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

For the Course of Microbiology

Curriculum – Second Year Undergraduate Programme

Semester-III and Semester -IV

(Under NEP)

2024-25

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 Certificat e 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.

Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course. Learn ers 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

Preamble

Microbiology is the study of microbes such as bacteria, viruses, fungi, algae, cyanobacteria, protozoa and many other microscopic organisms. They are very important as they carry out diverse activities ranging from causing diseases in humans, animals and plants to production of highly useful products like antibiotics, enzymes, alcohol, fermented foods, and recycling of dead and decaying organic matter in the environment. Microbiology is emerging as a key biological science as recognition of the ability of microorganisms to decompose materials such as herbicides, pesticides, and oils in oil spills; potential of microorganisms as food supplements; exploitation of microbial activity to produce energy such as methane gas for rural consumption; and the potential of new therapeutic substances by microorganisms.

Knowledge of different aspects of Microbiology has become crucial and indispensable to the society. Several discoveries in the last two to three decades, which significantly impact these areas, have put Microbiology on the centre stage of teaching, research and development all over the globe. In a country like ours, where fast and tremendous technological advancement and population growth happens, the demand and supply of trained man power is not on par. Introduction of a Microbiology program with an amalgamation of interdisciplinary aspects of the field is the remedy to this major skill gap in the country.

The SYBSc Microbiology syllabus (SMB) is a Choice based credit system comprising of two papers having three units each in both semesters. The course covers different disciplines like Microbiology, Immunology, Biochemistry, Industrial Microbiology, Environmental Microbiology, and Food Microbiology.

The understanding, knowledge and skills in Microbiology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts. It is envisaged that the students trained under this curriculum will have the required attributes of knowledge, skills, temperament and ethics related to the subject of Microbiology to meet the increasing demand.

Course Objectives and Learning Outcomes:

Semester III

USMB 301

Course Objectives:

The course aims –

1. To Strengthen the basics of Quantitative macromolecule estimations, thermodynamics, and bioenergetics.
2. To identify the significance of High-energy phosphate compounds, NAD, NADPH and FAD in metabolic pathways.
3. To understand and apply the laws of inheritance.
4. To understand significance of nucleic acids, their structures, and diverse functions.
5. To describe the process of DNA methylation and the structural complexity of chromosomes in eukaryotic cells.
6. To understand the application of biofuels, biofertilizer, biopesticides, microbial enzymes and nanotechnology.

Learning Outcomes:

After the completion of the course, the learner will be able to-

1. Compare the various methods of estimation for different types of macromolecules.
2. Explain the principles of thermodynamics, characteristics of metabolic pathways and role of high energy phosphate compounds.
3. Elaborate, apply and solve problems using Mendel's law of heredity.
4. Analyze the structural details of nucleic acids transformative mechanisms.
5. Describe the functions of nucleic acids, comprehend DNA methylation processes and the structural organization of eukaryotic chromosomes.
6. Explain the role of biofuels, marine microbes, nanotechnology in solving environmental and health care problems.

USMB 302

Course Objectives:

The course aims -

1. To understand the role of microorganisms in air, space, water, marine environment and soil.
2. To understand different types of sampling techniques used for environmental sampling.
3. To understand and apply the importance of biogeochemical cycles and soil bioremediation.
4. To acquire knowledge of water treatment, purification and quality standards in water analysis.

5. To understand the analysis of waste water and modern wastewater treatment strategies.

Learning outcomes:

After the completion of the course, the learner will be able to-

1. Acquire skills to analyze methods used for sampling environmental samples
2. Discuss the role of different microorganisms found in air,space and soil.
3. Explain the importance of different biogeochemical cycles.
4. Discuss the kinds and significance of microorganisms in various ecological niches.
5. Elaborate on the various wastewater and solid waste treatment methods and acquire skill to analyze water and sewage samples.

