HSNC University Mumbai

Ordinances and Regulations
With Respect to
Choice Based Credit System
(CBCS)
For the Programmes Under
The Faculty of Science and Technology HSNC University Mumbai
Ordinances and Regulations

With Respect to
Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Biotechnology

Curriculum – First Year Undergraduate

Programmes Semester-I and Semester -II

2023-24 (As per NEP 2020)

HSNC UNIVERSITY, MUMBAI

Board of Faculty of Science & Technology

Board of Studies in Biotechnology Subject

1.) Name of Chairperson/Cochairperson/Coordinator:

Dr. Pratibha Shah
Associate Professor,
Department of Microbiology,
K. C college
HSNC University
Churchgate, Mumbai –400 020
Email ID- pratibha.shah@kccollege.edu.in

2.) Two to five teachers each having minimum five years teaching experience amongst the full time teachers of the Departments, in the relevant subject.

a.)Dr. Sejal Rathod
Associate Professor and Course co-ordinator- Biotechnology,
K. C college
HSNC University
Churchgate, Mumbai –400 020.
Email ID- sejal.rathod@kccollege.edu.in

b.) Mr. Karun Sodah
Assistant Professor,
Head of the Department
Department of Chemistry,
HSNC University
Churchgate, Mumbai –400 020
Email ID- karun.sodah@kccollege.edu.in

c.) Dr. Suvarna Sharma,
Assistant Professor
Department of Life Science
K C College
HSNC University

Mumbai-40002
Email ID: suvarna.sharma@kccollege.edu.in

d.) Mrs. Rajitha Satish
Assistant Professor,
Department of Microbiology,
HSNC University
Churchgate, Mumbai –400 020
Email ID- rajitha.satish@kccollege.edu.in

e.) Mrs. Amina Dholkawala
Assistant Professor,
Department of Microbiology,
HSNC University
Churchgate, Mumbai –400 020
Email ID- amina.dholkawala@kccollege.edu.in

f.) Ms. Chinmayee Mahadik
Assistant Professor,
Department of Biotechnology,
HSNC University
Churchgate, Mumbai –400 020
Email ID- Chinmayee.mahadik@kccollege.edu.in

3.) **One Professor / Associate Professor from other Universities or professor / Associate Professor from colleges managed by Parent Body; nominated by Parent Body; -**
a.) **Dr. Tara Menon**
Co-ordinator,
Department of Biotechnology
S.I.E.S. College
Mumbai- 400 022
Email ID- taram@sies.edu.in

b.) **Mr. Chetan Ramesh Patil**
Co-ordinator,
Department of Biotechnology
R D National College
Mumbai- 400050
Email ID – chetanrpatil86@gmail.com

4.) Four external experts from Industry / Research / eminent scholar in the field relevant to the subject nominated by the Parent Body;

a.) Dr. Jayagouri Shastri (Eminent Scholar)
Former Co-ordinator,
Department of Biotechnology,
Former-HOD, Department of Microbiology,
K.C. College,
Mumbai- 400020
Email ID – jaya2016@gmail.com

b.) Dr. Anu Ghosh (Eminent Scholar)
Scientific Officer 'G',
BARC,
Mumbai-42130
Email ID – anug.barc@gmail.com

c.) Mr. Ali Asgar Dholkawala (Industry Expert)
Senior Manager Legal,
Novi Digital Entertainment Private Limited
Mumbai- 400013
Email ID – aliasgar.dholkawala@gmail.com

d.)Dr. Sukendu Ghosh (Research and Industry Expert)
Scientific Officer 'G',
BARC,
Mumbai-421306
Email ID – sbghosh11@yahoo.co.in

5) Two Former Students

a.) Mr. Shubankar Dubey (undergraduate student 18-19)
Email Id-dubeshubhankar@gmail.com

b.) Ms. Shreshtha Shah (undergraduate student16-17)
Email ID-shreshthashah97@gmail.com

Signature
Dr. Pratibha Shah
BOS chairperson
Biotechnology

Part 1- Preamble

The current "Age of Biotechnology" is being experienced and benefited by the entire planet. One of the more recent subfields of the life sciences, which have grown and developed as a multidisciplinary applied science in the last few years, is biotechnology. At its core, biotechnology envisions an extensive examination of the components of life, and this has led to a novel status for biotechnology in both science and industry.

The financial viability of biotechnology is established and has almost come to be equated with contemporary advancement. Biotechnology is used in practically every industry that touches on human activity. Applied biotechnology is now being researched for use in industry, agriculture, health care, and the environment.For the Industrial and Research divisions of biotechnology, well-educated and professionally competent experts are needed. Because the field is new, all fields are asked to contribute to infrastructure and technology. The importance of inventions that can make life easier is currently spreading around the globe. The world's technologies and human perspective are destined to undergo a paradigm shift brought on by biotechnology.

In the area of fundamental research and industry, there is a growing need for experts who are knowledgeable in biotechnology. To support the Biotechnology Revolution, the academic and research sectors also need transdisciplinary trained workers.

Establishing a prospectus that adapts to new environments and innovation while putting an emphasis on applications and outlining innovation from top to bottom is crucial. The current curriculum was created with an eye on the needs of the biotechnology industry and a stronger emphasis on developing practical skills. The main focus is on perfecting the timetable through advancements in the academic, scientific, and business sectors. The newly designed theory and practical course will inspire a variety of skills to progress the biotechnology sector.

NEP 2020 has been introduced to foster a scientific mindset and encourage an inclusive approach to education.

The ultimate goal of education is to create exceptional individuals who can think critically and take appropriate action. They should also be brave and resilient, have a scientific mindset, a creative imagination, and strong ethical foundations and values. Our Constitution aims to produce engaged, effective, and contributing citizens in order to build the equitable, inclusive, and pluralistic society it envisions.

By developing an education system anchored in Indian culture that directly helps to transforming India, or Bharat, sustainably into an equal and vibrant knowledge society, this National Education Strategy 2020 seeks to make India a global knowledge superpower. In accordance with the policy, our institutions' curricula and pedagogy must instill in students a deep respect for their nation, a sense of their fundamental obligations, and a cognizant awareness of their obligations in a changing world.

The new prospectus for NEP 2020 combines fundamental understanding of physics, chemistry, and biology while taking advancements in innovation into account. The educational programme

is to provide crucial information, focusing on its applications to get the students ready for business.

We have incorporated Online Courses (OLC) that are accessible on the NPTEL or SWAYAM portals under the MOOCS programme being established by MHRD in order to comply with the NEP 2020 of the Government of India. The students would develop the habit of independent study at their own speed through the online courses, and they would become accustomed to new learning technologies.

Course Objectives

Semester I

US-FBT-101 Major 1
Biotechnology: Introduction and applications
Learning Objectives:

- To study history of Biotechnology
- To understand different branches of biotechnology and their significance
- To study Ethics in Biotechnology
- To understand basics of Intellectual Property Rights

Learning Outcomes:

- The learner will understand the historical importance of traditional and modern biotechnology
- The learner will be able to comprehend the importance of biotechnology in various industries
- The learner will gain knowledge about Bioethics
- The students will be able to differentiate between copyright, trademark and trade secret.

US-FBT-102 Major 2
Fundamentals of Microbiology
Learning Objectives:

- To provide an overview of the ultra structure of cells, distinguishing between prokaryotic and eukaryotic cells.
- To explore the nutritional requirements of microorganisms and understand the different types of culture media in microbiological studies.
- To introduce the concept of sterilization and its importance in controlling microbial contamination in laboratory and industrial settings.
- To study the history of microscopy, understanding the development and significance of different types of microscopes in scientific research and observation.

