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 – Second Year Undergraduate Programme

Semester-III and Semester -IV

2024-25 (As per NEP 2020)

HSNC UNIVERSITY, MUMBAI

Board of Faculty of Science & Technology

Board of Studies in Biotechnology Subject

1.) Name of Chairperson/Co-chairperson/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

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c.) Dr. Suvarna Sharma,

Assistant Professor

Department of Life Science

K C College

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d.) Dr. Rajitha Satish

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e.) Mrs. Amina Dholkawala

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f.) Ms. Chinmayee Mahadik

Assistant Professor,

Department of Biotechnology,

HSNC University

Churchgate, Mumbai –400 020

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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) Top rankers of the Final Year Graduate and Final Year Post Graduate examination of previous year of the concerned subject as invitee members for discussions on framing or revision of syllabus of that subject or group of subjects for one year.

a.) Mr. Shubankar Dubey (undergraduate student 18-19)

Email Id-dubeshubhankar@gmail.com

b.) Ms. Shreshtha Shah (undergraduate student16-17)

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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 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 mind-set 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 mind-set, 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 instil 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 –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 as per NEP 2020 implemented From The Academic Year 2024-2025 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 (to be 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 d epending 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.

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.

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.

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.

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.

10. 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 discussing, attending lectures / counselling sessions, watching include a variety of learning activities like reading, reflecting, 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.

11. 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 four 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.

12. 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.

13. 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.

14. 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
Semester End Examination shall evaluate the performance of the learners in two components for total 100 marks per Paper: Formative by way of continuous evaluation and Summative assessment.

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.	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 percentage 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 III and IV.
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 resource 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 least 3 days before the commencement of the evaluation session

− Viva Voce
− Any other innovative method

PROGRAMME OBJECTIVES

PO	PROGRAM OBJECTIVES **A student completing Bachelor's Degree in Biotechnology programme will be able to:**
PO1	Understand the basic concepts, fundamental theories and basic terminologies of various disciplines such as immunology, cell biology, Enzymology and bioinformatics introduced in biotechnology.
PO2	Apply theoretical concepts of biophysics and organic chemistry and implementing it in experimentation and thus developing skills for organic and Nano material synthesis.
PO3	Analyse the structure and functions of enzymes along with learning fundamentals of enzymes kinetics in order to evaluate enzyme activity.
PO4	Implementing techniques of biostatistics in research for data analysis and sampling along with introduction of bioinformatics for familiarisation with databases and sequence retrieval.
PO5	Acquaint with basic terminologies, instrumentation and applications of bioprocess technology and tissue culture in research and industrial arenas.
PO6	Development of practical skills from various disciplines like chemistry, physics, information technology and statistics and applying them in field of biology for holistic development.

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**

Stakeholders of biotechnology were academic, research and industrial experts from the field of biotechnology. Biotechnology is a stand-alone course. There has been shuffling and introduction of some new basic concepts at first year due to the implementation of new education policy. Detailed insight to the basics covered in first year and introduction of certain new topics like Molecular diagnostic techniques, Tissue culture, Immunology, Biostatistics, Bioinformatics and Enzymology were done in semester III and semester IV. Following suggestions from stakeholders were incorporated. As suggested by academics and industrial experts, concepts like biosafety levels, detailed concept of lab layout structure in tissue culture laboratories were incorporated. Hands-on practicals of primer designing were suggested by stakeholders to incorporate it in third year syllabus. For the subject of open elective, which is opted by students of different faculty, biotechnological start-ups-oriented teaching is incorporated.

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

Semester –III

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Biotechnology)			BIO201B, BIO202B,BIO203 B	
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)			BIO204C	
5	Vocational Courses(VOC)			-	

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

Summary

Second Year Semester III 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	BIO201B	Immunology	3	20% *	3			3	15	60	75
2	BIO201D	Practicals Based on BIO201B			0		6	1		25	25
3	BIO202B	Cell Biology and Cytogenetics	3	20% *	3			3	15	60	75
4	BIO202D	Practicals Based on BIO202B			0		6	1		25	25
5	BIO203B	Biophysics and Organic Chemistry	3	20% *	3			3	15	60	75
6	BIO203D	Practicals Based on BIO203B			0		6	1		25	25
	Total Hours / Credit			Total Marks				12			300

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

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

Second Year Semester III - Units – Topics – Teaching Hours

Sr No	Subject Code	Subject Unit Title		Hours/Lectures	Total No. of hours/lectures	Credit
1	BIO201B Immunology	1	Cells and organs of Immune system	15	45 L	3
		2	Immune cell Receptors	15		
		3	Immunotechniques	15		
2	BIO201D	1	Practicals Based on BIO201B	30	30x2= 60 lectures per batch	1
3	BIO202B Major 2 Cell Biology and Cytogenetics	1	Cell biology	15	45L	3
		2	Mendelian genetics and cytogenetics	15		
		3	Population genetics	15		
4	BIO202D	1	Practicals Based on BIO202B	30	30x2= 60 lectures per batch	1
5	BIO203B Biophysics and Organic Chemistry	1	Fundamentals of Biophysics	15	45L	3
		2	Synthesis of Organic compounds	15		
		3	Green Chemistry and Nanomaterials	15		
6	BIO203D	1	Practicals Based on BIO203B	30	30x2= 60 lectures per batch	1
	Total Hours / Credit				315	12

SEMESTER III

Part -3 Detailed Scheme Theory

Program: Bachelor of Science (Biotechnology)				**Semester : 3**	
Course : Immunology				**Course Code:** BIO201B	
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 introduce to the cells and organs of the immune system and membrane receptors.				
LO2	To understand the concepts of immunity and the mechanism of cellular and humoral immune response.				
LO3	To discuss the genetic basis for immunological diversity in acquired immunity.				
LO4	To illustrate the practical knowledge and applications of immunoassay techniques.				
Course Outcomes: After completion of course, students will be able to:					
CO1	Cater the essential concepts of immunology.				
CO2	Understand the principles of qualitative and quantitative analysis in serology.				

CO3	Acquaint with the knowledge and understanding of intermediate and advanced skills in the laboratory techniques.
CO4	Apply the techniques and instrumentation in diagnosis and detection of pathogen

Course code: BIO201B Major 1 - Immunology

Unit	Content	No. of Lectures
1	**Cells and organs of Immune system** **1.1. Overview of the Immune system and its cells (5L)** 1.1.1 Types of Immune System 1.1.2 Primary and Secondary lymphoid organs 1.1.3 Granulocytes and Agranulocytes 1.1.4 Antigens and Antibodies 1.1.5 Natural killer cells 1.1.6 Mononuclear phagocyte 1.1.7 Mast cells 1.1.8 Dendritic cells **1.2. Haematopoiesis (1L)** **1.3. Phagocytosis (2L)** **1.4. Inflammation (1L)** **1.5. Complement system (6L)** 1.1.1 Classical 1.1.2 Alternate 1.1.3 Lectin 1.1.4 Regulation and Biological effects of Complement system 1.1.5 Deficiencies of Complement system	15
2	**Immune cell Receptors** **2.1 B-Cell receptor (3L)** 2.1.1. Structure 2.1.2. Activation 2.1.3. Maturation **2.2 T-cell Receptor(2L)** 2.2.1. Structure of T cell and TCR-CD3 complex 2.2.2. Activation **2.3 B-T Cell Interaction (B-T cell Cooperation) (1L)** **2.4 Antigen Presenting Cells(4L)** 2.4.1. Types of Antigen Presenting Cells 2.4.2. Endocytic Pathways 2.4.3. Exocytic Pathways **2.5 MHC (Major Histocompatibility Complex) Classes (5L)**	15

