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

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

Study & Evaluation Scheme of
Bachelor of Science (Biotechnology)
Session 2021-22

Programme:	Bachelor of Science (Biotechnology)
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:

- Pursue for higher education i.e. M.Sc. in the different fields of life science.
- Hold research skills for R&D as well as quality control jobs in pharmaceutical, fermentation and allied areas of biotechnology.
- Recognize the influence of biotechnological innovations on environment, health sector, agriculture, etc.
- Work exclusively as well as in group to survive in multidisciplinary environment.
- Hands on technical and experimental skills to starts up in allied area of biotechnology.

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
									End Sem Exam		
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
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
PRACTICALS / PROJECT											
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
		Total Credit	15	5	4			310	490	800	**23**

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: (10 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 II: (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: (6 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, 8th Edition. Benjamin Cummings.2012.
4. Freeman & Herron. Evolutionary Analysis, 3rd 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

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(Effective from 2021-22)

PSD-101: PROFESSIONAL SKILL DEVELOPMENT-I

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
- www.englishgrammar.org
- www.usingenglish.com
- www.grammarly.com

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(Effective from 2021-22)

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
- onlinecourses.nptel.ac.in
- https://www.geeksforgeeks.org/
- https://www.tutorialspoint.com/computer_fundamentals/index.htm

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(Effective from 2021-22)

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, clatherates, 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 1º, 2 º and 3 º 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. $KMnO_4$, acidic dichromate, conc. HNO_3). 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 alcohole, 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.cleariitmedical.com/
  https://www.cliffsnotes.com/study-guides/chemistry/

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

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
									End Sem Exam		
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
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
PRACTICALS / PROJECT											
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
		Total Credit	15	5	4			310	490	800	**23**

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

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. Dhami & Dhami, Invertebrate Zoology, 5th Edn., S. Chand Publication, 2006.
4. Dhami & Dhami, 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/

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(Effective from 2021-22)

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. 2nd edition, Palgrave Macmillan; 1973 edition, January 14, 2014.
2. Ganguli and Kar, College Botany Vol. I and II, 6th revised edition, New Central Book Agency; 1 January, 2011.
3. V. Singh, P.C. Pande& D.K. Jain. A Text Book of Botany, 4th edition, Rastogi Publication, 2008-2009.
4. N.S. Subrahmanyam, Modern Plant Taxonomy,1st 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, 2nd edition, Affiated East-west press Pvt Ltd, 1999.

Website Sources:

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

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. Subramaniyam; 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

Website Sources:

- 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-andengineering/environmental-science-and-sustainability
- https://nptel.ac.in/course.html

IFTM University, Moradabad
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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

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 *Euglena, Paramecium, Vorticella, Trypnosoma & Noctiluca*	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 *Prawn* & *Scoliodon*	Experiment 5
10.	Identification and study of Cyanobacteria-*Nostoc*.	Experiment 6
11.	Identification and study of some algal forms: *Chlamydomonas*, *Volvox*	Experiment 7
12.	Identification and study of fungi-*Rhizopus, Agaricus*	Experiment 8
13.	Cut the T.S of given plant material (*Riccia/Marchantia, Marselia/Selaginella, Cycas/ Pinus*) 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

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BSB-254 Introduction to Microbiology

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Microbiology Good Laboratory Practices and Biosafety.	Experiment 1
6.	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
7.	Preparation of culture media (Nutrient Broth and Nutrient Agar) for bacterial cultivation.	Experiment 3
8.	Sterilization of medium and Glass ware using Autoclave and Hot Air Oven and assessment for sterility.	Experiment 4
9.	Sampling and quantification of microorganisms in air, soil and water	Experiment 5
10.	Isolation of bacteria [Streak plate, spread plate, pour plate, serial dilution].	Experiment 6
11.	Identification of microorganisms from the habitats [simple staining, differential staining, acid fast staining, capsule staining, spore staining and motility].	Experiment 7
12.	Observation of morphology - shape and arrangement of cells bacteria, phytoplanktons & zooplanktons.	Experiment 8

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

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
									End Sem Exam		
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
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-303	Plant Physiology	3	1	0	20	10	30	70	100	4
4.	BSB-304	Basics of Immunology	3	1	0	20	10	30	70	100	4
5.	BSB-306	Genetics	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
PRACTICALS / PROJECT											
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
		Total Credit	**18**	**5**	**4**			**310**	**490**	**800**	**23**

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

IFTM University, Moradabad
Bachelor of Sciences (B.Sc.), Programme
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(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
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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 Enymology, 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. Tymoczo & 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

IFTM University, Moradabad
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(Effective from 2021-22)

BSB-303: PLANT PHYSIOLOGY

Objective(s): The objectives of this course:

- Will primarily enable the student to learn about with the life processes of plants and how actually metabolic processes occur inside them.
- Is to make students aware and develops interest to work on plants having medicinal properties or plants producing secondary metabolites.