Learning Outcomes:

- Students will recognize the nutritional requirements of microorganisms, enabling them to create suitable growth environments for different types of organisms.
- The students will be able to analyze growth curves and apply continuous culture techniques for various applications.
- Students will understand the principles, components, and applications of various microscopes.

US-FBT-103 - Minor 3
Bio-organic Chemistry
Learning Objectives:

- To understand different types of isomerism found in organic compounds and bio molecules.
- To classify carbohydrates based on their molecular structures and functional groups.
- To classify amino acids and understand the properties that contribute to their unique characteristics.
- To comprehend the structure, types, and functions of nucleic acids and their constituents.

Learning Outcomes:

- Learners will be able to distinguish between stereoisomers and learn their nomenclature.
- Students will learn to classify biomolecules based on their structures and functions.
- Students will be able to understand the various biochemical properties of carbohydrates, lipids, proteins and nucleic acids.

Semester II

US-FBT-201 Major 4
Molecular biology and genetic engineering M4
Learning Objectives:

- To understand the process of semi-conservative DNA replication in prokaryotic cells.
- To study various DNA repair mechanisms and the significance of DNA repair in maintaining genomic stability and preventing mutations.
- To grasp the fundamental principles of gene cloning and its significance in biotechnology and genetic engineering.

Learning Outcomes:

- Learners will be able to compare and contrast the differences in DNA replication between prokaryotes and eukaryotes.
- Students will be able to understand the significance of gene transfer mechanisms in bacterial evolution and genetic diversity.
- Students will be able to identify various types of mutations and will be able to understand their importance in genetic variation and evolution.

US-FBT-202 Major 5
Ecology, plant and animal physiology
Learning Objectives:

- To define ecosystems and identify their major components.
- To identify and explain different types of population interactions.
- To study the fundamental reactions of photosynthesis.
- To understand the physiology of digestion, respiration and circulation of humans and animal systems.

Learning Outcomes:

- Students will be able to compare and contrast aquatic and terrestrial ecosystems, recognizing their unique characteristics and ecological dynamics.
- Students will learn to interpret the various ecological pyramids.
- Learners will be able to study the energetics of photosynthesis.
- Learners will understand the structure and functioning of various organs.

US-FBT-203-Minor 6
Analytical Chemistry
Learning Objectives:

- To learn and apply the IUPAC nomenclature rules for naming organic compounds.
- To identify and explain various types of organic reactions.
- To understand the terminologies related to titration.
- To learn the principle, advantages, and disadvantages of different chromatographic technique.

Learning Outcomes:

- Students will be able to apply the IUPAC nomenclature rules to systematically name a wide range of organic compounds.
- Students will gain the ability to recognize and explain various types of organic reactions, including addition, elimination, and substitution reactions.
- Students will understand the process of gravimetry and titrimetry.
- Students will acquire an in-depth understanding of natural product chemistry along with techniques used for their separation.

1. **Process adopted for curriculum designing:**

The curriculum was designed in a stepwise manner, firstly based on feedback obtained from department teachers and students. Later several meetings were conducted with representatives from academia, industries and research institutions to assure that the syllabus is enriched in all the aspects.

2. **Salient features, how it has been made more relevant:**

While designing of the syllabus, care has been taken to balance biotechnological techniques with entrepreneurship skills .The course would help the students to develop creativity in designing products, build research skills, and provide better employment opportunities in areas like health care, agriculture, industry and environment.

3. **Course Outcomes:**

The First Year Biotechnology syllabus introduces students to the fundamentals of biotechnology, including genetic engineering, microbiology, macro nutrients, ecology, and biodiversity. It emphasizes the importance of chemistry as a foundation for biological concepts and aims to develop interdisciplinary knowledge, critical thinking, and problem-solving skills. The program also covers recent advancements in biotechnology to create social and economic impacts. Students will gain practical skills in handling equipment and conducting experiments. Additionally, courses focus on genetic manipulation, DNA, genes, biodiversity, and laboratory techniques in microbiology, enzymology, bioanalysis, and molecular biology.

4. **Input from stakeholders**

There has been shuffling and introduction of some new basic concepts at the first year due to the new education policy. Some overlapping topics from biology and chemistry are shortened, due to reduction of the paper numbers. Biotechnology will continue to be the stand alone course. The stakeholders were academic, research and industry experts from the field of biotechnology. Following suggestions were incorporated in the syllabus for Semester I and Semester II. The syllabus is designed to clear the basic fundamental knowledge in the field and similarly gain advanced knowledge in the respective topics. As suggested by the academic and research experts, the lecture load on introduction to the replication of prokaryotes and eukaryotes was trimmed and introduction to genetic mapping will be discussed. Hands- on training on restriction digestion can be done by using the DNA digestion teaching kits, so that concepts are better understood and appreciated by the students. Streamlining of organic and inorganic chemistry was needed in the minor paper. The experts advised to be brief on confocal microscopy. The experts suggested introducing all the staining techniques in Semester II, as it will complement the vocational studies in the same semester. In the Open Electives Paper 1- Genetic Engineering, reduction in the concepts of restriction enzymes was required. In the OE 2- Nutrition and Nutraceuticals, introduce the sports diet as one of the sub-topic. In OE 3- Reproductive health and genetic counseling paper, concise the portion on sex hormones and endocrinology. In OE 4- Cancer and stem cells paper, initiate the discussion on stem cells as the subtopic for the types of cells. Following suggestions were made with the aim for gaining and developing interest in the field of biotechnology.

Part-II

The Scheme of Teaching and Examination For Major and Minor Subjects

The performance of the learners shall be evaluated in two components for total 100 marks per Paper: Formative Assessment with 15% marks by way of continuous evaluation and Summative assessment by Semester End Examination with 85% marks by conducting the theory and practical examination.

Formative ASSESSMENT:- It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

A). Formative Assessment–15% of overall marks – 15 marks

The internal assessment involves a presentation on the basis of "self learning and evaluation" topics. The 20% of the lectures will be identified as "self learning and evaluation" topics in the syllabus.They shall be learnt independently by the students in a time bound manner preferably from online resources such as Swayam or NPTEL. Evaluative sessions shall be conducted by the teachers.

Distribution of Marks in Summative assessment:

Sr. No.	Particulars	Marks
1	Self-Learning Evaluation	10 Marks
2	Active participation in routine class instructional deliveries	05 Marks

B) The Summative assessment includes semester end examination and practical examination based on the theory.

A. Semester End Examination- 60 % of overall marks - 60 Marks

1) Duration – These examinations shall be of 2 Hours duration.
2) Question Paper Pattern: -

1. There shall be four questions each of 15 marks.
2. All questions shall be compulsory with internal choice within the questions.
3. The paper may be sub-divided into sub-questions a, b, c, d & e only and the allocation of marks depends on the weightage of the topic.
4. The marks of the internal assessment should not be disclosed to the students till the results of the corresponding semester is declared.