Semester IV

USMB 401

Course Objectives:

The course aims -

1. To understand concepts related to enzyme characteristics, enzyme kinetics and enzyme purification.
2. To describe the role of coenzymes and regulation of enzyme activity.
3. To comprehend the first and second line of immunological defense.
4. To understand the concepts and importance of epidemiology.
5. To describe principle and applications of Centrifugation, Chromatographic and Electrophoretic techniques.
6. To study the principle and applications of U.V - Visible Spectroscopy.

Learning outcomes:

After the completion of the course, the learner will be able to-

1. Discuss the properties of enzymes and mode of action of different types of enzymes.
2. Elaborate on the effect of pH, temperature, substrate concentration, inhibitor on enzyme activity.
3. Explain the different systems involved in immune defenses.
4. Explain the role and working of first and second line of defense in immunity.
5. Discuss Patterns of disease, Healthcare-associated infections, Emerging infectious diseases, Bioterrorism.
6. Analyse different biological samples using instruments like centrifuges and U.V - Visible Spectroscopy.

USMB 402

Course Objectives:

The course aims -

1. To explain different concepts of food preservation and control of spoilage in food.
2. To understand and apply advanced trends of packaging used in industries.
3. To discuss types of fermenters used in industries.
4. To elaborate stepwise fermentation of milk.
5. To introduce the role of regulatory bodies involved in food and dairy industry regulation.

Learning outcomes:

After the completion of the course, the learner will be able to-

1. Understand food spoilage and food adulteration.
2. Compare different packaging materials and analyze the quality of materials.
3. Discuss the different fermenters used in industry.
4. Acquire and apply knowledge on fermentation products.
5. Analyse microbiological quality of milk & milk products

Sr No.	Subject Code	Subject Unit Title		Hours/Lectures	Total No. of hours /lectures	Credit	Total Marks
1	US-SMB-301 Biomolecules, Genetics and Microbial Biotechnology	1	Biomolecules and bioenergetics	15	45 L	3	75 (60+ 15)
		2	Classical genetics and Nucleic acid Structure	15			
		3	Microbial Biotechnology	15			
2	US-SMB-302 Environmental Microbiology	1	Aeromicrobiology and Astromicrobiology	15	45 L	3	75 (60+ 15)
		2	Water microbiology	15			
		3	Soil and Geomicrobiology	15			
5	US-SMB-3P1		Practicals based on US-SMB -301			1	25
6	US-SMB-3P2		Practicals based on US-SMB -302			1	25
			TOTAL			08	200

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

1 credit = 15 hours theory/ 30 hours practical

SEMESTER III

US-SMB-301

Course Code	Unit	Topics	Credits
US-SMB-301		**Biomolecules, Genetics and Microbial Biotechnology**	**3**
	I	Biomolecules and bioenergetics	
	II	Classical genetics and Nucleic acid Structure	
	III	Microbial Biotechnology	
	Practicals based on the above three courses in theory		**1**

US-SMB-301- Biomolecules, Genetics and Microbial Biotechnology				
Course Code	**Unit**	**Topics**	**Credits**	**L / Sem**
US-SMB-301	**I**	**Biomolecules and bioenergetics**	**1**	**15L**
		1.1. Macromolecular composition of a microbial cell and elemental analysis - tabular list [1L] Carbon, Nitrogen, Phosphorus **1.2. Estimation of Proteins and amino acids [3L]** 1.2.1 Amino acid estimation by Ninhydrin method 1.2.2 Protein estimation by Biuret method (Direct and indirect) 1.2.3 Advanced methods for protein quantitation- Tabular list **1.3. Estimation of Carbohydrates [2L]** 1.3.1 Total carbohydrates by Anthrone method 1.3.2 Reducing Sugars by DNSA method 1.3.3 Advanced methods for total carbohydrate quantitation - Tabular list **1.4. Extraction of Lipids by Soxhlet method [1L]** 1.4.1 Advanced methods for lipid quantitation (with and without extraction) - Tabular list **1.5. Estimation of Nucleic acids [2L]** 1.5.1 DNA by DPA method 1.5.2 RNA by Orcinol method 1.5.3 Advanced methods for Nucleic acid quantitation - Tabular list **1.6. Introduction to metabolism & bioenergetics [6L]** 1.6.1 Biological systems conform to the general laws of thermodynamics (Free energy, Enthalpy, Entropy) 1.6.2 Introduction to metabolism and metabolic pathways 1.6.3 High-energy phosphate compounds play a central role in energy capture and transfer (tabular) 1.6.4 Structure, synthesis and consumption of ATP 1.6.5 Oxidation-reduction reactions		