UNIT I: **(8 Sessions)**

Photosynthesis in plants: Role of photosynthesis pigments, PS II and PS I complex and mechanism of photosynthetic electron transport.

UNIT II: **(8 Sessions)**

Vascular Tissue: Role of xylem and phloem, Movement of water in plants in relation to water potential, pressure potential and metric potential, guttation, transpiration, physiology of stomatal opening and closing.

UNIT III: **(8 Sessions)**

Plant Hormones: Plant growth regulators, distribution and their metabolism, mechanism of action of plant growth regulators, role of major plant growth regulators in various plant developmental processes.

UNIT I: **(8 Sessions)**

Photophosphorylation: Mechanism of carbon dioxide fixation in C3, C4 and CAM plants, Photorespiration.

UNIT I: **(8 Sessions)**

Photomorphogenesis: Role of phytochrome, cytochrome and phototropin, mechanism of photomorphogenesis photoperiodism, biological clock, vernalization. Dormancy: seed dormancy and bud dormancy, significance.

Course Outcomes:

Students completing this course will be able to:

- Understand that how to biological system works together to sustain all forms of life on this planet.
- Role of plant hormones and how it can be used in practical works.
- Mechanism of how plants have evolved to adapt to the existing environment.
- Students can do further studies in plant molecular biology or plant tissue culture laboratory in future.
- Students can also develop their own farms work as an entrepreneur after having proper knowledge of any specific plant in particular.

Suggested Readings:

1. F. B. Salisbury, C. W. Ross. & V. G. Velázquez, Plant physiology, 4th Edn, Wadsworth Pub. Co., 1992.
2. T. Lincoln & Z. Eduardo, Plant Physiology, 5th Edn, Sinauer Associate Inc, 2010.
3. H. S. Srivastava, Plant Physiology Biochemistry and Biotechnology, 1st Edn,, Rastogi Publication, 2005.
4. S.C. Bhatle & M. A. Lal, Plant Physiology, Development and Metabolism, Springer Singapore, 2018.

Website Sources:

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

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); Hematopoesis; 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, 12th 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
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(Effective from 2021-22)

BSB-306: GENETICS

Objective: The objectives of this course:

- Is to cover the basics of hereditary.
- To concentrate on two areas of genetics: Mendelian (or transmission) genetics and population/evolutionary genetics.
- To tell that how the genetic material replicates and is passed on, contains information that results in a phenotype, and can change.
- to discuss recent discoveries as well as historical concepts.

UNIT I: **(8 Sessions)**

Introduction to Genetics: Historical perspective and theories (Preformationism, Epigenesis, Pangenesis, Hybrid Experiments); Chromosomes- Polytene, Lampbrush & DNA in Chromosomes; Significance of DNA- Griffith, Harsh & Chase, Avery Macleod and Macarty's Experiments.

UNIT II: **(8 Sessions)**

Mendelian Principles: Mendel's Experiment and terminologies; Law of Segregation; Law of Independent assortment, Segregation-Assortment of Haploids; Punnet Square; Tetrad analysis; Incomplete, Over and Co-dominance, Multiple allelism (ABO blood group); Gene interaction and lethality.

UNIT III: **(8 Sessions)**

Arrangement of genetic material: Sex linkage and maternal effect of cytoplasmic hereditary; Linkage and recombination; Bacterial transformation, transduction and conjugation.

UNIT IV: **(8 Sessions)**

Chromosomal aberrations: Euploidy, polyploidy, aneuploidy; Sex chromosomes number; barr bodies, heterochromatin, trisomy of 21st chromosome and related syndromes; Structural variations- duplication, inversion, breakage; Mutation and repair.

UNIT V: **(8 Sessions)**

Population genetics: Gene frequencies; Gene pool; Population equilibrium; Selection and fitness; Genetic drift and shift; Inbreeding and heterosis- Types and theories.