B. Practical Examination-25% of overall marks - 25 Marks

1. Practical exam would be conducted over a period of 3 days; 25M for each practical paper (2 Majors and 1 Minor in each semester).
2. Each student to perform at least 1 major and 1 minor practical for Semester I and II.
3. Viva would be conducted during the practical during the practical examination.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

Part 2- The Scheme of Teaching and Examination is as under:

Semester I

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Biotechnology)			BIO101B, BIO102B, BIO103B.	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course	-	
		2.2	Dissertation/Project	-	
		2.3	Generic Elective (GE) Course	BIO102C	
3	Ability Enhancement Courses (AEC)			-	
4	Skill Enhancement Courses (SEC)			-	
5	Vocational Courses(VOC)			BIO107D	

Part 2- The Scheme of Teaching and Examination is as under:

Summary
First Year Semester I Internal and External Detailed Evaluation Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week					Credit	Internals		Total Marks
			Units	S.L.	L	T	P		S.L.E.	SEE	
1	BIO101B (Major 1)	Biotechnology : Introduction and Applications	3	20% *	3			3	15	60	75
2	BIO101D	Practicals Based on BIO101D			0		6	1		25	25
3	BIO102B (Major 2)	Fundamentals of Microbiology	3	20% *	3			3	15	60	75
4	BIO102D	Practicals Based on BIO102D			0		6	1		25	25
5	BIO103B (Minor 3)	Bio-organic Chemistry	3	20% *	3			3	15	60	75
6	BIO103D	Practicals Based on BIO103D			0		6	1		25	25
	Total Hours / Credit		9	Total Marks							300

One to two lectures to be taken for CONTINUOUS self -learning Evaluation.

First Year Semester I - Units – Topics – Teaching Hours

Sr No	Subject Code	Subject Unit Title		Hours/Lectures	Total No. of hours/lectures	Credit
1	BIO101B - Major 1 Biotechnology : Introduction and Applications	1	Scope and Introduction to Biotechnology	15	45 L	3
		2	Applications of Biotechnology	15		
		3	Food and Fermentation Biotechnology	15		
2	BIO101D	1	Practicals based on BIO101D	30	30x2= 60 lectures per batch	1
3	BIO102B - Major 2 Fundamentals of Microbiology	1	Ultrastructure of cell, Nutrition and Cultivation of Microorganisms	15	45L	3
		2	Growth of microorganisms and Sterilization Techniques	15		
		3	Microscopy and stains	15		
4	BIO102D	1	Practicals based on BIO102D	30	30x2= 60 lectures per batch	1
5	BIO103B- Minor-M3 Bio-organic Chemistry	1	Sterochemistry, Carbohydrates, Lipids	15	45L	3
		2	Amino acids and Protein	15		
		3	Nucleic acids	15		
6	BIO103D	1	Practicals based on BIO103D	30	30x2= 60 lectures per batch	1
	Total Hours / Credit				315	12

1. Lecture Duration – 60 Minutes = 01 Hours. (45 Lectures equivalent to 45 hours)
2. One Credit (For theory) = Equivalent to 15 Hours
3. One Credit (For practicals) = Equivalent to 30 Hours
4. L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE- Self learning evaluation CT-Commutative Test, SEE- Semester End Examination , PA-Project Assessment, AT- Attendance

SEMESTER I

Course Code: BIO101B - Biotechnology: Introduction and Applications (Major 1)

Unit	Content	No. of Lectures
1	**Scope and Introduction of Biotechnology** 1.1. Introduction to Biotechnology (4L) 1.1.1. What is Biotechnology? 1.1.2. History of Biotechnology 1.1.3. Traditional and Modern Biotechnology 1.1.4. Global impact of Biotechnology. 1.2. Branches of Biotechnology (4L) 1.2.1. Plant biotechnology 1.2.2. Animal biotechnology 1.2.3. Marine biotechnology 1.2.4. Agricultural biotechnology 1.2.5. Healthcare biotechnology 1.2.6. Industrial biotechnology 1.2.7. Pharmaceutical biotechnology 1.2.8. Environmental biotechnology 1.3. Ethics in Biotechnology(3L) 1.4. Overview on IPR: (4L) 1.4.1. Plant breeder's right 1.4.2. Introduction to Patents 1.4.3. Copyright 1.4.4. Trademark 1.4.5. Trade secret 1.4.6. Geographical indication	15
2	**Applications of Biotechnology** 2.1. Introduction to (1L) 2.1.1. Genes, Genome, Recombinants, Hybrids , rDNA technology 2.2. Introduction to GMOs (1L) 2.3. Applications of biotechnology for human welfare(5L) 2.3.1. Insulin 2.3.2. Vaccines: Recombinant and Edible vaccines 2.3.3. Molecular farming 2.3.4. Transgenic cattle 2.3.5. Gene Therapy 2.4. Application of biotechnology in warfare (3L) 2.4.1. Bioweapons	15

	2.4.2. Bioterrorism 2.4.3. Case studies on bioterrorism 2.5. Applications of GMOs in agriculture (5L) 2.5.1. GM Papaya 2.5.2. GM Tomato 2.5.3. Golden rice 2.5.4. Bt-Cotton 2.5.5 Starch quality improvement in potatoes	
3	**Food and Fermentation Biotechnology** 3.1. Role of Microbes in Food Biotechnology (1L) 3.1.1. Food spoilage and fermentation 3.2. Microbial role in Food fermentation and Food Spoilage: Bacteria, Molds and Yeast (2L) 3.3. General principles of food preservation (3L) 3.3.1. Freezing, Canning, Pasteurization, Irradiation, Dehydration, Microwave. 3.4. Processing of Meat (1L) 3.4.1. Aging, Tenderizing, Curing 3.5. Food Additives – Intentional / Unintentional: (3L) 3.5.1. Antioxidants, chelating agents, colouring agents, Flavouring agents. 3.5.2. Emulsions, humectants and anticaking agents, leavening agents, nutrient supplements, non-nutritive sweeteners, pH controlling agents 3.6. Probiotic, Prebiotics, Synbiotic foods: (1L) 3.7. Fermented Products: (4L) 3.7.1. Acetic Acid, Ethanol, Citric Acid, Antibiotics(penicillin, streptomycin), Enzymes, Beverages (Beer, Wine)	15

References:

A Textbook of Biotechnology – R.C. Dubey, S. Chand Publishing
Biotechnology by B.D. Singh
The Cell by Geoffrey Cooper
iGenetics molecular approach (3rd edition) by Peter J Russell
Food Microbiology by William C. Frazier and Dennis C. Westhoff – 4th Edition

Self-Learning topics (Unit wise):

Sub- unit	Topic
1.	Contribution of Biotechnology in green revolution
2.	Guidelines for regulating r-DNA technology
3.	Advanced methods of food processing and food preservation

Online Resources

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9146367/
https://www.fao.org/3/Y5160E/y5160e08.htm
regulation & guidelines for recombinant DNA research & biocontainment 2017
https://nptel.ac.in/courses/102103013
https://biologyreader.com/food-preservation-techniques.html

Detailed Scheme Practicals

Course Code: BIO101D

Practicals	Credits
1. Study of lab instruments: Centrifuge, LAF, Weighing Balance, Colorimeter, pH meter, Refrigerator, micropipette. 2. Verification of Beer-Lambert's law 3. Isolation of DNA from plant source 4. Preparation of TAB vaccine 5. Staining of starch granules from potatoes. 6. Fermentative production of Ethanol a. Qualitative detection of ethanol 7. Production of Wine 8. Isolation of probiotics 9. Isolation of Antibiotic Producers by crowded plate method 10. Isolation of organism causing food spoilage a. Pectinolytic b. Proteolytic c. Cellulolytic d. Amylolytic e. Lipolytic 11. Assignment on branches of Biotechnology	1