		1.6.6 Role of NAD, NADPH and FAD in metabolic pathways		
	II	**Classical genetics and Nucleic acid Structure**	**1**	**15L**
		2.1. Mendel's law of heredity [2L] 2.1.1 Definition (alleles, homozygous, heterozygous, genotype, phenotype, trait, monohybrid and dihybrid cross) 2.1.2 Overview of the Principle of dominance, Principle of segregation, Principle of independent assortment and Test cross. 2.1.3 Mendel's Principle in Human genetics- Pedigree Analysis **2.2. Nucleic Acid Structure [7L]** 2.2.1 DNA stores genetic information 2.2.2 DNA molecules have a distinctive base composition 2.2.3 DNA is a double helix DNA that can occur in different 3D forms 2.2.4 DNA sequences adopt unusual structures 2.2.5 Messenger RNAs code for polypeptide chains 2.2.6 Many RNAs have complex 3D structures **2.3. Nucleic acid chemistry [3L]** 2.3.1 Denaturation of double-helical DNA and RNA 2.3.2 Nucleic acid from different species can form hybrids 2.3.3 Nucleotides and nucleic acids undergo non- enzymatic transformations 2.3.4 DNA methylation **2.4. Other Functions of nucleotides [1L]** **2.5. Structures of chromosomes of eukaryotic cell [2L]**		
	III	**Microbial Biotechnology**	**1**	**15L**
		3.1. Energy and Biotechnology [4L] 3.1.1 Biofuels 3.1.2 Sources of biomass 3.1.3 Production of ethanol and methane from biomass		

		3.1.4 Hydrogen production **3.2. Biotechnology and Health care [3L]** 3.2.1 Use of probes in disease diagnosis 3.2.2 Use of monoclonal antibodies in disease diagnosis and treatment. **3.3. Biofertilizer, Biopesticide [2L]** **3.4. Novel uses of marine microbes and microbial enzymes [1L]** **3.5. Nanobiotechnology [5L]** 3.5.1 Introduction of Nanobiotechnology 3.5.2 Types of nanomaterials- nanoparticles, nanocapsules, nanotubes, liposomes, nanogels, dendrimers 3.5.3 Application in drug and gene delivery		

Paper I Self-Learning topics (Unit wise)

Unit	Topics
1	1.1 Macromolecular composition of a microbial cell Advanced methods of macromolecule detection
2	2.1 Mendel's law of heredity
2	2.2.1 DNA stores genetic information
3	3.5.1 Introduction of nanobiotechnology

Online Resources

Online module: Cell chemistry
https://nptel.ac.in/courses/102/105/102105087/
https://actascientific.com/ASMI/pdf/ASMI-05-1072.pdf
https://www.cusabio.com/c-21049.html
https://www.mdpi.com/1422-0067/25/4/2249
Online module: Mendelian Inheritance Patterns & Law of Heredity
https://www.swayamprabha.gov.in/index.php/program/archive/9
Online module: DNA-1
https://www.swayamprabha.gov.in/index.php/program/archive/9
Online module: Introduction to Nanotechnology, Lec-1
https://nptel.ac.in/courses/102/107/102107058

US-SMB-302

Course Code	Unit	Topics	Credits
US-SMB-302		**Environmental Microbiology**	**3**
	I	Aeromicrobiology and Astromicrobiology	
	II	Water microbiology	
	III	Soil and Geomicrobiology	
	Practical's based on the above three courses in theory		**1**