Course outcomes:

Students completing this course will be able to:

- Explain the nature of inheritance, the genetic material and how it results in phenotype, variation in genetics, and relationship between these concepts.
- Use the concepts of Classical, Molecular and Population genetics to analyze data and solve novel genetics problems.
- Design and carryout genetics experiments, and participate in the generation and evaluation of genetic knowledge.

Suggested Readings:

1. Genetics – Classical to modern, 1st Edition. P.K. Gupta. 2013.
2. Principles of Genetics, 7th Edition, Robert H. Tamarin. 2002. Tata- Mc Graw Hill publications.
3. Theory and Problems of Genetics. W. D. Stansfield. 2002. Mc Graw Hill publications.
4. Genetic Maps, 6th edition by O'Brien, S (1993) Book
5. Genetics, 2nd Edition, by Weaver, R.F. and Hendrick, P.W. (1992). W.C. Brown.
6. Instant notes in Genetics by P.C.Winter, G.I. Hickey and H.L.Fletcher (2003) Viva Books Pvt.Ltd.
7. Principles of Genetics by E.J.Gardener, M.J.Simmons and D.P.Snustad.J.Wiley and Sons pubs (1998).

Website Sources:

- https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/
- https://www.edx.org/learn/genetics
- https://unlockinglifescode.org/node/976
- https://serc.carleton.edu/introgeo/interactive/examples/14297.html
- https://educationaladvancement.org/blog-introduction-to-mendelian-genetics/
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists/19

IFTM University, Moradabad
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(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, IIAS 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
- http://www.ifrc.org/en/what-we-do/disaster-management
- http://www.wcpt.org/disaster-management/what-is-disaster-management
- 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

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Introduction to Enzymology Laboratory.	Experiment 1
6.	Extraction of enzyme from plant source.	Experiment 2
7.	To determine the effect of temperature on the rate of enzyme action.	Experiment 3
8.	To determine the effect of pH on the rate of enzyme action.	Experiment 4
9.	To determine the effect of substrate concentration on the rate of enzyme action.	Experiment 5
10.	To determine the effect of enzyme concentration on the rate of enzyme action.	Experiment 6
11.	Extraction of pure amylase enzyme and its mode of action on substrate (starch).	Experiment 7
12.	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.	*In vitro* 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. BIOTECHNOLOGY
Fourth 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			
THEORY											
1.	BSB-401	Introductory Bioinformatics	3	1	0	20	10	30	70	100	4
2.	BSB-404	Industrial Biotechnology	3	1	0	20	10	30	70	100	4
3.	BSB-405	Biochemistry and Metabolism	3	1	0	20	10	30	70	100	4
4.	BSB-406	Cell & Molecular biology	3	1	0	20	10	30	70	100	4
5.	BMA-409	Introductory Biostatistics	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
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
		Total Credit	**15**	**5**	**4**			**310**	**490**	**800**	**23**

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-404: INDUSTRIAL BIOTECHNOLOGY

Objective(s): The objectives of this course:

- To understand the use of living cells such as bacteria, yeast, algae or component of cells like enzymes, plants and animals to generate industrial products and processes.
- To study techniques for genetic improvement of micro-organisms to improve yield of byproducts.

UNIT I: **(8 Sessions)**

Introduction to Industrial Biotechnology: Brief history, developments and application of Industrial Biotechnology; Techniques of microbial culture, growth media, sources of nutrition.

UNIT II: **(8 Sessions)**

Strain improvement and preservation: Mutation; Protoplast fusion; Genetic engineering techniques; Preservation of cultures-storage on agar slants, soil culture; maintenance of microbial culture and strain preservation- Lyophilization; Cryopreservation- Storage in liquid nitrogen.

UNIT III: **(8 Sessions)**

Fermentation: Fermenter and its component- baffle, impeller and sparger; Type of fermenter- aerated and agitated fermenter; Types of fermentation process- Solid state fermentation, Suspension fermentation.

UNIT IV: **(8 Sessions)**

General concept of recovery: Recovery process-biomass separation, centrifugation, cell disruption, liquid-liquid extraction.

UNIT V: **(8 Sessions)**

Microbial production of industrial products: Production of organic acids (Citric and lactic acid), Amino Acids (Glutamic acid), Ethanol and Penicillin G.