Course Code: BIO102B - Fundamentals of Microbiology (Major 2)

Unit	Content	No. of Lectures
1	**Ultrastructure of cell , Nutrition and Cultivation of Microorganisms** 1.1. Overview of Ultrastructure of cell: (2L) 1.1.1. Understanding Prokaryotic cell 1.1.2. Understanding Eukaryotic cell organelles 1.2. Nutrition and Cultivation of Microorganisms (4L) 1.2.1. Nutritional Requirements: Carbon, Oxygen, Hydrogen, Nitrogen, 1.2.2. Phosphorus, Sulphur and Growth Factors 1.2.3. Different Nutritional Types of Organisms 1.3. Types of Culture Media (4L) 1.3.1. General Medium (Nutrient agar) 1.3.2. Differential Medium (MacConkey's agar) 1.3.3. Selective Medium (Sabouraud's agar and Cetrimide agar) 1.3.4. Enriched Media (Superimposed Blood Agar) 1.3.5. Enrichment media(Ashby's Mannitol Broth, Thioglycolate Broth) 1.4. Pure culture techniques (2L) 1.4.1. Spread plate method 1.4.2. Pour plate method 1.4.3. Side-streak method 1.5. Preservation of Culture (3L) 1.5.1. Traditional methods 1.5.2. Advance Preservation techniques	15

2	**Growth of microorganisms and Sterilization Techniques** 2.1 Growth of microorganisms (6L) 2.1.1. Growth curve 2.1.2. Measurement of microbial growth 2.1.3. Continuous culture of microorganisms (Chemostat, Turbidostat) 2.2 Introduction to Sterilization (1L) 2.3 Physical and mechanical methods and their mode of action (3L) 2.3.1. Dry Heat 2.3.2. Steam under pressure 2.3.3. Gases 2.3.4. Radiation 2.3.5. Filtration 2.4 Chemical agents and their mode of action (5L) 2.4.1. Aldehydes 2.4.2. Halogens 2.4.3. Quaternary ammonium compounds 2.4.4. Phenol and phenolic compounds 2.4.5. Heavy metals 2.4.6. Alcohol 2.4.7. Dyes 2.4.8. Detergents	15
3	**Microscopy and Stains** 3.1. History of Microscopy (1L) 3.2. Types of Microscopes - Principle, Parts, Functions and Applications (7L) 3.2.1. Simple and Compound Microscope 3.2.2. Dark Field Microscope 3.2.3. Phase Contrast Microscope 3.2.4. Fluorescence Microscopy 3.2.5. Confocal Microscopy 3.3. Stains and Staining Solutions (7L) 3.3.1. Definition of Dye, Stain ,Chromogen, Chromophore and Auxochromes 3.3.2. Functions of Mordant and Fixative 3.3.3. Natural and Synthetic Dyes 3.3.4. Simple Staining, Differential Staining (Gram Staining and Acid Fast Staining),	15

Self-Learning topics (Unit wise):

Sub- unit	Topic
1	Extremophiles
2	Phenol coefficient studies of different disinfectant brands
3	Electron Microscopy

Online Resources

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4187170/
https://asm.org/Articles/2023/March/How-Extremophiles-Push-the-Limits-of-Life
https://serc.carleton.edu/microbelife/extreme/extremophiles.html
https://nptel.ac.in/courses/102103015
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1353837/pdf/amjphealth00082-0025.pdf
https://www.researchgate.net/publication/343399960_COMPARISION_OF_DISINFECTANT_BY_PHENOL_COEFICIENT_METHOD
https://microbenotes.com/electron-microscope-principle-types-components-applications-advantages-limitations/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7152405/

References:

1. Microbiology-Pelczar, Reid, Chan 5th Edition, McGraw-Hill
2. Microbiology by Prescott, Harley & Klein,10th Edition
3. Advanced Biotechnology- R.C Dubey, S Chand Publishing
4. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology Biology by Verma Agarwal 2005.
5. General Microbiology - Roger Stanier, 5th Edition

Detailed Scheme Practicals
Course Code:BIO102D

Topics	Credits
1. Laboratory safety guidelines. 2. Demonstration of Simple microscope and Phase contrast Microscopy. 3. Study of sterilization of laboratory glassware: a. Autoclave b. Hot air oven 4. Preparation and sterilization of culture media: a. Liquid media: Broth b. Solid media: Butt, Agar plates, Slant. 5. Growth curve of bacteria. 6. Bacterial inoculation and isolation techniques: a. Inoculation into Liquid media b. Streaking on Nutrient agar slant c. Stab inoculation method on Nutrient agar butt d. T-streak method 7. Enumeration of the bacterial culture using spread plate technique. 8. Staining techniques: a. Monochrome Staining b. Gram Staining c. Cell wall Staining 9. Wet mount of fungal specimen. 10. Use of chemical compounds for the control of microorganisms: a. Inhibitory effect of Dyes on microbial growth b. Action of Chemical elements on growth of microorganisms - Oligodynamic action	1

Course Code:BIO103B - Bio-organic Chemistry (Minor 3)

Unit	Content	No. of Lectures
1	**Biomolecule: Stereochemistry, Carbohydrates and Lipids** 1.1. Stereochemistry (7 L) 1.1.1. Geometric isomerism: Enantiomers (Dextro and Laevo rotations), Diastereomers, Racemic mixtures (Cis- Trans, Erythro and Meso), Chirality, RS-EZ nomenclature 1.1.2. Conformation of ethane with energy profile diagram 1.1.3. Projection Formulae: Fischer, Sawhorse , and Newman 1.2. Carbohydrates (5 L) 1.2.1. Classification of carbohydrates 1.2.2. Stereoisomerism 1.3. Structure and properties: 1.3.1. Monosaccharides 1.3.2. Disaccharides and oligosaccharide 1.3.3. Polysaccharides: Storage and Structural 1.4. Lipids (3 L) 1.4.1. Structure of fatty acids 1.4.2. Nomenclature of fatty acids 1.4.3. Function of lipids 1.4.4. Structure of acyl glycerol, Glyceryl ethers 1.4.5. Phospholipids, Sphingolipids , Glycolipids, Lipoproteins 1.4.6. Waxes, Terpenoids, Steroids	15

2	**Amino Acids and Proteins** 2.1 Amino acids (9 L) 2.1.1. General structure of amino acids 2.1.2. Classification of amino acids with examples 2.1.3. Properties of amino acids: Solubility, Shape, Size, Isoelectric pH 2.1.4. Zwitterion and pKa studies of amino acids 2.2 Proteins (6 L) 2.1.1. Structure of Proteins - Peptide bond 2.1.2. Primary structure of protein 2.1.3. Secondary structure of protein 2.1.4. Tertiary structure of protein 2.1.5. Quaternary structure of protein 2.1.6. Denaturation of proteins 2.1.7. Protein folding	15
3	**Biomolecule: Nucleic Acids** 3.1. DNA (4L) 3.1.1. Structure of Purines and Pyrimidines 3.1.2. Nucleic acid bases in DNA and RNA 3.1.3. Structure of Nucleotide- nucleoside; Ribose and Deoxyribose sugars 3.1.4. Types of DNA structures 3.1.4.1. A-DNA 3.1.4.2. B-DNA 3.1.4.3. Z-DNA 3.2. Unusual structures of DNA: (2L) 3.2.1. Hairpin loop, 3.2.2. Palindromes 3.2.3. Bent DNA 3.2.4. Triple and Four Stranded DNA(only concept) 3.3. Organelle DNA: Mitochondria and Chloroplast(1L) 3.4. Extrachromosomal DNA: Plasmid (1L) 3.5. DNA structure by Watson and Crick model (5L): 3.5.1. Chargaff's rule 3.5.2. Tautomerism 3.5.3. Linking numbers,Writhing Number (only concept) 3.6. RNA (2L) 3.6.1. Structure , types and function of RNAs	15