US-SMB-302 Environmental Microbiology				
Course Code	**Unit**	**Topics**	**Credits**	**L / Sem**
US-SMB-302	**I**	**Aeromicrobiology and Astromicrobiology** **1.1.Aeromicrobiology [6L]** 1.1.1 Important airborne pathogens and toxins 1.1.2 Aerosols, nature of bioaerosols 1.1.3 Aeromicrobiological pathway, microbial survival in the air 1.1.4 Extramural aeromicrobiology 1.1.5 Intramural aeromicrobiology **1.2. Sampling devices for the collection of air samples, detection of microorganisms on fomites [3L]** **1.3. Air Sanitation [3L]** **1.4. Air Quality Standards - ISO, NAAQS [1L]** **1.5. Astromicrobiology [2L]** 1.5.1 Survival of Microorganisms in Outer Space 1.5.2 Microbiological research in the space environment.	**1**	**15L**
	II	**Water microbiology** **2.1 Freshwater Environments and microorganisms found in-** Springs, lakes, wetlands, glaciers, Permanently frozen lakes, streams and rivers **[1L]** **2.2. Potable water [4L]** 2.2.1 Definition Water purification & Water quality standards Bureau of Indian Standards (BIS) specifications for potable water (IS - 10500: 2012). 2.2.3 Pathogens transmitted through water (tabular) **2.3. Microbiological analysis of water [3L]** Indicator organisms and their detection in water	**1**	**15L**

		Total Coliforms, Fecal Coliforms and *E.coli*, Fecal *Streptococci, Clostridium perfringens* **2.4 Marine Environments and micro-organisms found in-[1L]** 2.4.1 Photic zone, Benthic zone, Coastal marine systems. **2.5. Sewage Microbiology [6L]** 2.5.1 Types and characteristics of wastewater 2.5.2 Modern wastewater treatment: Primary, Secondary and Tertiary treatment. 2.5.3 Monitoring of wastewater treatment process (BOD, COD). 2.5.4 Removal of pathogens by sewage treatment processes		
	III	**Soil & Geo Microbiology**	**1**	**15L**
		3.1. Soil as microbial environment [2L] 3.1.1 Biotic and abiotic stresses 3.1.2 Types of micro-organisms in Soil **3.2. Methods of studying soil microorganisms [5L]** 3.2.1 Sampling 3.2.2 Cultural methods 3.2.3 Physiological methods 3.2.4 Immunological methods 3.2.5 Nucleic acid-based methods 3.2.6 Radioisotope technique **3.3. Biogeochemical cycles [5L]** 3.3.1 Carbon 3.3.2 Nitrogen 3.3.3 Phosphorous 3.3.4 Sulphur 3.3.5 Iron **3.4. Soil Bioremediation [3L]** 3.4.1 Microorganisms used in remediation technologies 3.4.2 Stimulation of bioremediation by the utilization of biogenic substances 3.4.3 The classification of bioremediation methods 3.4.4 In situ methods 3.4.5 Ex-situ methods		

Paper 2 Self-Learning topics (Unit wise)

Unit	Topics
1	2.5.1 Types of waste water
2	3.3.1 Carbon cycle
3	3.3.2 Nitrogen cycle

Online Resources

Online module : Sources & types of waste water
https://nptel.ac.in/courses/105/105/105105178/
Online module: Biogeochemical cycles-1
https://nptel.ac.in/courses/102/105/102105087/
Online module: Biogeochemical cycles-1
https://nptel.ac.in/courses/102/105/102105087/