Course Outcomes:

Students completing this course will be able to:

- Develop key practical skills in fermentation biotechnology and better understanding of operations and commercial opportunities in fermentation-based biotechnology
- Increase their understanding that 'industrial biotechnology' is based on using machines to control the growth of microorganisms.
- Develop knowledge of a variety of fermentation strategies
- Analyse potential business opportunities in fermentation-based biotechnology

Suggested Readings:

1. M. M. Young, Comprehensive Biotechnology, 3rd Edn., Elsevier Science, 2019.
2. D. B. Wilson, H. Sahm, K. P. Stahmann, M. Koffas, Industrial Microbiology, Wiley Publication, 2019.
3. G. Reed, S. C. Prescott, C. Gordon, D. Prescott, Dunn's Industrial Microbiology, 4th Edn., CBS Publishers & Distributors, 2006.

Website Sources:

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

- https://www.edx.org/
- https://www.coursera.org/

IFTM University, Moradabad
Bachelor of Sciences (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 carbonhydrate 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 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 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: (5 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: (5 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: (12 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 students 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
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- 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 *E.coli.* cells	Experiment No 10

IFTM UNIVERSITY, MORADABAD
COURSE STRUCTURE
B.SC. BIOTECHNOLOGY
(Effective from 2021-22)
Fifth Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
									End Sem Exam		
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
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-504	Food Biotechnology	3	1	0	20	10	30	70	100	4
4.	BSB-505	Animal Biotechnology	3	1	0	20	10	30	70	100	4
5.	BSB-506	Recombinant DNA Technology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	BSB-551	Bioprocess	0	0	2	20	10	30	70	100	1
7.	BSB-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
		Total Credit	**15**	**5**	**4**			**380**	**420**	**800**	**23**

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, Lexix 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_{90}.

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
Bachelors of Science (B.Sc.), Programme
B.Sc. Biotechnology III Year (V Semester)
(Effective from 2021-22)

BSB–504: FOOD BIOTECHNOLOGY

Objective(s): The objectives of this course:

- To deals with the techniques involved in production, processing, preservation, packaging, labeling, quality management, and distribution of food products.
- Involving techniques and processes that are used to transform raw materials into food with good nutritive value.

UNIT I: **(8 Sessions)**

Introduction to food biotechnology: Historical development; intrinsic and extrinsic parameters of food that affect microbial growth; emerging trends- genetically modified foods, biofortification.

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

Food Fermentation: Production of culture for food fermentation, Production process - beer, bread, wine, vinegar, fermented vegetables pickles, sauerkraut, dairy products (cheese), tea, coffee, cacao, oriental fermented foods, soy sauce, tofu, idli.

UNIT IV: **(8 Sessions)**

Food Additives: Introduction, need of food additives in food processing, characteristics and classification of food additives -Sweetners, Colouring agents, Preservatives, Flavoring agents, Emulsifiers.

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:

- Understand the basic characteristics of microbes that are important in food industry and methods that are employed for the preservation of food.
- Understand basics of production of several industrially important fermented products like wine, cheese and vinegar.

Suggested Readings:

1. W. S. Frazier & D. C. Westhoff, Food Microbiology, 4th Edn., Tata McGraw Hill Publications, 1988.
2. N.A. M. Eskin, Biochemistry of Foods, 3rd Edn., Academic Press, 2008.
3. S. Damodaran, K. L. Parkin, & O. R. Fennema, Fennema's Food Chemistry, 4th Edn., CRC Press, 2007.
4. D. G. Rao, Fundamentals of Food Engineering, PHI Learning Private Limited, 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. Biotechnology III Year (V Semester)
(Effective from 2021-22)

BSB-505: ANIMAL BIOTECHNOLOGY

Objective: The main objective of the course:

- To make learner introduce with basic principles of animal biotechnology, in which molecular biology techniques are used to genetically engineer (i.e. modify the genome of) animals in order to improve their suitability for pharmaceutical, agricultural or industrial applications.

UNIT I: **(8 Sessions)**

Historical perspectives: Early experiments and scope of Animal Tissue Culture; Requirements for Animal Cell Culture; Media-Natural, Semi-synthetic and Synthetic; Role of ingredients in Animal Culture Media

UNIT II: **(8 Sessions)**

Basic Techniques of Mammalian Cell Culture: Disaggregation of animal tissue; Primary culture; Evolution of cell line; Organ culture; Stem Cell Culture; Embryo culture; Embryonic stem cells and their application; Maintenance of cell culture.