Self-Learning topics (Unit wise):

Sub- unit	Topic
1	Analysis of monosaccharides: Tautomerization, Osazone complex formation Analysis of lipids: Sudan B test, Saponification test
2	Zwitterion and pKa studies of amino acids
3	Nucleic Acids as genetic material, building blocks of nucleic acids, DNA & RNA structure and functions

Online Resources

https://nptel.ac.in/courses/104105076 https://onlinecourses.nptel.ac.in/noc22_cy06/preview https://nptel.ac.in/courses/104103121

References:

1. Outlines of Biochemistry Conn and Stumpf, 5th edition
2. Biochemistry Satyanarayan and Chakrapani, Elsevier 3rd Edition
3. An Introduction to practical Biochemistry, David Plummer, 3rd edition McGraw Hill
4. Fundamentals of Biochemistry, S. Chand Publishers Jain, Jain and Jain 6thEdition; 5. Lehninger Principles of Biochemistry, Nelson & Cox Lehninger, 4th Edition
5. Lehninger Principles of Biochemistry, Nelson & Cox Lehninger, 4th Edition

Detailed Scheme Practicals

Course Code: BIO103D

Topics	Credits
1. Qualitative detection of carbohydrate using: a. Molisch test b. Anthrone test c. Benedict's test d. Fehling's test 2. Estimation of Reducing sugar by DNSA method 3. Spot test of lipids by emulsification test 4. Spot test for Nucleic Acids a. DNA estimation by DPA method b. RNA estimation by Orcinol method 5. Spot test of amino acids using Ninhydrin test 6. Estimation of Proteins using Biuret test 7. Estimation of Proteins using Lowry test 8. Demonstration of Edman degradation for sequencing amino acid in peptide	1

SEMESTER II

Part 2- The Scheme of Teaching and Examination is as under:

Semester –II

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (**Biotechnology**)			BIO104B, BIO105B, BIO106B	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course	-	
		2.2	Dissertation/Project	-	
		2.3	Generic Elective (GE) Course	BIO106C	
3	Ability Enhancement Courses (AEC)			-	
4	Skill Enhancement Courses (SEC)			-	
5	Vocational Courses(VOC)			BIO108D	

Part 2- The Scheme of Teaching and Examination is as under:

Summary
First Year Semester II Internal and External Detailed Evaluation Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week					Credit	Internals		Total Marks
			Units	S.L.	L	T	P		S.L.E.	SEE	
1	BIO104B (Major 4)	Molecular biology and Genetic Engineering	3	20%*	3			3	40	60	75
2	BIO104D	Practicals Based on BIO104D			0		6	1		25	25
3	BIO105B (Major 5)	Ecology, plant and animal physiology	3	20%*	3			3	40	60	75
4	BIO105D	Practicals Based on BIO105D			0		6	1		25	25
5	BIO106B (Minor 6)	Basic and Applied Chemistry	3	20%*	3			3	40	60	75
6	BIO106D	Practicals Based on BIO106D			0		6	1		25	25
	Total Hours / Credit		9	Total Marks							300

***One to two lectures to be taken for CONTINUOUS self -learning Evaluation.**

First Year Semester – II Units – Topics – Teaching Hours

Sr No	Subject Code	Subject Unit Title		Hours/Lectures	Total No. of hours/lectures	Credit
1	BIO104B Molecular biology and Genetic Engineering	1	DNA replication and recombination	15	45 L	3
		2	DNA Mutations and Repair	15		
		2	Recombinant DNA technology	15		
4	BIO104D	1	Practicals based on BIO104D	30	30x2= 60 lectures per batch	1
2	BIO105B Ecology, plant and animal physiology	1	Ecosystem and Interactions	15	45L	3
		2	Plant physiology	15		
		3	Animal physiology	15		
5	BIO105D	1	Practicals based on BIO105D	30	30x2= 60 lectures per batch	1
3	BIO106B Basic and Applied Chemistry	1	Water, Buffers and redox reactions	15	45L	3
		2	Nomenclature, separation and quantitative chemistry	15		
		3	Analytical chemistry	15		
6	BIO106D	1	Practicals based on BIO106D	30	30x2= 60 lectures per batch	1
	Total Hours / Credit				315	12

1. Lecture Duration – 60 Minutes = 01 Hours. (45 Lectures equivalent to 45 hours)
2. One Credit (For theory) = Equivalent to 15 Hours
3. One Credit (For practicals) = Equivalent to 30 Hours
4. L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE- Self learning evaluation CT-Commutative Test, SEE- Semester End Examination , PA-Project Assessment, AT- Attendance

Course Code: BIO104B Molecular biology and Genetic Engineering (Major 4)

Unit	Content	No. of Lectures
1	**DNA replication and recombination** 1.1. Replication in Prokaryotes (3L) 1.1.1. Semi-conservative DNA replication 1.1.2. Enzymes involved in DNA replication : Helicase,Topoisomerases, DNAGyrase, DNA Ligase, Polymerases. 1.2. Replication in Circular DNA (2L) 1.2.1. Bidirectional Replication of Circular DNA molecules. 1.2.2. Rolling Circle Replication 1.3. Replication in Eukaryotes(2L) 1.4. Modes of gene transfer (5L) 1.4.1. Conjugation 1.4.2. Transformation 1.4.3. Transduction (Generalized Transduction and Specialized Transduction) 1.5. Genetic Mapping (3L)	15
2	**DNA Mutations and Repair** 2.1. Mutation (2L) 2.1.1. Definition 2.1.2. Types of Mutations 2.2. Mutagens and its types (3L) 2.2.1. Physical 2.2.2. Chemical 2.2.3. Biological 2.3. Luria Delbruck experiment (2L) 2.4. AMES test (2L) 2.5. DNA Repair (6L) 2.5.1. Photoreversal, 2.5.2. Base Excision Repair, 2.5.3. Nucleotide Excision Repair 2.5.4. Mismatch Repair, 2.5.5. SOS Repair 2.5.6. Recombination Repair	15

3	**Recombinant DNA technology** 3.1. Basic Principles and Importance of Gene Cloning(2L) 3.2. Basic techniques used in genetic engineering (3L) 3.2.1. Extraction, separation, purification of Nucleic Acids 3.3. Types of enzymes used in recombinant DNA technology (3L) 3.3.1. Restriction enzymes (properties and types) 3.3.2. Ligases 3.3.3. Polymerases 3.3.4. Terminal transferases 3.4. Vectors used in recombinant DNA technology (5L) 3.4.1. Basic biology of vectors 3.4.2. Plasmid vectors (pBR322, pUC18) 3.4.3. Lambda Phage vectors 3.4.4. Cosmids, phasmids, 3.4.5. Advanced vectors : Shuttle vectors, BAC, YAC 3.5. cDNA libraries (1L) 3.6. Genomic libraries (1L)	15

