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

e.)Mr. Ramlal Moorjani (Eminent Scholar)
Former Professor
Department of Chemistry,
K.C. College,
Mumbai- 400020
Email ID – ramlalkc@rediffmail.com

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 (Ag) Chairperson
Biotechnology

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. ** : The Definitions Of The Key Terms Used In The Choice Based Credit System And Grading System Introduced From The Academic Year 2023-2024 are as under:**

1. Core Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
2. Elective Course: Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (tobe offered by main discipline / subject of study).

2.2 Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

2.3 Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. Choice Base Credit System : CBCS allows students to choose inter- disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.
4. Honours Program : To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honours Program will have 40 additional credits to be undertaken by the learner in fourth year.
5. Program: A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.
6. Course: A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various

components of a course. A number of linked courses considered together are in practice, a 'program'.

7. Bridge Course: Bridge course is visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester, will be specified. The Bridge Course can be conducted in online mode. The Online content can be created for the Bridge Course Topics.
8. Module and Unit: A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within a course is treated as a Unit. Each course should have exactly 3 Units.
9. Self-Learning: 20% of the topics will be marked for Self-Learning. Topics for Self-Learning are to be learned independently by the student, in a time- bound manner, using online and offline resources including online lectures, videos, library, discussion forums, fieldwork, internships etc.
10. Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course. Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved in the topics earmarked for Self-Learning.
11. The teacher's role in these evaluative sessions will be that of a Moderator and Mentor, who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which may have been missed by the students, in the course of the Self-Learning process.
12. The modes to evaluate self-learning can be a combination of the various methods such as written reports, handouts with gaps and MCQs, objective tests, case studies and Peer learning. Groups can be formed to present self- learning topics to peer groups, followed by Question-and-Answer sessions and open discussion. The marking scheme for Self-Learning will be defined under Examination and Teaching.
13. The topics stipulated for self-learning can be increased or reduced as per the recommendations of the Board of Studies and Academic Council from time to time. All decisions regarding evaluation need to be taken and communicated to the stakeholders preferably before the commencement of a semester. Some exceptions may be made in exigencies, like the current situation arising from the lockdown, but such ad hoc decisions are to be kept to the minimum possible.
14. **Credit Point:** Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit in theory is construed as corresponding to approximately 15 learning hours.

15. **Credit Completion and Credit Accumulation:** Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus the learner 'accumulates' course wise credits.
16. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to different programs or credit exemptions given may also be stored with the individual's history.
17. **Credit Transfer:** (performance transfer) When a learner successfully completes a program, he/she is allowed to transfer his/her past performance to another academic program having some common courses and Performance transfer is said to have taken place.
18. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these academic programs is allowed to skip these 'equivalent' courses while registering for the new program. The Learner is 'exempted' from relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the credits corresponding to the exempted courses.

Part-II

The Scheme of Teaching and Examination

The performance of the learners shall be evaluated in two components for total 100 marks per Paper: Formative by way of continuous evaluation and Summative assessment by Semester End 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.

Summative assessment :- It is defined as the assessment of the learners on the basis of Semester end assessment 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.

Distribution of Marks

Sr. No.	Particulars	Marks
1	End-Semester Examination	60 Marks
2	Self-Learning Evaluation	15 Marks
3	Practicals	25 Marks

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

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.

Project and Assignment:

- Project or Assignment, which can in the following forms
  - Case Studies
  - Videos
  - Blogs

- Research paper (Presented in Seminar/Conference)
- Field Visit Report
- Presentations related to the subject (Moot Court, Youth Parliament, etc.)
- Internships (Exposition of theory into practice)
- Open Book Test
- any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

4.Self-Learning Evaluation

20% OF THE TOPICS OF CURRICULUM ARE LEARNED BY THE STUDENT THROUGH SELF LEARNING USING ONLINE / OFFLINE ACADEMIC RESOURSE SPECIFIED IN THE CURRICULUM.

HENCE 20% OF THE LECTURES SHALL BE ALLOCATED FOR EVALUATION OF STUDENTS ON SELF LEARNING TOPICS

- The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources.

CLUB The self-learning topics into 3-4 GROUPS OF TOPICS ONLY FOR EVALUATION.