UNIT III: **(8 Sessions)**

Therapeutic Technology: Hybridoma Technology; Production of vaccines; Interferons; Baculoviruses as animal viral vectors; Hormones in ATC; Gene therapy; Ethical values in Animal Biotechnology.

UNIT IV: **(8 Sessions)**

Transgenic: Cloning; Gene transfer to animals-chemical and physical transfection techniques, transgenic animals-Sheep, goat, cow, fishes; Animal breeding; *In vitro* fertilization- Embryo transfer; ICSI; Embryo splitting.

UNIT V: **(8 Sessions)**

Applied and Economic Zoology: Sericulture; Commercial production of silk; Silkworm as bioreactor; Aquaculture; Apiculture.

Course Outcomes:

Students completing this course will be able to:

- Describe the limitations and challenges facing the animal industries and disciplines.
- Be able to describe gene transfer technologies for animals and animal cell lines.
- Be able to describe techniques and problems both technical and ethical in animal cloning.
- Know the valuable genes in animals

Suggested Readings:

1. R. I. Whitney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edn., Wiley Blackwell, 2015.
2. A. Puhler, Genetic Engineering of Animal, VCH Publishers: Weinheim New York Basel Cambridge, 1993.
3. M.M. Ranga, Animal Biotechnology, Agrobios India Publishers, 2007.
4. R. Sasidhara, Animal Biotechnology, MJP Publishers, 2019.
5. U. Satyanarayana, Biotechnology, Books and Allied (P) Ltd, 2013.
6. P. K. Gupta, Elements of Biotechnology, Rastogi publications, 2010.

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

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

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

BSB-551: BIOPROCESS

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 *Sacchromyces cerevisae* 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. BIOTECHNOLOGY
(Effective from 2021-22)

Sixth Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
									End Sem Exam		
			L	T	P	Mid Sem Exam	AS +AT	Total			
THEORY											
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.	BSB-603	Immunoinformatics	3	1	0	20	10	30	70	100	4
4.	BSB-604	Fundamentals of Proteomics and Genomics	3	1	0	20	10	30	70	100	4
5.	BSB-605-607	Departmental Elective	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	BSB-651	Fermentation Technology	0	0	2	20	10	30	70	100	1
7.	BSB-652	Proteomics and Immunoinformatics	0	0	2	20	10	30	70	100	1
8.	GP-501	General Proficiency	0	0	0	0	0	100	-	100	1
		Total Credit	**15**	**5**	**4**			**310**	**490**	**800**	**23**

IFTM UNIVERSITY, MORADABAD
B. Sc. Biotechnology
Course Structure
(Effective from 2021-22)

Sixth Semester

LIST OF DEPARTMENT ELECTIVES		
S. No.	**Course Code**	**Course Name**
1	BSB-605/606/607	Biomedical Instrumentation/ Plant Tissue Culture/ Developmental Biology

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: **(10 Sessions)**

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

UNIT III: **(10 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.

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- 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. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

BSB 603: IMMUNOINFORMATICS

Objective: The main objective of this course:

- Provides fundamental knowledge on immunology and immunoinformatics along with its recent advances and emerging research in complex biological systems and enable students to acquire skills for *insilico* immunological studies.

UNIT I: **(8 Sessions)**

Immunoglobulins (Ig): Fine structure of Ig- Variable-Region and Constant- Region, Domains, Antigenic determinants on Immunoglobulins, Epitopes, Properties of Epitopes, Membrane receptors for antigen- B cell surface receptor for antigen (BCR), The T cell surface receptor for antigen (TCR)

UNIT II: **(8 Sessions)**

Immunoglobulin gene: Multigene Organization of Ig Genes, Variable-Region Gene Rearrangement (V-J Rearrangement in Light chain and V-D-J Rearrangements in Heavy chain DNA), Allelic exclusion, Generation of Antibody Diversity, Antibody engineering-hybrid monoclonal antibodies, Major histocompatibility complex (MHC).

UNIT III: **(8 Sessions)**

Immunoinformatics and its tools: Introduction to immunoinformatics, Tools and databases- BIMAS, SVMHC, ProPed, B-cell epitope database, T-cell epitope database.