Self-Learning topics (Unit wise):

Sub- unit	Topic
1	Holliday Model for Recombination- Transformation
2	Transposable elements
3	Applications of Gene Cloning and DNA Analysis in Research

Online Resources

https://archive.nptel.ac.in/courses/102/103/102103074/
https://youtu.be/8jMZQSHEM-4
https://www.youtube.com/watch?v=rEed9iU0WtM
https://www.youtube.com/watch?v=O1v4CI00kOg
https://archive.nptel.ac.in/courses/104/103/104103121/

References:

Principles of Gene Manipulation and Genomics : S. B. Primrose and R. M. Twyman
iGenetics- Peter Russell -Pearson Education
Gene cloning and DNA analysis-T. A. Brown

Detailed Scheme Practicals

Course Code: BIO104D

Topics	Credits
1. Extraction of DNA from bacteria 2. Estimation of DNA content using spectrophotometric method 3. Evaluation of DNA purity using spectrophotometric method 4. Restriction digestion of DNA 5. Separation of DNA using gel electrophoresis 6. Isolation and selection of lactose non fermenter UV mutants 7. Problems based on transformation, conjugation and transduction 8. Effect of mutagens on mitotically dividing cells: colchicine and PDB	1

Course Code: BIO105B Ecology, Plant and Animal Physiology (Major 5)

Unit	Content	No. of Lectures
1	**Ecosystem and Interactions** 1.1. Ecosystem (5L) 1.1.1. Ecosystems, Definition and Components 1.1.2. Structure and Function of Ecosystems 1.1.3. Aquatic and Terrestrial Ecosystems 1.1.4. Biotic and Abiotic Factors 1.1.5. Trophic Levels 1.1.6. Energetics of ecosystem 1.2. Food chain and food web (1L) 1.3. Ecological Pyramids (2L) 1.3.1. Pyramid of Energy 1.3.2. Pyramid of Biomass 1.3.3. Pyramid of Number 1.4. Biogeochemical Cycles (5L) 1.4.1. Water Cycle 1.4.2. Carbon Cycle 1.4.3. Oxygen Cycle 1.4.4. Nitrogen Cycle 1.4.5. Sulphur Cycle 1.4.6. Phosphorus Cycle 1.5. Population Interactions (2L) 1.5.1. Commensalism 1.5.2. Amensalism 1.5.3. Mutualism 1.5.4. Predation 1.5.5. Competition	15

2	**Plant Physiology** 2.1. Photosynthesis (2L) 2.1.1. Ultrastructure of Chloroplast 2.1.2. Fundamental Reactions of Photosynthesis 2.2. Photosynthetic Pigments (2L) 2.2.1. Hill Reaction and its Significance 2.3. Light Reactions (3L) 2.3.1. Cyclic and Non-Cyclic Photophosphorylation 2.3.2. Energetics of Photosynthesis 2.4. Dark Reactions (1L) 2.5. Photorespiration (1L) 2.6. CO_2 fixation (3L) 2.6.1. C3 cycle 2.6.2. C4 cycle 2.6.3. CAM pathways 2.7. Significance of Plant hormones (3L) 2.7.1. Auxins 2.7.2. Cytokinins 2.7.3. Gibberellins 2.7.4. Ethylene 2.7.5. Abscisic acid	15
3	**Animal Physiology** 3.1. Physiology of Digestion (4L) 3.1.1. Movement of Food and Absorption 3.1.2. Secretary functions of Alimentary Canal 3.1.3. Digestion and Absorption 3.1.4. Assimilation in Gut of Human 3.2. Anatomy and physiology of Human Kidney (3L) 3.2.1. Structure of Nephron 3.2.2. Physiology of Urine Formation 3.2.3. Role of Kidney in Excretion and Osmoregulation 3.3. Respiration (3L) 3.3.1. Physiology of Respiration 3.3.2. Mechanism of Respiration 3.3.3. Principles of Gaseous Exchange in the Blood and Body Fluids 3.4. Blood and Circulation (5L) 3.4.1. Blood Composition 3.4.2. Structure and Function of Blood cells: RBCs, WBCs,	15

	Platelets 3.4.3. Blood Coagulation and Anticoagulants 3.4.4. Haemoglobin and its Polymorphism 3.4.5. Structure of Human heart	

Self-Learning topics (Unit wise):

Sub- unit	Topic
1	Ecological niche, Remote Sensing
2	Auxin & Cytokinin as growth promoters, Ethylene & Abscisic acid as growth inhibitors
3	Reproductive system, Lower respiratory tract

Online Resources

https://nptel.ac.in/courses/102106097
https://nptel.ac.in/courses/102103015/
https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
https://onlinecourses.nptel.ac.in/noc20_bt42/preview
https://onlinecourses.nptel.ac.in/noc19_ge23/preview
https://nptel.ac.in/courses/122103039

References:

Cell Biology, Genetics, Molecular Biology, Evolution & Ecology Biology by Verma & Agarwal 2005
The Cell, Cooper & Hausman 4th edition
Textbook of Plant Physiology by V. Verma, Ane's Student edition
Medical Physiology by Guyton, Applegate Anatomy and Physiology learning system, 4th Edition, Elsevier

Detailed Scheme Practicals

Course Code: BIO105D

Topics	Credits
1. Study of Photomicrographs of Cell Organelles 2. Differential staining of blood cells 3. Study of population interactions with examples 4. Study of Synergistic activity of bacteria 5. Enrichment of Nitrosifiers and Nitrifiers by preparation of Winogradsky's Column 6. Isolation and Detection of Nitrosifiers and Nitrifiers by biochemical analysis 7. Enumeration of bacteria from soil using pour plate method 8. Study of Absorption Spectra of plant Pigments from spinach and beetroot 9. Isolation of Chloroplast from spinach and demonstration of Hill's reaction 10. Study of Normal Constituents of Urine a) Qualitative detection of urea b) Qualitative detection of uric acid c) Qualitative detection of Ammonia 11. Study of Abnormal Constituents of Urine a) Qualitative detection of glucose b) Qualitative detection of albumin c) Qualitative detection of Bile pigments	1

Course Code: BIO106B Basic and Applied Chemistry (Minor 6)

Unit	Content	No. of Lectures
1	**Inorganic chemistry** 1.1. IUPAC nomenclature (4 L) 1.1.1. Nomenclature and classification systems of organic 1.1.2. Alkanes, Alkenes, Alkynes 1.1.3. Aromatic compounds 1.1.4. Alcohol, Acids, Ethers 1.1.5. Aldehyde, Ketones 1.1.6. Amines and Amides 1.2. Chemical bonds (3 L) 1.2.1. Covalent Bond : Structure of CH_4 , BF_3 1.2.2. Non Covalent Bonds: Ionic bonds, Van Der Waal‘s 1.2.3. forces, Hydrogen Bonding 1.3. Chemistry of Water (1L) 1.3.1. Properties of Water 1.3.2. Interaction of Water with Solutes: 1.3.3. Polar-Charged, Non-Polar- Hydrophobic Effect 1.4. Solutions (3L) 1.4.1. Normality 1.4.2. Molarity 1.4.3. Molality 1.4.4. Mole fraction 1.4.5. Mole concept 1.4.6. Solubility 1.4.7. Weight ratio 1.4.8. Volume ratio 1.4.9. Weight to Volume ratio 1.4.10. ppb and ppm 1.4.11. Millimoles 1.4.12. Milliequivalents (Numericals) 1.5. Acids and Bases (4 L) 1.5.1. Lowry-Bronsted and Lewis Concepts 1.5.2. Strong and Weak Acids and Bases 1.5.3. Ionic Product of Water - pH, pKa, pKb 1.5.4. Buffer solutions: Henderson–Hasselbalch equation	15