- PRESCRIBE TIME DURATION (IN DAYS) FOR COMPLETION OF EACH GROUP OF TOPIC AND EARMARK SELF LEARNING EVALUATION LECTURES IN THE TIMETABLE. HENCE EACH GROUP OF TOPIC CAN BE ASSIGNED 3 REGULAR LECTURES FOR THIS EVALUATION FOR ENTIRE CLASS

Methods for Evaluation of Self-learning topics:
- Seminars/presentation (PPT or poster), followed by Q&A − Objective questions /Quiz / Framing of MCQ questions.
- Debates
- Group discussion
- You-Tube videos (Marks shall be based on the quality and viewership)
- Improvisation of videos
- Role Play followed by question-answers

Teachers can frame other methods of evaluation also provided that the method, duly approved by the college examination committee, is notified to the students at least 7 days before the commencement of the evaluation session and is forwarded for information and necessary action at leat 3 days before the commencement of the evaluation session
- Viva Voce
- Any other innovative method

HSNC University Mumbai

(2023-2024)

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)

PO	PROGRAM OBJECTIVES **A student completing Bachelor's Degree in Biotechnology programme will be able to:**
PO1	Understand fundamental concepts of biotechnology and it's allied field of sciences, which will build their foundation for higher education.
PO2	Illustrate a scientific problem, critically analyse it and explore practical solutions by data collection and organization followed by creating a work plan to execute.
PO3	Compute technical data and scientific information by using tools of bioinformatics and biostatistics to draw correct interpretations from research data.
PO4	Acquire effective communication skills to present their innovative ideas articulating research and scientific vocabulary, to efficiently showcase their research work to a wider audience.
PO5	Employ ethical practices at work place, following good lab practices and acknowledging the importance of biosafety protocols to protect the biodiversity and environment.
PO6	Develop practical skills of biotechnological, microbiological, chemical and biochemical techniques for conducting research and collection of scientifically valid data.
PO7	Demonstrate application of fundamental biological process at the molecular, cellular, industrial, medical and environmental levels.
PO8	Acquire entrepreneur skills to materialize and commercialize their scientific ideas, solutions and inventions for sustainable development of the society.

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. **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, consice 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 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.

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	-	
3	Ability Enhancement Courses (AEC)			-	
4	Skill Enhancement Courses (SEC)			-	
5	Vocational Courses(VOC)			-	

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

Summary
First Year Semester I Summative and Formative 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	Biotechnology : Introduction and Applications	3	20% *	3			3	15	60	75
2	BIO101D	Practicals Based on Biotechnology : Introduction and Applications			0		6	1		25	25
3	BIO102B	Fundamentals of Microbiology	3	20% *	3			3	15	60	75
4	BIO102D	Practicals Based on Fundamentals of Microbiology			0		6	1		25	25
5	BIO103B	Bio-Organic Chemistry	3	20% *	3			3	15	60	75
6	BIO103D	Practicals Based on Bio-Organic Chemistry			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- 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 Biotechnology : Introduction and Applications	30	30x2= 60 lectures per batch	1
3	BIO102B- 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 Fundamentals of Microbiology	30	30x2= 60 lectures per batch	1
5	BIO103B- 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 Bio-Organic Chemistry	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

Program: Bachelor of Science (Biotechnology)				**Semester : 1**	
Course : Biotechnology: Introduction and Application.				**Course Code: BIO101B**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Selft Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
3	3	-	3+1	15	60
Course Objectives:					
LO1	To aquaint students with history of biotechnology, it's branches and ethics involved in biotechnology.				
LO2	To discuss the applications of biotechnology in agriculture, warfare , food and fermentation industries.				
LO3	To illustrate the role of microorganisms in food production and spoilage.				
LO4	To study the techniques and instruments used in biotechnology.				
Course Outcomes: After completion of course, students will be able to:					
CO1	State the branches of biotechnology				
CO2	Compare between traditional biotechnology v/s modern biotechnology				
CO3	Explain the methodlogies for production of genetically modified organisms and ethics involved				
CO4	Classify microbes involved in food production and spoilage.				
CO5	Evaluate the efficiency of lab instruments				
CO6	Produce ethanol and wine at lab scale.				