	2.5.1. General Organization and Inheritance 2.5.2. Structures and Peptide Interactions 2.5.3. Class I and Class II MHC Molecules 2.5.4. Class I and Class II Diversity and Polymorphism 2.5.5. MHC Restriction	
3	**Immunotechniques** **3.1. Principles of Antigen-Antibody interaction (1L)** **3.2. Types of Serological reaction: Precipitation, Agglutination, Flocculation (1L)** **3.3. Precipitation Reactions(3L)** 3.3.1. Immunoprecipitation 3.3.2. Immunoelectrophoresis: Counter, Rocket, 2-D **3.4. Agglutination Reactions (4L)** 3.4.1. Hemagglutination 3.4.2. Passive agglutination 3.4.3. Coomb's Test 3.4.4. Complement Fixation Tests **3.5. Flocculation reaction: VDRL (Venereal disease research laboratory) (1L)** **3.6. Immunofluorescent Antibody tests(4L)** 3.6.1. RIA(Radioimmunoassay) 3.6.2. ELISA (Enzyme-linked immunosorbent assay) 3.6.3. ELISPOT assay (Enzyme-linked immunosorbent spot) 3.6.4. Chemiluminescence 3.6.5. Immunofluorescence **3.7. Alternatives to Antigen-Antibody Reactions(1L)**	15

Self-Learning topics (Unit wise):

Unit	Topic
1	Cells and organs of immune system, complement system
2	Antigen presenting cells, T-cells
3	ELISA, RIA

Online Resources

https://nptel.ac.in/courses/104/108/104108055/

https://nptel.ac.in/courses/102/103/102103038/

BIO201D - Practicals based on BIO201B

Unit	Practical Content	No. of Lectures
1,2,3	1. Isolation of Mononuclear cells by Ficoll-Hypaque method. 2. Determination of human blood group by ABO and Rh antigen. 3. Immunodiffusion assay a) Determination of antigen identity- Ouchterlony's method b) To study Radial immunodiffusion by Mancini method 4. Coombs direct test. 5. VDRL (Venereal disease research laboratory) test (Qualitative). 6. Determination of isoagglutinin titre. 7.Study of Complement Fixation Test (CFT) 8. Demonstration of ELISA(Enzyme-linked immunosorbent assay) - DOT ELISA (Kit-based) 9. Preparation of TAB vaccine.	30

Program: Bachelor of Science (Biotechnology)				**Semester : 3**	
Course : Cell biology and Cytogenetics				**Course Code:** BIO202B	
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 learn basics of cell biology with respect to, cytoskeleton, cell membrane and cytogenetics.
LO2	To discuss the structure and functions of chromosomes, chromosome mapping and various cytogenetic aspects.
LO3	To understand variations in chromosome number, the use of haploids, apomictic populations and their role in genetics and breeding.
LO4	To gain knowledge related to quantitative, microbial and population genetics.
Course Outcomes: After completion of course, students will be able to:	
CO1	Gain knowledge associated with advanced cytogenetics techniques.
CO2	Exemplify genetic diseases and various chromosomal aberration related syndromes.
CO3	Perform linkage and genetic mapping, and to evaluate conclusions that are based on genetic data.
CO4	Gain insight into mathematical, statistical data analysis of genetic diversity.

Course code: BIO202B Cell biology and Cytogenetics – MAJOR 2

Unit	Content	No. of Lectures
1	**Cell biology** **1.1. Microtubules (3L)** 1.1.1. Microtubule associated proteins 1.1.2. Microtubule as agents of Intracellular Motility 1.1.3. Microtubule Organizing Centre 1.1.4. Dynamic Properties of Microtubules 1.2. **Microtubules in Cilia and Flagella (2L)** 1.2.1. Importance of Dynein arm 1.2.2. Mechanism of ciliary and flagellar locomotion 1.3. **Intermediate Filaments: (2L)** 1.3.1. Assembly and Disassembly 1.3.2. Types and Function of Intermediate filaments 1.4. **Microfilaments : Assembly , Disassembly (1L)** 1.5. **Molecular Motors- Mechanism: Kinesin, Dynein, Myosin (1L)** 1.6. **Muscle contractility: Sliding filament model (1L)** 1.7. **Cell Permeability and principles of membrane transport (3L)** 1.7.1. **ATP driven pumps -Na+, K+ pump** 1.8. **Cell Junctions (2 L)-concept only** 1.8.1. Microvilli 1.8.2. Tight Junctions 1.8.3. Gap Junctions 1.8.4. Desmosome	15
2	**Mendelian genetics and cytogenetics** **2.1. Introduction to Mendelian genetics (1L)** **2.2. Mendel‘s Laws of Heredity Monohybrid Cross (2L)** 2.2.1. Principle of Dominance and Segregation 2.2.2. Mendel‘s Laws of Heredity Dihybrid Cross 2.2.3. Principle of Independent Assortment (Punnett Square and Branch diagram for monohybrid and dihybrid cross) **2.3. Deviations from Mendelian Principles(3L)** 2.3.1. Incomplete Dominance and co-dominance 2.3.2. Multiple Alleles 2.3.3. Epistasis 2.3.4. Environmental effect on the expression of the Human Genes and Epigenetics-Concept only **2.4. Pedigree analysis(1L)** 2.4.1. Autosomal dominant, 2.4.2. autosomal recessive, 2.4.3. X-linked dominant,	15

	2.4.4. X-linked recessive, 2.4.5. Y-linked disease **2.5. Cytogenetics: (5L)** 2.5.1. Sex Determination, mechanism and Sex Linkage : Mechanisms of Sex Determination (XX-XY, ZZ-ZW, XX-XO) 2.5.2. Dosage Compensation and Barr Body. 2.5.3. Genetic Linkage, Crossing Over and Chromosomal Mapping **2.6. Tetrad Analysis (3L)** 2.6.1. Two-point Cross 2.6.2. Three-point Cross	
3	**Population genetics** **3.1. Definitions (2L)** 3.1.1. Genotypic Frequencies 3.1.2. Allelic Frequencies **3.2. Hardy- Weinberg Law (5L)** 3.2.1. Assumptions 3.2.2. Law 3.2.3. Problems **3.3. Genetic Variations in Populations (5L)** 3.3.1. Measuring Genetic Variation at Protein Level 3.3.2. Measuring Genetic Variations at DNA level 3.3.3. Natural Selection 3.3.4. Genetic Drift 3.3.5. Speciation **3.4. Role of Population Genetics in Conservation Biology (3L)**	15

Self-Learning topics (Unit wise):

Unit	Topic
1.2,1.6	Microtubules, Molecular motors
2.3	Membrane transport
3.4	Tetrad analysis, gene mapping