UNIT IV: **(8 Sessions)**

Vaccine design: Introduction to vaccine design, categories of vaccines, traditional methods of vaccine production- DPT and rabies vaccine; products of modern vaccines e.g.- Hepatitis vaccine; Reverse Vaccinology.

UNIT V: **(8 Sessions)**

Structure Activity Relationship: QSAR- Methodology, Various Descriptors used in QSAR-Electronics, Topological, Quantum Chemical based Descriptors.

Course Outcomes:

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

- Understand the various concepts of immunology like immunity and its types
- Determine the structure of immunoglobulins and the biological role of various antibodies.
- Explore the various pathways of antigen processing, types of antigens and their properties.
- Understand the levels of structural organization of macromolecules and experimental methods of structure determination.
- Know the approaches for structure analysis.
- Acquire knowledge of various algorithms & methods of structure prediction.
- Understand the principles of macromolecular interaction and database of MHC binding and non-binding peptides, T-cell epitope databases, B-cell epitope databases. SYFPEITHI MHC presented epitopes.

Suggested Readings:

1. T. J. Kindt, B. A. Osborne, R. A. Goldsby, Kuby, Immunology, 6th Edn., W. H. Freeman & Co., 2007
2. O. Lund, M. Nielsen, C. Lundegaard, C. Kesmir, & S. Brnak, Immunological Bioinformatics, MIT Press, USA, 2005.
3. G. R. Bock, J. A. Goode, Immunoinformatics Bioinformatic Strategies for Better Understanding of Immune Function, 1st Edn., 2003.
4. P. J. Delves, S. J. Martine, D. R. Burton, I. M. Roitt, Roitt's Immunology, 12th Edn. Wiley-Blackwell, 2011.

5. A. K. Chakravarty. Immunology and Immunotechnology, 1st Edn., Oxford University Press, 2006.

Website Sources:

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2967261/
- https://www.hindawi.com/journals/jir/2018/6718083/
- https://www.limswiki.org/index.php/Immunoinformatics
- https://link.springer.com/protocol/10.1007/978-1-0716-0389-5_6

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

BSB-604: FUNDAMENTALS OF PROTEOMICS AND GENOMICS

Objective(s): The objectives of this course:

- Is to acquaint learner with modern techniques of protein biochemistry, bioinformatics, proteomics, and functional genomics.
- Will include a discussion of basic concepts of protein structure and function, protein characterization and purification, various techniques of functional and structural genomics and organization and structure of genomes.

UNIT I: **(8 Sessions)**

Organization and Structure of Genomes: In prokaryotes and eukaryotes: chloroplast, mitochondrial and nuclear genomes. Tandem repeated sequences: minisatellites and microsatellites, Retrotransposons: LTR and Non- LTR

UNIT II: **(8 Sessions)**

Gene Mapping: RFLPs, Sequence tags, SNPs, AFLPs; Sequencing Genomes: High-throughput sequencing, Shotgun sequencing and sequence assembly tools.

UNIT III: **(8 Sessions)**

Comparative Genomics: Orthologs and paralogs in gene evolution, Identification of genes and regulatory elements, Generation of new gene structure, Genome resources on web, Human Genome Project.

UNIT IV: **(8 Sessions)**

Expression Analysis and Characterization of Proteins: Yeast two hybrid system, Surface plasmon resonance (SPR), Luciferase assay, 2D electrophoresis, MALDI-TOF.

UNIT V: **(8 Sessions)**

Analysis of Protein Structures: Protein structure databases (PDB, MMDB) and structure visualization tools (Cn3D, Kinemage, CHIME), protein classification approaches (SCOP, CATH).

Course Outcomes:

Students completing this course will be able to:

- Have an understanding of concepts such as gene regulation, gene networks, proteomics, transcriptomics, metabolomics, and their relationships.
- Describe advanced genomics and proteomics technologies and the ways in which their data are stored
- Know the role of bio-informatics analyses.
- Know the principles of several important analytical methods that are relevant to a functional genomics approach.