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 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	15
3	**Food and Fermentation Biotechnology**	15

	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)	

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

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. Amylolytic d. Lipolytic 11. Assignment on branches of Biotechnology	1

Course Code: BIO102B - Fundamentals of Microbiology

Program: Bachelor of Science (Biotechnology)				**Semester : 1**	
Course : Fundamentals of Microbiology				**Course Code: BIO102B**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Selft Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
3	3	-	3+1	15	60
Learning objectives					
LO1	To introduce students to the basic concepts in organization, structure and function of Prokaryotes and Eukaryotes cell.				
LO2	To acquaint students to the basic concepts in microbial nutrition and microbial growth.				
LO3	To provide students with the detailed knowledge of different physical and chemical methods for the control of microorganisms.				
LO4	To introduce students to the importance and applications of basic microscopy as well as staining techniques in the study of microorganisms.				
Course Outcomes: At the end of this course students will be able to:					
CO1	To acquire the knowledge of structure of cells and different microorganisms.				
CO2	Analyse the difference between the ultra-structure of various types of living cells with its evolutionary significance.				
CO3	Describe different enrichment, culturing,isolation , identification and maintenance techniques of various microorganism.				
CO4	Justify the importance of Sterilization and its different methods.				
CO5	Enlist different types of Microscopes with their principle and appliactions.				
CO6	To prcatice the preparation of the specimens using various staining techniques for the microscopy.				

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

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

Program: Bachelor of Science (Biotechnology)				**Semester : 1**	
Course : Bio-organic Chemistry				**Course Code: BIO103B**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Selft Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
3	3	-	3+1	15	60

Learning objectives	
LO1	To understand the stereochemical structures of carbohydrates
LO2	To describe the classification and functions of carbohydrate and lipid in the cell.
LO3	To memorize and associate the functions and properties of amino acids and proteins
LO4	To study the nucleic acids structures and different types of genetic materials of the prokaryotic and eukaryotic cells
LO5	To perform qualitative and quantitative detection experiments for sugars, amino acids, proteins and fats
Course Outcomes: At the end of this course students will be able to:	
CO1	Describe the structures and functions of sugars, carbohydrates and lipids
CO2	Explain extraction of proteins and amino acids on the principles of isoelectric constant
CO3	Compare the principles of genetic materials from a prokaryotic and eukaryotic cell
CO4	Estimate the sugars, lipids, proteins, amino acids from natural products like fruits and vegetables
CO5	Produce stereochemical structures of carbohydrates
CO6	Compose protein studies by denoting appropriate amino acids in the protein structures

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	15

	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	

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**)				
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	-	
3	Ability Enhancement Courses (AEC)			-	
4	Skill Enhancement Courses (SEC)			-	
5	Vocational Courses(VOC)			US-FBT-VOC 1	

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

Summary
First Year Semester II Summative and Formative 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	Molecular biology and Genetic Engineering	3	20%*	3			3	40	60	75
2	BIO104D	Practicals Based on Molecular biology and Genetic Engineering			0		6	1		25	25
3	BIO105B	Ecology, Plant and Animal physiology	3	20%*	3			3	40	60	75
4	BIO105D	Practicals Based on Ecology, Plant and Animal physiology			0		6	1		25	25
5	BIO106B	Basic and Applied Chemistry	3	20%*	3			3	40	60	75
6	BIO106D	Practicals Based on Basic and Applied Chemistry			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 Molecular biology and Genetic Engineering	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 Ecology, Plant and Animal Physiology	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 Basic and Applied Chemistry	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

Program: Bachelor of Science (Biotechnology)				**Semester : II**	
Course : Molecular biology and Genetic Engineering				**Course Code: BIO104B**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Selft Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
3	3	-	3+1	15	60
Learning objectives					
LO1	To make learners aware about the process of DNA replication				
LO2	To develop an understanding of DNA mutations and mutagens				
LO3	To acquaint students with the concept of gene cloning				
LO4	To study the factors affecting gene transfer and genomic libraries				
Course Outcomes: At the end of this course students will be able to:					
CO1	Enlist the enzymes involved in DNA replication				
CO2	Describe the modes of gene transfers in microorganisms				
CO3	Categorize mutagens and their types				
CO4	Distinguish between different DNA repair mechanism				
CO5	Justify importance of Recombinant DNA technology in biotechnology				
CO6	Separate DNA using electrophoretic techniques				