Online Resources

https://www.youtube.com/watch?v=7G29wxWMkCQ

https://nptel.ac.in/courses/115/101/115101121/

https://nptel.ac.in/courses/102/103/102103012/

https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/lecture8.pdf

https://nptel.ac.in/content/storage2/courses/102103013/pdf/mod6.pdf

BIO201D - Practicals based on BIO202B

Unit	Content	No. of Lectures
1,2,3	1. To test the viability of cells by Trypan blue dye exclusion method. 2. Total proteins in cell by Mercuric Bromophenol Blue staining 3. Blood cell counting using haemocytometer 4. Differential Leucocyte Count 5. Mitosis in plant cells 6. Meiosis in Onion Root-Tip Cells 7. Induction of Polyploidy by PDB Treatment using Suitable Plant Material. 8. Study of osmosis using potato disc 9. Study of normal and abnormal chromosome pattern using karyotype. 10. Pedigree Analysis- Autosomal and Sex-Linked 11. Mapping based on Tetrad Analysis and Three Point Cross 12. Buccal smear – Identification of Barr Body 13. Study of Chromosomal Aberrations- Deletion, Duplication, Inversion, 2; 10 Translocation and Syndromes- Trisomy 21, Trisomy 13, Trisomy 18, Klinefelter, Turner and Cri-du-Chat syndrome. 14. Problems based on calculation of gene and genotype frequencies, Hardy-Weinberg Law	**30**

Program: Bachelor of Science (Biotechnology)				**Semester : 3**	
Course : Biophysics and Organic chemistry				**Course Code: BIO203B**	
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 understand the physical phenomenon of optics, heat and magnetism.
LO2	To study the phenomenon of radioactivity in the diagnosis and treatment of disease.
LO3	To discuss the importance of organic chemistry for the synthesis of polymers.
LO4	To illustrate the application of nanotechnology in green farming.
Course Outcomes: After completion of course, students will be able to:	
CO1	State the concepts of biophysics in biotechnological experimentation.
CO2	Apply the principles of radioactivity in detecting the amount of radioisotopes.
CO3	Create different organic reactions in polymer-supported synthesis.
CO4	Prepare chemicals using green chemistry in pesticides as an effective method of farming.

Course Code: BIO203B Biophysics and Organic chemistry- MINOR

Unit	Content	No. of Lectures
1	**Fundamentals of Biophysics** **1.1. Introduction to Optics :(2L)** 1.1.1. Properties of Light - Reflection, Refraction, Dispersion, Interference 1.1.2. Spectroscopy **1.2. Introduction to Lasers :(2L)** 1.2.1. Properties of Lasers 1.2.2. Applications of Laser **1.3. Heat:(2L)** 1.3.1. Concept of Temperature 1.3.2. Modes of Heat Transfer 1.3.3. Measuring Temperature **1.4. Magnetism:(2L)** 1.4.1. Magnetic Field 1.4.2. Magnetism of Earth 1.4.3. Paramagnetism 1.4.4. Diamagnetism 1.4.5. Ferromagnetism **1.5. Biological applications of Optics, Heat and Magnetism(2L)** **1.6. Introduction to radioactivity: (2L)** 1.6.1. Significance of radioisotope techniques. 1.6.2. Nature of radioactivity **1.7. Detection and measurement of radioactivity:(3L)** 1.7.1. Methods based upon Gas ionization (GM counters). 1.7.2. Excitation of solids and solutions (Scintillation counting).	**15**
2	**Synthesis of Organic compounds** **2.1. Criteria for Ideal Synthesis; Selectivity and Yield.(2L)** **2.2. Linear and Convergent Synthesis(2L)** **2.3. Multicomponent Reactions(2L)** **2.4. Microwave Assisted Organic Synthesis(2L)** **2.5. Ultrasound in Synthesis and Polymer supported Synthesis(2L)** **2.6. Use of organocatalysts in organic synthesis(3L)**	**15**

	2.6.1. First generation organocatalysts 2.6.2. Second generation organocatalysts **2.7. Retrosynthesis (2L)**	
3	**Green Chemistry and Nanomaterials** **3.1. Introduction to Green Chemistry (1L)** **3.2. Root of innovation, limitations (1L)** **3.3. Tools and Principles of Green Chemistry (2L)** **3.4. Green Synthesis in Industry using:(4L)** 3.4.1. Green Materials 3.4.2. Reagents 3.4.3. Green Solvents 3.4.4. Green Catalysts **3.5. Biological applications of Green Chemistry(3L)** 3.5.1. Supercritical fluids and biocatalysts 3.5.2. Waste water treatment using green materials 3.5.3. Biopesticide and Biofertilizer **3.6. Nanomaterials: (4L)** 3.6.1. Introduction to Nanomaterials. 3.6.2. Forms of Nanomaterials: Nanoparticles, Nanofilms 3.6.3. and Nanotubes 3.6.4. Synthesis and Characterization of Nanomaterials 3.6.5. Applications of Nanomaterials	**15**

Self-Learning topics (Unit wise):

Unit	Topic
1	Nature of Radioactivity
2	Retrosynthesis
3	Application of nanotechnology

Online Resources

https://www.mooc-list.com/tags/radioactivity
https://nptel.ac.in/courses/104105087
https://nptel.ac.in/courses/118102003

BIO203D - Practicals based on BIO203B

Unit	Content	No. of Lectures
1,2,3	1. Study of Absorption Spectra of Coloured Compounds (CuSO4, CoCl2, KMnO4). 2. Studying Conduction of heat using Calorimeter and to plot a cooling curve. 3. Identification of Organic Compound of Known Chemical Type (Min 4 Compounds). 4. Purification of any TWO Organic Compounds by Recrystallization selecting Suitable Solvent. 5. Separation of Binary (Solid-Solid) Mixture (Minimum 4 Compounds). 6. Organic Preparations: a) Acetylation of Primary Amine (Preparation of Acetanilide). b) Base Catalysed Aldol Condensation (Synthesis of Dibenzalpropanone) 7. Chemical and Biological synthesis of Silver Nanoparticles using plant extracts 8. Characterization of nanoparticles using spectroscopic methods 9. Detection of Anti-microbial properties of silver nanoparticles.	30

SEMESTER IV

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

Semester –IV

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Biotechnology)			BIO205B, BIO206B, BIO207B	
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)			BIO205C	
5	Vocational Courses(VOC)			-	

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

Summary

Second Year Semester IV 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	BIO205B	Industrial Biotechnology	3	20% *	3			3	15	60	75
2	BIO205D	Practicals Based on BIO205B			0		6	1		25	25
3	BIO206B	Molecular Biology and Diagnostic Techniques	3	20% *	3			3	15	60	75
4	BIO206D	Practicals Based on BIO206B			0		6	1		25	25
5	BIO207B	Biochemistry	3	20% *	3			3	15	60	75
6	BIO207D	Practicals Based on BIO207B			0		6	1		25	25
	Total Hours / Credit			Total Marks				12			300

