submerged conditions using <i>Saccharomyces cerevisiae</i> .	Experiment 1
6.	To purify ethanol produced under submerged conditions.	Experiment 2
7.	To produce the lactic acid from whey.	Experiment 3
8.	To produce the Citric acid from whey with sugars and additives by <i>Aspergillus niger</i> .	Experiment 4
9.	To produce the Sauerkraut by using microorganisms.	Experiment 5
10.	To produce the Wine from Grape juice.	Experiment 6
11.	To determine the effectiveness of antibiotic using agar well dilution bioassay test.	Experiment 7
12.	To produce the amylase by using <i>Aspergillus niger</i> by fermentative method.	Experiment 8

**IFTM University, Moradabad**  
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**BMB-651: Dairy Microbiology Lab**

<b>1.</b>	Introduction of Laboratory Practices	
<b>2.</b>	Safety Measures	
<b>3.</b>	Do and Don't	
<b>4.</b>	About Equipments and Accessories: Principle and Working	
<b>5.</b>	To check the quality of the given milk sample based on the difference in the microbial load milk sample provided.	Experiment 1
<b>6.</b>	To perform cheese preparation.	Experiment 2
<b>7.</b>	To produce yoghurt from milk	Experiment 3
<b>8.</b>	To demonstrate the use of rennet in casein coagulation in different pH conditions.	Experiment 4
<b>9.</b>	To produce lactic acid from whey.	Experiment 5
<b>10.</b>	To prepare and sterilize the nutrient broth media.	Experiment 6
<b>11.</b>	To prepare and sterilize the nutrient agar media (NAM) and to prepare nutrient agar slants.	Experiment 7
<b>12.</b>	To isolate and enumerate microorganisms from whey sample by spread and streak plate methods.	Experiment 8