Suggested Readings:

1. S.B. Primrose, R.Twyman. Principles of Gene Manipulation and Genomics, Wiley-Blackwell, 2013.
2. J. Pevsner. Bioinformatics and Functional Genomics, 3rd Edn., Wiley-Blackwell, 2015.
3. D. W. Mount. Bioinformatics: Sequence and Genome Analysis, 2nd Edn., University of Arizona, Tucson, 2004.
4. D. L. Nelson, A. L. Lehninger, M. M. Cox, Lehninger Principles of Biochemistry, 8th Edn., W. H. Freeman, 2017.
5. Z. Ghoshm B. Mallick. Bioinformatics: Principles and Applications, Oxford University Press, 2012.
6. S. C. Rastogi, Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery, 3rd Edn., PHI Learning Pvt. Ltd., 2013.

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

BSB-605: BIOMEDICAL INSTRUMENTATION

Objective: The main objective of this course:

- Is to introduce the student to basic concept of biomedical instruments and their use in measurement of different parameters in biosystems and related constraints.

UNIT I: **(8 Sessions)**

Bio Potential Generation and Electrodes Types: Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes

UNIT II: **(8 Sessions)**

Bio-signal Characteristics and Electrode Configurations: Bio-signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT III: **(8 Sessions)**

Signal Conditioning Circuits: Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering.

UNIT IV: **(8 Sessions)**

Measurement of non-electrical parameters: Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT V: **(8 Sessions)**

Medical Imaging Monitoring Equipment: Arrhythmia Monitor, Foetal Monitor, and Incubator: X-ray machine, Computed Tomography (CT), Ultrasound Imaging system.

Course Outcomes:

Students completing this course will be able to:

- Differentiate and analyse the biomedical signal sources.
- Elucidate cardiovascular system and related measurements.
- Explain the respiratory and nervous systems and related measurements measure non-invasive diagnostic parameters.

Suggested Readings:

1. L. Cromwell, F. J. Weibell, E. A. Pfeiffer. Biomedical Instrumentation and Measurement, Prentice Hall of India, 2001
2. R. B. Northrop. Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation, 2nd Edn., CRC Press, 2012.
3. C. D. Ferris. Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Application, Humana Press, 2013.
4. R. Singh. Biomedical Instrumentation: Technology and Applications, Blacklick, Ohio, U.S.A.: McGraw-Hill, 2004.

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- https://library.nitrkl.ac.in/
- https://study.com/

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

BSB-606: PLANT TISSUE CULTURE

Objective: The main objective of this course:

- to give the student an overview of plant tissue culture which will make her/him appreciate the different techniques involved in the process and finally the applications of plant tissue culture for the greater goal of crop improvement.

Unit-I **(9 Sessions)**

Basics of Plant tissue culture: History of Tissue Culture technique. Requirements for a plant tissue culture lab -Laminar air flow device, Sterilisation scheme for culture chamber; Totipotency of plant cells-dedifferentiation and redifferentiation; Nutrient media: Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents, vitamins, amino acids etc.; Sterilisation of the media and appliances by autoclaving.

Unit-II: **(9 Sessions)**

Methods in Plant tissue culture: Culture of plant materials-explants selection and technique of culturing the same; Growth conditions; Methods of sub culturing and transfer of regenerated plants to the field; Micro propagation: Proliferation of axillary buds, induction of adventitious buds and bulbs, callus regeneration, somatic embryogenesis; Continuous culture, immobilized cultures, estimation of growth and artificial seeds; Biochemical and molecular basis of differentiation in plant tissue culture.

Unit-III: **(9 Sessions)**

Cloning and storage methods: Cloning- Isolation of single cells, culturing of single cell-different methods, culture cell viability test; Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture.

Unit-IV: **(9 Sessions)**

Applications in Crop improvement I: Basics of plant breeding. Scope and application of plant tissue culture in agriculture; Crop improvement by induced in vitromutations. physical and chemical mutagents. Advantages and limitations; Methods for production of haploids and development of homozygous lines, Gametoclonal variations, analytical breeding; Protoplast culture and regeneration of plants, isolation, merits and demerits. Somaclonal variations, isolation of somaclonal variants. Molecular basis of somaclonal variation; Seaweed tissue culture -callus induction and plantlet regeneration, protoplast culture and somatic hybridisation.

Unit-V: **(9 Sessions)**

Applications in Crop improvement II: In vitro breeding- Overcoming pre-fertilisation and post-fertilisation crossing barriers in plant breeding. In vitro pollination, mentor pollen technique, Endosperm culture for polyploidy breeding, Embryo rescue. Advantages and limitations- Production of virus free plants-shoot meristem culture. Thermotherapy, cryotherapy and chemotherapy. Virus indexing. Maintenance of virus free stocks. Applications and limitations. Significance of in vitropropagation techniques in developing transgenic crops.