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

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

Second Year Semester IV - Units – Topics – Teaching Hours

Sr No	Subject Code	Subject Unit Title		Hours/Lectures	Total No. of hours/lectures	Credit
1	BIO205B Industrial Biotechnology	1	Plant Tissue Culture	15	45 L	3
		2	Animal Tissue Culture	15		
		3	Bioprocess technology	15		
2	BIO205D	1	Practicals Based on BIO205B	30	30x2= 60 lectures per batch	1
3	BIO206B Molecular Biology and Diagnostic Techniques	1	Gene Expression-Transcription and Translation	15	45L	3
		2	Regulation of gene expression	15		
		3	Molecular diagnostics	15		
4	BIO206D	1	Practicals Based on BIO206B	30	30x2= 60 lectures per batch	1
5	BIO207B - Biochemistry	1	Bioenergetics and carbohydrate metabolism	15	45L	3
		2	Amino acid metabolism	15		
		3	Lipid metabolism	15		
6	BIO207D	1	Practicals Based on BIO207B	30	30x2= 60 lectures per batch	1
	Total Hours / Credit				315	12

Program: Bachelor of Science (Biotechnology)				**Semester: 4**	
Course : Industrial Biotechnology				**Course Code: BIO205B**	
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 acquaint students with the concepts of Plant tissue culture systems and micropropagation techniques
LO2	To obtain knowledge on the principles and design of the Animal tissue culture laboratory.
LO3	To study the functions of fermentation and understand the role of distinct parts of the fermenter.
LO4	To explain the ethanol and penicillin fermentation process from industrial biotechnology.
Course Outcomes: After completion of course, students will be able to:	
CO1	Describe types of different plant tissue culture techniques for rapid growth of plants.
CO2	Recognize the importance of cell lines and ATC in detecting and treating diseases.
CO3	Categorize different concepts of fermentation technology and formulate the fermented products.
CO4	Analyse the fermentation process and develop products

Course code: BIO205B Industrial Biotechnology- Major 4

Unit	Content	No. of Lectures
1	**Plant Tissue Culture** **1.1. Introduction to Plant tissue culture (PTC) (1L)** 1.1.1. Cell culture Theory 1.1.2. Concept of Cell Culture 1.1.3. Cellular Totipotency **1.2. Design of PTC lab (2L)** **1.3. Culture Medium: Nutritional requirements of the explants (3L)** **1.4. Precautions to maintain Aseptic Conditions (1L)** **1.5. Crop improvement using PTC (8L)** 1.5.1. Callus Culture: Technique and suspension culture 1.5.2. Direct and Indirect Organogenesis 1.5.3. Micropropagation 1.5.4. Artificial seeds 1.5.5. Protoplast isolation culture and fusion 1.5.6. Somatic hybrids 1.5.7. Cybrids 1.5.8. Hairy root culture	15
2	**Animal Tissue Culture** 2.1. **Introduction to Animal Tissue Culture (ATC) (1L)** 2.1.1. Advantages and Limitations of ATC 2.2. **Biology of cultured cells (1L)** 2.2.1. Cell Adhesion 2.2.2. Cell Proliferation 2.2.3. Cell differentiation 2.3. **Lab layout of ATC lab-Single and Double room (1L)** 2.4. **Equipment and Instruments used in ATC Lab (2L)** 2.5. **ATC media (3L)** 2.5.1. Nutritional and physiological growth factors and parameters 2.5.2. General metabolism and growth kinetics of animal cells 2.5.3. Defined Media And Supplements 2.5.4. Natural Vs Synthetic Media 2.6. **Cell culture techniques (2L)**	15

	2.6.1. Primary, secondary and continuous cell lines, 2.7. **Maintenance of Cell Lines (2L)** - Primary Cell Cultures of Adherent and Non-Adherent Cell Lines with examples 2.8. **Subculture and Propagation of cell lines (2L)** 2.8.1. Choosing a Cell Line, 2.8.2. Routine Maintenance 2.8.3. Subculture 2.9. **Application of ATC (1L)**	
3	**Bioprocess technology** **3.1. Introduction to Bioprocess technology(1L) (concepts of upstream, fermentation and downstream)** **3.2. Design of a Fermenter (3L)** 3.2.1. Basic design of a fermenter 3.2.2. Parts of a typical fermenter **3.3. Fermentation Media (3L)** 3.3.1. Components 3.3.2. Design and Optimization **3.4. Process Parameters (2L)** 3.4.1. pH 3.4.2. Temperature 3.4.3. Aeration 3.4.4. Agitation 3.4.5. Foam **3.5. Types of Fermentation (3L)** 3.5.1. Surface, Submerged, solid state fermentation 3.5.2. Batch, Continuous and fed-batch 3.5.3. Aerobic and Anaerobic **3.6. Desirable characteristics and strains of industrially important microorganisms (1L)** **3.7. Study of Fermentation Process and concept of downstream processing with examples (2L)** 3.7.1. Penicillin Production 3.7.2. Ethanol Production	15

Self-Learning topics (Unit wise):

Unit	Topic
1	Tissue Engineering, Tissue Culture
2	Cell culture, Types of Cell culture, Media
3	Design of fermenter

Online Resources

https://nptel.ac.in/courses/102/106/102106081/

https://nptel.ac.in/courses/102/103/102103016/

https://nptel.ac.in/courses/102/104/102104059
https://nptel.ac.in/content/storage2/courses/102103015/module6/lec3/1.html

BIO205D Practicals based on BIO205B

Unit	Content	No. of Lectures
1,2,3	1. Equipment in tissue culture; principle, working and applications a) CO_2 incubator b) Inverted microscope c) Filter assembly and membrane filters d) Cold freezer e) Centrifuge f) Laminar Airflow 2. Explant sterilization and inoculation for callus culture 3. Preparation of synthetic seeds 4. Media preparation and sterilization for animal tissue culture 5. Trypsinization of animal tissue and viability count 6. Screening for an antibiotic producing strain of microorganism. 7. Determination of the alcohol tolerance and sugar tolerance for yeast. 8. Lab Scale Production of Penicillin (Static and Shaker). 9. Estimation of penicillin by Biological (Bioassay) Method. 10. Lab Scale Production and purification of Ethanol 11. Estimation of alcohol by Chemical method- Dichromate method	30

Program: Bachelor of Science (Biotechnology)				**Semester : 4**	
Course : Molecular Biology and Diagnostic Techniques				**Course Code: BIO206B**	
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 provide students with an in-depth understanding of the basic concepts of molecular biology.
LO2	To facilitate the students to have a strong knowledge of the molecular basis of life and the underlying mechanisms.
LO3	To comprehend, analyse and perform the relevant molecular tests to identify different samples.
LO4	To train students in understanding genetics and relate modern technology for disease diagnosis and therapy.
Course Outcomes: After completion of course, students will be able to:	
CO1	Understand the central dogma of life, structure of DNA, RNA, Protein and the fundamentals of molecular techniques.
CO2	Identify and determine the factors that regulate the gene expression.
CO3	Analyse and detect nucleic acids and proteins from various samples.
CO4	Understand Different applications of molecular techniques in different fields.