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

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

Program: Bachelor of Science (Biotechnology)				**Semester : II**	
Course : Biotechnology: Ecology, plant and animal physiology.				**Course Code:BIO105B**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Selft Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
3			3+1	15	60
Course Objectives					
LO1	To acquaint students with the concepts of Ecology and physiology of plants, animals and humans				
LO2	To obtain the knowledge of various different ecosystems and population interactions within biotic factors of the ecosystem.				
LO3	To study the process of photosynthesis and organization of photosynthetic systems in plants				
LO4	To illustrate the role of various body organs in functioning of physiological systems of animals and humans.				
Course Outcomes:					
CO1	Learner will be able to identify and classify components of the ecosystem,				
CO2	Students will learn to compare and contrast between terrestrial and aquatic ecosystems				
CO3	Students will be able to determine the role of plant hormones in plant development.				
CO4	Learners will be able to analyze the process of light and dark reactions of photosynthesis.				
CO5	Students will understand the organization of respiratory, circulatory, digestive and excretory systems.				
CO6	Students will be able to perform biochemical and chemical analysis of blood and urine.				

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, Platelets 3.4.3. Blood Coagulation and Anticoagulants 3.4.4. Haemoglobin and its Polymorphism 3.4.5. Structure of Human heart	15

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

Program: Bachelor of Science (Biotechnology)				**Semester :II**	
Course : Basic and Applied Chemistry				**Course Code: BIO106B**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Selft Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
3	3	-	3+1	15	60
Learning objectives					
LO1	To acquire knowledge about IUPAC system, molarity, normality, nature of chemical bonds and buffers				
LO2	To identify types of redox reactions in biological systems				
LO3	To detect the molecules on the principles of titrimetric and gravimetric studies				
LO4	To comprehend the basic knowledge and advancements in chromatographic and spectroscopic techniques				
Course Outcomes: At the end of this course students will be able to:					
CO1	Name different chemical compounds on the basis of IUPAC systems				
CO2	Justify multiple physiological reactions using the working knowledge about redox reactions				
CO3	Enlist the titrations techniques in detecting molecules from natural products and to use gravimetric techniques in many proximate analyses				
CO4	Analyze phytoconstituents from natural products using the fundamentals of chromatography				
CO5	Estimate multiple constituents using spectroscopic studies				
CO6	Prepare solutions of various concentration and buffer systems for research project works				

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	15

	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	
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) 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	15

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)

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)

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.

BIO107D: Basic Microbiology

Program: Bachelor of Science (Biotechnology)				**Semester : 1**	
Course : Basic Microbiology				**BIO107D**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Selft Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
-	3	-	1	-	25

Learning objectives	
LO1	To illustrate students with essentialsafety measures and practices in Microbiology Lab to ensure well-being of individuals and maintain a safe working environment.
LO2	To acquainte students with the demonstration of various basic laboratory experiments while maintaining sterile conditions.
LO3	To introduce students with advanced staining techniques to study cell organelles.
LO4	To introduce students with proper techniques for collecting and examine samples from marine environment, sewage and clinical sources for micrbiological analysis.
Course Outcomes: At the end of this course students will be able to:	
CO1	To perform various aseptic techniques.
CO2	To evaluate morphological studies of microorganisms on various media.
CO3	To analyse different clinical samples.
CO4	To identify and differentiate the cell organelles by different staining techniques.
CO5	To illustrate the importance of Microbiological skills

BIO107D: Basic Microbiology
Paper: Basic Microbiological skills

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

BIO108D: Good Laboratory Practices

Program: Bachelor of Science (Biotechnology)				**Semester : II**	
Course : Good Laboratory Practices				**BIO108D**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Selft Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
-	3	-	1	-	25
Learning objectives					
LO1	To illustrate students with various signs and symbols used in laboratory for good lab practices				
LO2	To provide hands-on experience in calibrating various laboratory instruments				
LO3	To produce standard operating procedures for proper mainteinance of laboratory instruments				
LO4	To examine chemical assays of carbohydrate, lipids, antioxidants and other phytoconstinuent using thin layer chromatography				
Course Outcomes: At the end of this course students will be able to:					
CO1	Identify and interpret different signs and symbols				
CO2	Demonstrate calibration of laboratory instruments				
CO3	Prepare accurate SOP of different instruments				
CO4	Conduct spot tests for carbohydrates, lipids, antioxidants on natural products				
CO5	Prepare TLC slide and separate multiple phytoconstiuent from natural products				

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**