Course Outcomes:

Students completing this course will be able to:

- Understand and explain the concept of genetic Understand basics of plant tissue culture and application of plant tissue culture in crop improvement.
- Understand Basic Knowledge of genetic engineering of plants using several genetic engineering tools.
- Ethics and government regulations that are there for the safe introduction of GMOs.

Suggested Readings:

1. Hammond, John, Peter McGarvey, and Vidadi Yusibov, eds. Plant biotechnology: new products and applications. Vol. 240. Springer Science & Business Media, 2012.
2. Stewart Jr, C. Neal, ed. Plant biotechnology and genetics: principles, techniques and applications. John Wiley & Sons, 2012.
3. Bhojwani, Sant Saran, and Maharaj K. Razdan. Plant tissue culture: theory and practice. Vol. 5. Elsevier, 1986.
4. HS Chawla. Introduction to plant biotechnology. Science Publishers, 2002.

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

BSB-607: DEVELOPMENTAL BIOLOGY

Objective: The main objective of this course:

- Is to introduce the student to the principles behind how a single cell becomes a multicellular organism with specialized tissues and organs.

UNIT I: **(8 Sessions)**

Basic concepts of development: Stages of development- zygote, blastula, gastrula, morula: cell fate & commitment – potency, concept of embryonic stem cells, differential gene expression, terminal differentiation, lineages of three germ layers, fate maps; Mechanisms of differentiation-cytoplasmic determinants, embryonic induction, concept of morphogenesis, mosaic and regulative development.

UNIT II: **(8 Sessions)**

Germ cell specification& migration: Pattern formation- axis specification, positional identification (regional specification): Morphogenetic movements; Model organisms in Developmental biology.

UNIT III: **(8 Sessions)**

Early Development in invertebrate/vertebrate models: *Drosophila, C. elegans, Xenopus*, human- Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates.

UNIT IV: **(8 Sessions)**

Late Development in invertebrate /vertebrate models: Organogenesis- development of central nervous system in vertebrates; vulva formation in *C.elegans*.

UNIT V: **(8 Sessions)**

Medical implications of developmental biology: Genetic errors; teratogenesis; stem cell therapy- embryonic and adult stem cells, regeneration and aging.

Course Outcomes:

Students completing this course will be able to:

- Ask the key questions in development
- Understands how cells communicate in promoting the development of a multicellular organism.
- Know the body plan of a multicellular organism is patterned to give rise to specialized tissues and organs.
- Appreciate the conservation of the molecular and cellular principles across different species
- How the external environment can influence the developmental process.

Suggested Readings:

1. Grubb, Brenda Judge. "Developmental Biology, Scott F. Gilbert, editor. (2006).
2. Essential Developmental Biology by Jonathan Slack 3rd Edition, Willy Publications
3. Developmental Biology by Werner A Muller 2012 Eition, Springer.
4. Principles of Development by Lewis Wolpert 6th Edition,
5. Developmental Biology by M Subramanian 2019 Edition, MJP Publishers.

Website Sources:

- https://people.ucalgary.ca/~browder/virtualembryo/learning.html
- https://thenode.biologists.com/teaching-resources/
- https://onlinecourses.nptel.ac.in/noc20_bt35/preview
- https://onlinecourses.nptel.ac.in/noc20_bt35/preview

IFTM University, Moradabad
Bachelor of Sciences, Programme
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(Effective from 2021-22)

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 *Saccharomyces cerevisiae.*	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 *Aspergillus niger.*	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 *Aspergillus niger* by fermentative method.	Experiment 8

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

BSB-652: Proteomics and Immunoinformatics

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To estimate given amount of protein by Folin-Lowry method.	Experiment 1
6.	To estimate the protein content in the given sample by Biurret methods.	Experiment 2
7.	Identification of amino acids in a given solution sample by ascending paper chromatography.	Experiment 3
8.	To separate & identify lipid by Thin Layer Chromatography.	Experiment 4
9.	To learn technique SDS-PAGE and to separate protein according to their molecular size.	Experiment 5
10.	To predict the secondary structure of a protein using the Chou-Fasman method.	Experiment 6
11.	To identify the 10- homologues sequences of P68871 of various origins. Find the conserved region existing between them comment on the same.	Experiment 7