Course code: BIO206B Molecular Biology and Diagnostic Techniques –Major 5

Unit	Content	No. of Lectures
1	**Gene Expression- Transcription and Translation** **1.1. Central Dogma: An Overview(1L)** **1.2. Transcription Process in Prokaryotes (2L)** 1.2.1. Initiation of Transcription at Promoters 1.2.2. Elongation of RNA chain 1.2.3. Termination of RNA Chain. **1.3. Transcription Process in Eukaryotes (4L)** 1.3.1. Types of Eukaryotic RNA Polymerase 1.3.2. Eukaryotic Promoters and Enhancers 1.3.3. Transcription of Protein Coding Genes by RNA Polymerase 1.3.4. Eukaryotic mRNAs 1.3.5. Spliceosomes; RNA editing **1.4. Gene Expression-Translation-Nature of Genetic Code(1L)** 1.4.1. The Genetic code is a triplet code 1.4.2. Deciphering the Genetic code 1.4.3. Characteristics of Genetic code **1.5. Wobble Hypothesis (1L)** **1.6. Translation: The process of protein synthesis (5L)** 1.6.1. Transfer RNA 1.6.2. Ribosomes 1.6.3. Initiation of Translation 1.6.4. Elongation of polypeptide chain 1.6.5. Termination of translation **1.7. Post Translational Modification(1L)**	15
2	**Regulation of gene expression** **2.1. Regulation of gene expression in Prokaryotes (4L)** *2.1.1.* lac Operon of *E.coli* *2.1.2.* trp Operon of *E.coli* **2.2. Regulation of Gene Expression in Phage Lambda (4L)** 2.2.1. Early Transcription Events 2.2.2. The Lysogenic Pathway 2.2.3. Role of lambda repressor 2.2.4. The Lytic Pathway	15

	2.3. Regulation of gene expression in Eukaryotes (1L) 2.3.1. Operons in Eukaryotes **2.4. Control of Transcriptional Initiation: (5L)** 2.4.1. By activators and repressors 2.4.2. Role of chromatin in regulating gene transcription 2.4.3. Gene Silencing and Genomic Imprinting 2.4.4. Gene silencing at a telomere 2.4.5. Gene silencing by DNA methylation **2.5. Post-Transcriptional Control; RNA Interference (1L)** 2.5.1. Si RNA 2.5.2. mi RNA	
3	**Molecular diagnostics** **3.1. Overview of Polymerase Chain Reaction (PCR) (1L)** **3.2. Components of typical PCR reaction (3L)** **3.3. Characteristics of ideal primer (2L)** **3.4. Control of PCR Contamination & Mispriming (1L)** **3.5. PCR product cleanup & detection (1L)** **3.6. PCR types (Principle, Working & Applications) (2L)** 3.6.1. Real time PCR 3.6.2. Reverse transcriptase PCR **3.7. Analysis and Detection of Nucleic Acids and Proteins(5L)** 3.7.1. Restriction Enzyme Mapping 3.7.2. Analysis of proteins and nucleic acid via electrophoresis. 3.7.3. Probes: Nucleic acid probes, Protein probes 3.7.4. Southern, Northern, Western Hybridization	15

Self-Learning topics (Unit wise):

Unit	Topic
1	Prokaryotic and Eukaryotic transcription, Eukaryotic RNA Polymerase
2	Eukaryotic gene expression, Wobble hypothesis
3	Types of PCR

Online Resources

https://nptel.ac.in/content/storage2/courses/104108056/module1/PNR%20lecture%201.pdf

http://www.siumed.edu/~bbartholomew/-lectures/Transcription%2009.pdf
https://nptel.ac.in/content/storage2/courses/104108056/module4/PNR%20lecture%2012.pdf

http://www.jiwaji.edu/pdf/ecourse/biochemistry/Wobble%20Hypothesis.pdf
https://nptel.ac.in/content/storage2/courses/102103041/module5/lec29/1.html
https://nptel.ac.in/courses/102/104/102104052/

BIO206D Practicals based on BIO206B

Units	Practicals	No. of Lectures
1,2,3	1. Study of *E.coli* Diauxic Growth Curve- (Lactose and Glucose). 2. Preparation of competent cells. 3. Study of LacZ gene expression using blue-white screening. 4. Expression of β-galactosidase and measurement of its activity. 5. Separation of DNA using AGE. 6. Restriction enzyme digestion. 7. Demonstration of PCR. 8. Separation of proteins using SDS PAGE. 9. Problems based on restriction mapping.	30

Program: Bachelor of Science (Biotechnology)				**Semester : 4**	
Course : Biochemistry				**Course Code: BIO207B**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Self Learning and Evaluation (SLE) (Marks)**	**Semester End Examinations (SEE) (Marks)**
3	3	-	3+1	15	60

Course Objectives:	
LO1	To understand different types of carbohydrate metabolism in bacterial, plant, and animal cells.
LO2	To explain the concept of amino acid catabolism in humans.
LO3	To state the biosynthesis and functions of different hormones.
LO4	To list types of fats present and study their catabolism in the body.
Course Outcomes: After completion of course, students will be able to:	
CO1	Justify and compare carbohydrate metabolism in bacterial, plant, and animal cells.
CO2	Calculate energetics in different cell types based on their biochemical pathway.
CO3	Enlist uric acid synthesis by catabolism of amino acids and explain the functions of different hormones in humans.
CO4	Explain the types and storage of fats and interpret the oxidation of fats for generating energy for the cell.

Course code: BIO207B Biochemistry -Minor

Unit	Content	No. of Lectures
1	**Bioenergetics and carbohydrate metabolism** **1.1. Metabolism of carbohydrates(1L)** **1.2. Catabolism of carbohydrates: (6L)** 1.2.1. Glycolysis under aerobic conditions (pathway regulation and energetics) 1.2.2. Glycolysis under anaerobic conditions: 1.2.2.1. Homolactic fermentation 1.2.2.2. Heterolactic fermentation 1.2.2.3. Alcoholic fermentation 1.2.3. Citric acid cycle (pathway regulation and energetics) 1.2.4. Pentose phosphate pathway **1.3. Anabolism of Carbohydrates: (4L)** 1.3.1. Gluconeogenesis 1.3.2. Glyoxylate pathway 1.3.3. Reductive TCA **1.4. Amphibolic pathways (1L)** **1.5. Oxidative phosphorylation and high energy compounds (3L)** 1.5.1. Electron transport chain: Inhibitors of electron transport system 1.5.2. ATP- energy currency, structure, hydrolysis. 1.5.3. Other energy-rich compounds (Phosphoenol pyruvate, Creatine phosphate)	15
2	**Amino acid metabolism** **2.1. Amino acid catabolism (7L)** 2.1.1. Mechanism of Deamination 2.1.2. Mechanism of Transamination 2.1.3. Urea cycle 2.1.4. Metabolic breakdown of individual amino acids: Methionine, Lysine, Tryptophan, Glycine, Serine, Alanine, Cysteine, Threonine, Proline **2.2. Biosynthesis of compounds derived from amino acids and their significance (8L)** 2.2.1. Biosynthesis of Epinephrine 2.2.2. Biosynthesis of Dopamine	15