2	**Organic, Quantitative and Separation chemistry** 2.1. Introduction to Types of Organic Reactions (4 L) 2.1.1. Addition - Markovnikov and Anti Markovnikov's rule with mechanism 2.1.2. Elimination - E1 & E2 mechanism 2.1.3. Substitution- SN1 & SN2 mechanisms 2.2. Redox reactions (4 L) 2.2.1. Oxidising and reducing agents 2.2.2. Oxidation numbers 2.2.3. Balancing redox reactions 2.3. Titrimetric Analysis (2 L) 2.3.1. Terminology: 2.3.2. Titration, Titrant, Titrand, End Point, Equivalence Point, 2.3.3. Titration Error, Indicator 2.3.4. Types of titration techniques 2.4. Gravimetric Analysis (2 L) 2.4.1. Solubility and Precipitation 2.4.2. Factors affecting Solubility 2.4.3. Washing of precipitate 2.5. Methods of Separation (3L) 2.5.1. Solvent extraction 2.5.2. Centrifugation : Types of centrifuges 2.5.3. Precipitation 2.5.4. Filtration 2.5.5. Distillation	15
3	**Natural Product Chemistry and Analytical Techniques** 3.1. Metal Coordination in Biological Systems (2L) 3.1.1. Biological Role of Metalloenzymes -Myoglobin, Haemoglobin 3.1.2. Biological Role of Carboxypeptidases, Catalases and Peroxidases 3.2. Natural Products (3L) 3.2.1. Primary and Secondary Metabolites 3.2.2. Classification and Application of Natural Products based on Biosynthesis 3.2.3. Classification of Natural Products based on structure- Alkaloids, Phenolics, Essential Oils, Steroids 3.3. Chromatography (7L)	15

	3.3.1. Principle, Advantages and disadvantages of chromatography: 3.3.2. Paper chromatography, 3.3.3. Thin Layer Chromatography 3.3.4. Column chromatography, 3.3.5. Gas Chromatography, 3.3.6. High Performance Liquid Chromatography (HPLC) 3.4. Spectroscopy (3L) 3.4.1. Principle: Beer-Lambert's Law 3.4.2. Derivation and limitation of Beer-Lamberts law	

Self-Learning topics (Unit wise):

Sub- unit	Topic
1	Types of buffers
2	Types of redox reactions
3	Application of chromatography and spectroscopy

Online Resources

https://archive.nptel.ac.in/courses/104/105/104105102/
https://archive.nptel.ac.in/courses/104/106/104106121/
https://nptel.ac.in/courses/103108100
https://nptel.ac.in/courses/104101136
https://nptel.ac.in/courses/104104066
https://archive.nptel.ac.in/courses/104/101/104101127/

References:

References: Biochemistry Satyanarayan and Chakrapani, Elsevier 3rd Edition
Fundamentals of Analytical Chemistry, Skoog, West, Holler and Crouch, 8th Edition, Thomson-Brooks/Cole
Vogel's Textbook of Quantitative Analysis by J. Mendham, R.c. Denney, J. D. Barnes, M. J. K. Thomas ,6thEdition, Prentice hall
Phytochemical methods- J.C. Harbone
Principles & techniques of Biochemistry & Molecular Biology, Wilson & Walker. 22

Detailed Scheme Practicals

Course Code: BIO106D

Topics	Credits
1. Calibration of pH meter 2. Preparation of buffer Solutions using standard buffer tablets 3. Determination of strength of HCl in commercial sample 4. Determination of dissociation constant of Weak Acids by Incomplete Titration Method using pH Meter 5. Titrimetric determination of the amount of Fe (II) present in the given solution . 6. Titrimetric determination of amount of $NaHCO_3$ + Na_2CO_3 in the given solid mixture. 7. Saponification of Fats by acid-base titration method 8. Determination of percent composition of $BaSO_4$ and NH_4Cl in the given mixture gravimetrically 9. Separation of amino acids using paper chromatography 10. Separation of plant extracts using TLC	1

VOCATIONAL COURSES LINKED TO MAJOR / MINOR (VOC)

The Scheme of Teaching and Examination For Vocational Courses

The performance of the learners shall be evaluated in the form of Summative assessment by Semester End Examination of total 25 marks by conducting the practical examination.

The Summative assessment includes practical examination based on the topics covered in the syllabus.

Practical Examination

1. Practical exam would be conducted over a period of 2/3 days; 25 M for each practical paper
2. Viva would be conducted during the practical during the practical examination.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

HSNC University Mumbai

Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Biotechnology

Curriculum – First Year Undergraduate

Programmes Semester-I and Semester -II

VOCATIONAL COURSES LINKED TO MAJOR / MINOR (VOC)

2023-24

(As per NEP 2020)

VOC SEMESTER I

BIO107D : Basic Microbiology

Learning objectives:

- Familiarize students with essential safety measures and practices in the microbiology laboratory to ensure the well-being of individuals and maintain a safe working environment.
- Instruct students on the proper preparation of aseptic glassware for microbiological experiments.
- Teach students proper techniques for collecting samples from marine environments, sewage, and clinical sources for microbiological analysis.
- Demonstrate the microbial isolation techniques for the study of skin microbiota.

Learning outcomes:

- Students will understand and implement proper safety protocols to minimize risks and hazards in the microbiology laboratory.
- Students will be able to prepare aseptic glassware, reagents and SOPs for intruments by using appropriate techniques.
- Students will be able to practice various chromatographic techniques.
- Students will successfully perform extraction of pigments and oils from plant samples.

BIO107D : Basic Microbiology

Titles	Credits
1) Safety measures and practices in Microbiology Lab 2) Preparation of aseptic glassware: (Cotton plugging, Wrapping) a) Test-tubes b) Pipettes c) Petri dish 3) Determining efficiency of the fumigation using formalin and potassium permanganate in biotechnology laboratory 4) Aseptic transfer techniques in microbiology: a) Use of pipettes and micropipettes b) Tube to tube transfer c) Flask to flask transfer 5) Isolation of the pigment producing bacterial colony by: a) T streak method b) Side streak method 6) Sample collection from marine, sewage and clinical samples 7) Colony morphology studies on following agar: a) Chocolate agar b) MRS agar c) Potato Dextrose agar 8) Isolation of normal flora from skin using swabbing technique 9) Staining techniques: a) Negative staining b) Metachromatic staining c) Capsule staining d) Endospore staining e) Lipid staining f) Acid fast staining 10) Enumeration of the bacteria using pour plate technique. 11) Assignment on any one scientist and its contribution to Medical biotechnology	1

VOC SEMESTER II

BIO108D : Good Laboratory Practices

Leaning objectives:

- Familiarize students with various signs and symbols used in the laboratory for safety, hazard identification, and equipment usage.
- Provide hands-on experience in calibrating various laboratory instruments and creating Standard Operating Procedures (SOPs) for their proper usage and maintenance.
- Provide hands-on experience in performing spot tests for carbohydrates
- Provide hands-on experience in Thin Layer Chromatography.