	2.2.3. Biosynthesis of Serotonin 2.2.4. Biosynthesis of GABA 2.2.5. Biosynthesis of Histamine 2.2.6. Biosynthesis of Glutathione	
3	**Lipid metabolism** **3.1. Synthesis and storage of fatty acids (5L)** 3.1.1. Synthesis and storage of triacylglycerol 3.1.2. Digestion and transport of triacylglycerol 3.1.3. Biosynthesis of saturated fatty acid- Palmitic acid **3.2. Fatty acid oxidation (7L)** 3.2.1. Oxidation of β -saturated fatty acids 3.2.2. Oxidation of α -saturated fatty acids 3.2.3. Oxidation of ω -saturated fatty acids 3.2.4. Oxidation of unsaturated fatty acids 3.2.5. Oxidation of odd chain fatty acids 3.2.6. PUFA oxidation with physiological significance **3.3. Ketogenesis (3L)**	**15**

Self-Learning topics (Unit wise):

Unit	Topic
1	Gluconeogenesis, Glyoxylate pathway
2	Transaminase, Deaminase reactions
3	Ketogenesis

Online Resources

https://archive.nptel.ac.in/courses/102/106/102106087/
https://nptel.ac.in/courses/102105034
https://dth.ac.in/medical/courses/biochemistry/block-5/12/index.php

BIO207D Practicals based on BIO207B

Units	Practicals	No. of Lectures
1,2,3	1. Estimation of blood plasma glucose by GOD-POD method 2. Study of homo and hetero fermentation 3. Mixed acid fermentation - Detection of organic acids by chromatography 4. Isolation of mitochondria and demonstration of ETC using a marker Enzyme 5. Study of enzymes and biochemical pathways in characterization of micro-organisms: a Lysine decarboxylase activity b Phenylalanine deaminase activity c Urease test d Oxidase test e Bile solubility test 6. Determination of Liver Function Tests by detecting SGPT and SGOT levels from serum 7. Determination of Kidney functions by detection of Urea 8. Estimation of Uric Acid from urine sample 9. Estimation of Creatinine in urine sample 10. Determination of Total, LDL and HDL Cholesterol from Serum sample 11. Qualitative detection of Ketone body in a urine sample	30

References

SEMESTER	Paper No	Paper Name	REFERENCES
3	Bio201B	Immunology	1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stanford., 7th edition (2012), Freeman and Co., NY 28. 2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India 29. 3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA. 21 30. 4. Introduction to Immunology- C V Rao-Narosa Publishing House
	Bio202B	Cell Biology and Cytogenetics	1. iGenetics- Peter Russell -Pearson Education 2. Microbial Genetics- Freifelder –Narosa Publishing House 3. Population Genetics : iGenetics – A Mendelian Approach Peter Russell, Pearson Education 4. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P.S. Verma and V.K. Agarwal; S. Chand & Company Ltd. 5. Cell and Molecular Biology – De Robertis-Lippincott Williams& Wilkins 6. Cell and Molecular Biology- Concepts and Experiments—Karp – Wiley International
	Bio203B	Biophysics and Organic Chemistry	1. Methods in Molecular Biophysics, Igor N S, N Zaccai & J Zaccai, (2007) Cambridge 2. Advanced Methods in Protein Microsequencing, Witmann 3. Essential Biophysics, Narayanan, New Age Publications. 4. Handbook of Molecular Biophysics (Methods & Application), 2009, HG Bohr,

			Wiley 5. Organic Chemistry, R.T. Morrison, R.N. Boyd and S.K. Bhatacharjee, 7th Edition, Pearson Education (2011). 6. Organic Chemistry, T.W.G. Solomon and C.B. Fryhle, ninth Edition, John Wiley & Sons, (2008) 7. A guide to mechanism in Organic Chemistry, sixth Edition, Peter Sykes, Pearson Education 8. Fundamentals of Organic Chemistry, G. Marc Loudon, fourth Edition Oxford
4	BIO205B	Industrial Biotechnology	1.Introduction to Plant Tissue Culture M.K. Razdan2ndEdition,Science publishers 2.Plant Tissue Culture, Kalyan Kumar De, New Central Book Agency 3.Sant Saran Bhojwani, Prem Kumar Dantu (auth.) - Plant Tissue Culture_ An Introductory Text-Springer India (2013) 4.Principles and Practice of Animal Tissue Culture, Sudha Gangal, Universities Press 5.Culture of animal Cells, R Ian Freshney, 5th Edition, Wiley 6.Principles of Fermentation Technology, Stanburry ,Whittaker And S.J.Hall 7.Principles of Fermentation Technology, Arindam Kuila And Vinay Sharma, Wiley
	BIO206B	Cell Biology and Cytogenetics	1.iGenetics- Peter Russell -Pearson Education 2.Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA 3.Cell and Molecular Biology – De Robertis-Lippincott Williams& Wilkins 4.Cell and Molecular Biology- Concepts and Experiments—Karp – Wiley International 5.Molecular diagnostics- Fundamentals, methods and clinical applications – Buckingham and Flaws F.A. Davis Company Philadelphia.

			6. Principles & techniques of Biochemistry & Molecular Biology, Wilson & Walker
	BIO207B	Biophysics and Organic Chemistry	1.Biochemistry by Harper, Mc Graw Hill publishers, 25th edition (2003) 2.Biochemistry by U.Satyanarayana, Allied Book Publishers, 3rd edition (2006) 3.Lehninger Principles of Biochemistry, Fourth Edition, David L. Nelson and Michael M. Cox. W. H. Freeman; 4th edition (2004) 4.Voet D., Voet J.G, Biochemistry 4th Edition., John Wiley and Sons, 2011 5.Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN: 978-0-470-28173-4. 6.Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer L., W.H. Freeman and Company (New York), ISBN:10:1-4292-2936-5, ISBN:13:978-1- 4292-2936-4

SKILL ENHANCEMENT COURSE

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 – Second Year

Undergraduate Programmes Semester-III

and Semester -IV

SKILL ENHANCEMENT COURSE (SEC)

2024-2025

(As per NEP 2020)

The Scheme of Teaching and Examination for Skill Enhancement Course

The performance of the learners shall be evaluated in two components for total 75 marks: Formative Assessment with 27% marks by way of continuous evaluation and Summative assessment by Semester End Examination with 73% 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–27% 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 Formative assessment:

Sr. No.	Particulars	Marks (3credits)
1	Self-Learning Evaluation / class test	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 Theory Examination - 40% of overall marks - 30 Marks

B. Practical examination- 33% of overall marks – 25 Marks

Practical Examination

1. 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).
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.

BIO204C- Enzymology

1. Learning Objectives

- Provide an introduction to enzymes, including their definition, examples, classification, and chemical properties.
- Explain the mechanisms of enzyme catalysis, such as general acid-base, metal-ion catalysis, and covalent catalysis.
- Explore the factors that affect enzyme catalysis, including pH, temperature, and substrate/enzyme concentration.
- Introduce enzyme kinetics, including the Michaelis-Menten equation and Lineweaver-Burke plots.
- Discuss the types of enzyme inhibitors and provide examples of each.
- Explain the methods and applications of enzyme immobilization, including adsorption, covalent binding, cross-linking, entrapping, and encapsulation.

2. Learning Outcomes:

- Students will be able to define enzymes and describe their various properties and classifications.
- Students will understand the mechanisms involved in enzyme catalysis and how different factors influence enzymatic reactions.
- Students will be able to analyze enzyme kinetics using the Michaelis-Menten equation and interpret Lineweaver-Burke plots.
- Students will identify different types of enzyme inhibitors and demonstrate knowledge of their mechanisms of action.
- Students will gain practical skills in enzyme immobilization techniques and understand their applications in various industries.
- Students will recognize the significance of enzymes in industrial processes and identify commonly used enzymes in different industrial sectors, such as fruit juice production, brewing, dairy applications, and detergent/textile industries.

BIO204C - SEM 3 Skill Enhancement Course

Title of the paper : Enzymology

Unit	Content	No. of Lectures
1	**Enzymes Fundamentals and Mechanisms** **1.1. Introduction to enzymes (4L)** 1.1.1. Definition and examples - Active Sites, Enzyme Specificity, Co-factors, Coenzymes, Apoenzymes, Holoenzymes, Exoenzymes, Endoenzymes, Extremophiles-Extremozymes 1.1.2. Classification, Nomenclature, Chemical properties of enzymes 1.1.3. Fischer lock-and-key hypothesis 1.1.4. Koshland induced-fit hypothesis **1.2. Mechanism of Enzyme catalysis (2L)** 1.2.1. General Acid-Base, Metal-Ion catalysis, Covalent catalysis **1.3. Enzyme Kinetics (3L)** 1.3.1. Kinetics of enzyme-catalyzed reactions - Michaelis-Menten equation, Lineweaver-Burke plots **1.4. Factors affecting enzyme catalysis (2L)** 1.4.1. pH 1.4.2. Temperature 1.4.3. Substrate and Enzyme Concentration **1.5. Types of enzyme inhibitors and examples of each (2L)** 1.5.1. Competitive 1.5.2. Uncompetitive 1.5.3. Non-Competitive **1.6. Immobilization of enzymes (2L)** 1.6.1. Types: Adsorption, Covalent binding, Cross-linking, Entrapment, Encapsulation	15

2	**Applications of Enzymes in industries** **2.1 Commonly used industrial enzymes (3L)** 2.1.1. Amylase, Cellulases, Pectinases, Oxidoreductases, Lipase, Protease **2.2 Enzymes used in Fruit Juice Production and Processing (3L)** **2.3 Cell wall degrading enzymes (3L)** **2.4 Enzymes in Brewing (3L)** 2.4.1. Alpha- amylase in fermentation 2.4.2. Enzymes in Malting and Mashing **2.5 Enzymes in Dairy Applications (3L)** 2.5.1.Cheese making process 2.5.2.Milk Protein Hydrolysate beta-Galactosidase 2.5.3.Enzymes in Detergent and Textile Industry	15

BIO204D Practicals based on BIO204C

Unit	Content	No. of Lectures
	Study of Mesophilic enzymes 1. Isolation of mesophiles from a compost sample 2. Screening of potent enzymes : a Qualitative detection of Amylase producer b Qualitative detection of Protease producer c Qualitative detection of Lipase producer 3. Extracellular production of invertase enzyme 4. Purification of the enzyme by Salting out process 5. Evaluation of optimum thermal stability of invertase 6. Detection of enzyme units and specific activity of invertase enzyme 7. Determination of Km and Vmax of invertase by Michaelis-Menten graph 8. Immobilization of invertase enzyme from yeast by (alginate beads) entrapment method and determination of enzyme activity 9. Demonstration of protein characterization and mass determination using Mass Spectroscopy	**30**

References for SEC-Enzymology

1. Lehninger Principles of Biochemistry, Fourth Edition, David L. Nelson and Michael M. Cox. W. H. Freeman; 4th edition (2004)
2. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry by Trevor Palmer, Publisher; Horwood Publishing Limited (2004)
3. Enzymes: A Practical Introduction To Structure, Mechanism And Data Analysis by Robert A. Copeland, publisher: Wiley (2012)
4. Voet D., Voet J.G, Biochemistry 4th Edition., John Wiley and Sons, 2011
5. Practical Enzymology by Hans Bisswanger, Wiley Blackwell, 2007

BIO205C: Bioinformatics and Biostatistics

Learning Objectives:

- Familiarize students with the principles and applications of bioinformatics, biological databases, and biostatistics.
- Introduce students to sequence analysis techniques, including pairwise alignment, sequence similarity search, and multiple sequence alignment.
- Provide hands-on experience with biomolecule structure visualization software and genome data browsers.
- Equip students with the necessary statistical tools and methods for analyzing biological data.
- Combined Learning Outcomes:

Learning Outcomes:

- Students will gain a comprehensive understanding of bioinformatics, biological databases, and biostatistics principles.
- Students will demonstrate proficiency in conducting sequence analysis tasks, such as pairwise alignment and sequence similarity search.
- Students will be able to utilize biomolecule structure visualization software and genome data browsers effectively.
- Students will acquire the necessary statistical skills to analyze and interpret biological data accurately.

BIO205C - SEM 4 Skill Enhancement Course

Title of the paper -Bioinformatics and Biostatistics

Unit	Content	No. of Lectures
1	**1.1. Introduction to Bioinformatics and Biological Databases(4L)** 1.1.2. Primary (NCBI) 1.1.3. Secondary (PIR) 1.1.4. Tertiary or Composite (KEGG) Databases 1.1.5. Specialized databases(CATH,SCOP,pfam) **1.2. Pairwise alignment (3L)** 1.2.1. Identity and Similarity 1.2.2. Global and Local Alignment **1.3 Sequence Similarity Search and Alignment tools(2L)** 1.3.1. FASTA 1.3.2. BLAST **1.4. Multiple Sequence Alignment (MSA) (3L)** 1.4.1.MSA Definition and Consensus 1.4.2. Computational Complexity 1.4.3. Manual Methods 1.4.4. Simultaneous Methods 1.4.5. Progressive Methods **1.5. Biomolecule Structure Visualization Software(2L)** 1.5.1. Rasmol 1.5.2. pymol **1.6. Genome data browser (1L)**	**15**
2	**Biostatistics** **2.1. Definition & Importance of Statistics in Biology (1L)** **2.2. Types of Data, Normal and Frequency Distribution (1L)** **2.3. Measures of Central tendency (2L)** 2.3.1. Mean 2.3.2. Median 2.3.3. Mode **2.4. Representation of Data and Graphs (Bar Diagrams, Pie Charts and Histogram, Polygon and Curve)(2L)** **2.5. Types of Population Sampling (1L)** **2.6. Measures of Dispersion Range (1L)** **2.7. Variance and Coefficient of Variance (2L)**	**15**

	2.7. Standard Deviation and Standard Error (2L) **2.8. Hypothesis Testing (3L)** 2.8.1 Parametric tests: Z test and T test 2.8.2. Non Parametric tests: Chi square and Sign test	

BIO208D Practicals based on Bioinformatics and Biostatistics

Unit	Content	No. of Lectures
1	1. Sequence retrieval from primary databases:NCBI, EMBL, DDBJ 2. Familarization with secondary and tertiary databases: PIR, SWISS-Prot, KEGG 3. Use of NCBI BLAST Tool. 4. Pairwise and Multiple Sequence Alignment. 5. Classification of Proteins using CATH/SCOP. 6. Visualization Protein Molecules using a)Rasmol/Raswin b)Pymol 7. Genome visualization using Genome data browser 8. Calculating Standard deviation and Standard Error from sample data. 9. Hypothesis testing using parametric test: a)Z test b)T test 10. Problems based on Chi-square test	**30**

References:

1. BIOSTATISTICS: A Foundation for Analysis in The Health Sciences (9th Edition) WAYNE W. DANIEL
2. Mahajan's Methods in Biostatistics for Medical Students and Research Workers Eighth Edition
3. Bioinformatics Sequence and Genome Analysis by David Mount.
4.BIOINFORMATICS FOR BEGINNERS Genes, Genomes, Molecular Evolution, Databases and Analytical Tools Supratim Choudhuri.