Learning outcomes:

- Students will be able to identify and interpret different signs and symbols used in the laboratory.
- Students will demonstrate their ability to calibrate different laboratory instruments and prepare SOPs for ensuring accurate measurements and instrument functionality.
- Students will be able to conduct spot tests for carbohydrates and interpret the results.
- Students will be able to prepare TLC slide and perform Thin Layer Chromatography.

BIO108D : Good Laboratory Practices

Titles	Credits
1) Understanding signs and symbols in the laboratory 2) Understanding the waste disposal system using different color-coding system 3) Preparing chromic acid washed, clean and dry glassware in the laboratory 4) Introduction to biosafety laboratory instruments 5) Calibration and SOP making of different laboratory instruments: a) Refrigerator b) Incubator c) Weighing balance d) Pipettes e) Micropipettes f) Measuring cylinder g) Beakers 6) Preparation of Solutions: a) Molarity (1M NaOH, 01M NaOH) b) Normality (1N HCL, 0.1N HCL) 7) Filtration of the swamp waste-water using: a) Filter paper b) Whatman filter paper c) Membrane filtration using Buchner funnel 8) Spot test of carbohydrates using osazone crystallization method 9) Extraction of oils from seeds using: a) Cold press methods b) Solvent extraction methods 10) Isolation of mitochondria from plant extract and its detection by DCPIP 11) Chalk chromatography of different ink samples 12) Separation of plant pigments on paper chromatography 13) Preparation of silica coated slide for TLC 14) Separation of plant pigments on TLC	**1**

OPEN ELECTIVES

HSNC University Mumbai

Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Biotechnology

Curriculum – First Year Undergraduate

Programmes Semester-I and Semester -II

OPEN ELECTIVE II: Nutrition and Nutraceuticals

2023-24

The Scheme of Teaching and Examination For Open Elective courses

The performance of the learners shall be evaluated in two components for total 50 marks: Formative Assessment with 40% marks by way of continuous evaluation and Summative assessment by Semester End Examination with 60% marks by conducting the practical examination.

Formative ASSESSMENT:- It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

A). Formative Assessment–40% of overall marks – 20 marks

The internal assessment involves a presentation on the basis of "self learning and evaluation" topics. The 20% of the lectures will be identified as "self learning and evaluation" topics in the syllabus. They shall be learnt independently by the students in a time bound manner preferably from online resources such as Swayam or NPTEL. Evaluative sessions shall be conducted by the teachers.

Distribution of Marks in Summative assessment:

Sr. No.	Particulars	Marks
1	Self-Learning Evaluation	15 Marks
2	Active participation in routine class instructional deliveries	05 Marks

B) The Summative assessment includes semester end examination and practical examination based on the Major and Minor Subjects.

A. Semester End Examination- 60 % of overall marks - 30 Marks

Practical Examination

4. Practical exam would be conducted over a period of 3 days; 30 M for each practical paper (2 Majors and 1 Minor in each semester).
5. Each student to perform at least 1 major and 1 minor practical for Semester I and II.
6. Viva would be conducted during the practical during the practical examination.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

Open Elective 2: Nutrition and Nutraceuticals

Open Elective	Topics offered	Semester I	Semester II	Semester III	Semester IV
OE 2	Nutrition and nutraceuticals	Balanced Diet	Science behind fad diets	Nutritional Disorders	Nutraceuticals and their applications

Learning objectives:

- Understand the science behind fad diets and the potential risks associated with them.
- Explore the concept of nutraceuticals and their role in promoting health and preventing diseases.
- Identify the key nutrients essential for human health and their roles in various physiological processes.

Learning outcomes:

- Students will be able to critically evaluate fad diets and recognize their limitations and potential negative effects on health.
- Students will understand the potential benefits and limitations of nutraceuticals in maintaining good health.
- Students will have a comprehensive understanding of essential nutrients and their functions in the body.

Open Elective 2: Nutrition and Nutraceuticals

SEMESTER I - BIO102C Balanced Diet

Semester	Unit	Content	No. of Lectures
I	1	**Introduction to Balanced diet** 1.1. Introduction to Nutrition (3L) 1.1.1. Definition 1.1.2. Study of Human nutrition 1.2. Nutrition & Energy supply (4L) 1.2.1. Basal Metabolic rate (BMR) 1.2.2. Calorie distribution 1.3. Nutritional importance of biomolecules (6L) 1.3.1. Carbohydrates 1.3.2. Fibre 1.3.3. Lipids 1.3.4. Proteins 1.3.5. Minerals 1.3.6. Vitamins 1.4. Need of balanced diet (1L) 1.5. Recommended dietary Allowances (RDA) (1L)	15
I	2	**Principles of Meal Planning & Nutrition** 2.1. Introduction to Meal Planning (3L) 2.1.1. What is meal planning? 2.1.2. Basic principles 2.1.3. Factors to be considered while planning a menu for different age groups. 2.2. Significance of Food groups for planning Balanced diet (7L) 2.2.1. Food Groups 2.2.2. Food Guide pyramid 2.2.3. Vegetarian food guide 2.3. Nutrition (5L) 2.3.1. Dietary pattern 2.3.2. Factors influencing eating behaviour 2.3.3. Nutritional need of Adults (Men and Women) 2.3.4. Nutritional need during old age	15

Open Elective 2: Nutrition and Nutraceuticals

SEMESTER II - BIO106C Science behind Fad Diets

Semester	Unit	Content	No. of Lectures
II	1	**Food choices and Introduction to Fad Diet** 1.1. Food choice process model (3L) 1.1.1. Factors influencing food choices 1.1.2. Introduction to Food neophobia, Food fads, Food addiction 1.2. Introduction to Fad Diet: (5L) 1.2.1. Definition, 1.2.2. Characteristics, 1.2.3. How to identify Fad diets? 1.2.4. Myths regarding fad diets 1.3. Fad Diet: Pros and Cons (1L) 1.4. Overview of Fad diet and its efficacy (4L) 1.5. Importance of Nutraceuticals and superfoods in Fad diet(2L)	15
II	2	**Science behind Fad Diets** 2.1. Different types of Fad diets, Mode of action, it's effectiveness and Health consequences (9L) 2.1.1. Atkins Diet 2.1.2. Ketogenic 2.1.3. Paleolithic 2.1.4. Mediterranean 2.1.5. Vegan and Vegetarian 2.1.6. Intermittent Fasting 2.1.7. Detox 2.1.8. Sports nutrition 2.2. Vicious cycle of Fad diets and it's side effects (3L) 2.3. Evidence based perspective of fad diets (3L)	15

References:

1. Biochemistry by Satyanarayan 7th edition
2. NCERT books (11th and 12th) : Biology
3. Clinicalgate.com Chapter 11: Nutritional disorders and their management.
4. Eating for Autism: The 10 step Nutrition Plan to help treat Child Autism, Asperger's and ADHD.
5. Nutraceuticals- A guide of healthcare professionals, 2nd Edition Brian LockwoodHandbook of Nutraceuticals Volume1: Ingredients, Formulations and Applications., by Yashwanth Pathak
6. Biotechnology in Functional foods and Nutraceuticals by Debasis Bagchi, Francis C. Lau, Dilip K. Ghosh
7. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC9294402/
8. http://www.sciencedirect.com/topics/food-science/nutritional-disorder
9. https://www.news-medical.net/health/What-are-Nutraceuticals.aspx
10. http://www.researchgate.net/publication/262182153_Classification_Regulatory_Acts_And_Applications_Of_Nutraceuticals_for_Health