GENERAL ELECTIVE/OPEN ELECTIVE COURSE

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

OPEN ELECTIVE : Nutrition and Nutraceuticals

Curriculum – Second Year

Undergraduate Programmes Semester-III

and Semester -IV

2024-2025 (As per NEP 2020)

The Scheme of Teaching and Examination for Open Elective course

The performance of the learners shall be evaluated in two components for total 75 marks: Formative Assessment with 27% marks by way of continuous evaluation and Summative assessment by Semester End Examination with 73% 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–27% 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 Formative assessment:

Sr. No.	Particulars	Marks (3credits)
1	Self-Learning Evaluation / class test	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 Theory Examination - 40% of overall marks - 30 Marks

B. Practical examination- 33% of overall marks – 25 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** **BIO204B**	**Semester IV** **BIO208B**
OE 2	Nutrition and nutraceuticals	Balanced Diet	Science behind fad diets	Nutritional Disorders	Nutraceuticals and their applications

Learning objectives:

- To understand the science behind Nutritional Disorders and the potential risks associated with them.
- To identify the key nutrients essential for human health and their roles in various physiological processes.
- To explore the concept of nutraceuticals and their role in promoting health and preventing diseases.

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.

BIO204B - Open Elective: Nutrition and Nutraceuticals

SEMESTER III- Title of Paper: Nutritional disorders (2 credits)

Unit	Content	No. of Lectures
1	**Biomolecules** **1.1 Introduction to biomolecules (2L)** (Carbohydrates, Proteins, Lipids and Vitamins) **1.2 General structure, Dietary sources, Function and Regular Dietary Allowance of biomolecules (3L)** (Carbohydrates, Proteins, Lipids) **1.3 Vitamins : Dietary sources, Function and Regular Dietary Allowance (5L)** 1.3.1. Fat soluble (A,D, E and K) 1.3.2. Water soluble vitamins(Vitamin B complex ,Vitamin C) **1.4 Minerals :Physiological and biochemical functions: (5L)** 1.4.1 Principle elements(Ca, P, Na, K, Cl, Fe, and I) 1.4.2 Trace elements (Zn, F, Cu, Se).	**15**
2	**Introduction to Nutritional Disorders** **2.1 Introduction (1L)** **2.2 Protein Energy Malnutrition (PEM) (2L)** 2.2.1 Kwashiorkor 2.2.2 Marasmus **2.3 Malnutrition and Over nutrition (obesity) (1L)** **2.4 Vitamins deficiency and overconsumption related disorders: (5L)** 2.4.1 Vitamin A: Night blindness, Xerophthalmia, Hypervitaminosis A. 2.4.2 Vitamin D: Rickets, Hypervitaminosis D. 2.4.3 Vitamin C: Scurvy. 2.4.4 Vitamin B-complex: Beri-beri, Pellagra. **2.5 Mineral associated disorders: (3L)** 2.5.1 Iron: Anaemia 2.5.2 Iodine: Goitre 2.5.3 Calcium: Osteoporosis **2.6 Hormone associated disorders:** Diabetes , Hyperthyroidism , Hypothyroidism **(2L)** **2.7 Prevention of nutritional disorders: (1L)** (RDA, Dietary habits and balanced diet)	**15**

Practicals based on Nutritional Disorders

Unit	Practicals	Number of lectures
1,2	1. Qualitative estimation of reducing sugar (DNSA) 2. Qualitative estimation of total sugar (Anthrone) 3. Qualitative estimation of proteins (Follin-Lowry) 4. Qualitative estimation of lipids (Saponification) 5. Qualitative estimation of starch (Iodine) 6. Qualitative estimation of Vitamin C (DCPIP) 7. Estimation of Fe (Titration) 8. Estimation of Ca (Titration) 9. Extraction of casein from milk. 10. Staining of starch granules from potato. 11. Assignment- Case study of ANY ONE nutritional disorder.	**30**

References:

1. Fundamentals of foods, nutrition and diet therapy by S.R. Mudambi and M.V. Rajagopal.
2. Biochemistry-U. Satyanarayana and U. Chakrapani -4th edition.

BIO208B -SEMESTER IV- Title of Paper: Nutraceuticals and their application (2 credits)

Unit	Content	No. of Lectures
1	**Introduction to Nutraceuticals** **1.1. Basics of nutraceuticals**: sources and health benefits. **(2L)** **1.2. Types and categories:(4L)-**Traditional Nutraceuticals, Their Classification, and applications **1.2.1 Non- Traditional Nutraceuticals, their classification and applications (1L)** **1.3 Commercial Nutraceuticals - Startup oriented goals and their applications (2L)** **1.4 Concept of Antioxidant (1L)** **1.5 Nutraceuticals of plant origin:** Plant secondary metabolites- Terpenoids, phenolics, alkaloids, phytoestrogen, organ sulphur compounds, pigments.**(2L)** **1.6 Nutraceuticals of animal origin:** chitin, chitosan,glucosamine, choline, lecithin, eicosapentaenoic acid.**(3L)**	**15**
2	**Food additives and adulterants** **2.1Introduction:(2L)**-Definition, classification, function/ need of food additives **2.2Food preservatives.(1L)** **2.3 Overview of Antimicrobial agents**(types, mode of action and their application)**(2L)** **2.4 Forms of food additives:(3L)-**Sequestrants, surface active agents, stabilizers, thickeners, maturing agents, sweeteners, acid regulators. **2.5 Food colour and flavour(2L)-**Natural and synthetic, properties, applications **2.6 Food adulteration: (4L)** Definition, types, food adulterants with examples and its health effects. **2.7 Regulatory aspects and safety issues.(1L)**	**15**

Practicals based on Nutraceuticals

Unit	Practicals	Number of lectures
1,2	1.Study any two IP monographs and their identification using characteristic features of nutraceutical important plants like *Curcuma longa, Zingiber officinale.* 2. Design a diet plan for specific conditions w.r.t nutraceuticals- Pregnancy, lactation, sportsperson, infants. 3. Formulation of the functional foods and assessment of its nutritional value. 4. Formulation of the food products using nutraceuticals. 5. Shelf life studies (visible appearance) of different developed functional foods. 6. Testing for toxic adulterants in food samples.	**30**

References :(Nutraceuticals)

1. Frazier,W.C. and Weshoff, D. (1988) Food Microbiology. Tata McGraw-Hill
2.John Shi, Functional food Ingredients and Nutraceuticals processing technologies, Taylor and Francis.
3.Yashwant Pathak, Handbook of Nutraceuticals, volume1, CRC Press, 2010.
4.Israel Goldberg, Functional Foods (Designer Foods, Pharmafoods,Nutraceuticals), Aspen publication,1999.