SEMESTER III PRACTICALS

1	**Practical's based on US- SMB-301**	**Credits**	**Time**
	1. Analysis of macromolecules from microbial cellular extracts: a) Quantification of Total sugar by Anthrone method (Demonstration) b) Quantification of Reducing sugars by DNSA method c) Quantification of Proteins (free proteins and whole microbial cells) - Biuret method d) Quantification of DNA by DPA method e) Quantification of RNA by Orcinol method 2. Extraction & Quantification of lipid by Soxhlet method (Demonstration) 3. Problems on bioenergetics to calculate the Keq., Gibb's energy, enthalpy, etc. 4. Problems based on Mendelian genetics 5. Extraction and detection of biopolymers from Azotobacter 6. Preparation of nanoparticles and its characterization	**1**	**30 hrs**
2	**Practical's based on US- SMB-302**	**1**	**30 hrs**
	1. Analysis of air microflora from intramural and extramural environments, determination of sedimentation rate and screening of factors affecting air microflora. 2. Enumeration of microorganisms in air and studying the effect of fumigation on microbial load. 3. Routine analysis of water: a) Enumeration of culturable bacteria by Heterotrophic Plate Count b) Detection and Enumeration of coliforms in water by Presumptive Test. c) Study of types of coliform in water by confirmed and completed Test. 4. Wastewater analysis: a) Study of microbial flora in raw and treated sewage b) Determination of total solids in wastewater c) Determination of BOD and COD of wastewater. 5. Study of fresh water and marine ecosystem using Winogradskys column. 6. Isolation of Bacteria, Actinomycetes and Fungi from soil. 7. Enrichment and isolation of Cellulose degraders, Sulphate reducers and Phosphate solubilizers from soil 8. Enumeration of viable culturable bacteria from soil.		

Sr No.	Subject Code		Subject Unit Title	Hours/Lectures	Total No. of hours /lectures	Credit	Total Marks
1	US-SMB-401 Enzymology, Instrumentation and Immunology	1	Enzymology	15	45 L	3	75 (60+15)
		2	Instrumentation I	15			
		3	Immunology and Epidemiology	15			
2	US-SMB-402 Food, Industrial and Dairy Microbiology	1	Food Microbiology	15	45 L	3	75 (60+15)
		2	Industrial Microbiology	15			
		3	Dairy Microbiology	15			
5	US-SMB-4P1		Practicals based on US-SMB -401			1	25
6	US-SMB-4P2		Practicals based on US-SMB -402			1	25
			TOTAL			08	200

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

1 credit = 15 hours theory/ 30 hours practical

SEMESTER IV

US-SMB-401

Course Code	Unit	Topics	Credits
US-SMB-401		**Enzymology, Instrumentation and Immunology.**	**3**
	I	Enzymology	
	II	Instrumentation I	
	III	Immunology and Epidemiology	
	Practicals based on the above three courses in theory		**1**

US-SMB-401- Enzymology, Instrumentation and Immunology				
Course Code	**Unit**	**Topics**	**Credits**	**L / Sem**
US- SMB-401	**I**	**Enzymology** **1.1 Introduction to Enzymes [5L]** 1.1.1 Definitions of enzymes, coenzymes, cofactors, prosthetic group, apoenzymes, holoenzymes, metalloenzymes, endo/exoenzyme, inducible/ constitutive enzymes, zymogen, isoenzymes and ribozymes with important examples 1.1.2 General properties of enzymes 1.1.3 Mechanism of enzyme action 1.1.4 Derivation of Michaelis-Menten equation 1.1.5 Lineweaver Burk plot 1.1.6 Classification of enzymes **1.2 Overview of Coenzyme [1L]** Coenzymes: Different types and reactions catalyzed by water-soluble coenzymes and fat-soluble vitamins (in tabular form) **1.3 Enzyme Kinetics [7L]** 1.3.1 Effect of temperature and pH 1.3.2 Effect of substrate concentration (Saturation kinetics) 1.3.3 Effect of Inhibitors- Irreversible and Reversible- Competitive, Non-competitive and Uncompetitive inhibitors 1.3.4 Multi substrate reactions- Ordered, Random and Ping Pong reactions 1.3.5 Regulation of Enzyme Activity- Allosteric regulation, Covalent Modification (Only definitions) 1.3.6 Allosteric effects in enzyme catalyzed reactions- Koshland-Nemethy and Filmer model & Monod, Wyman and Changeux model. **1.4 Principles of Enzyme Purification [2L]**	**1**	**15 L**

	II	**Instrumentation**	**1**	**15 L**
		2.1 Centrifugation [3L] 2.1.1 Introduction 2.1.2 Basic principles of sedimentation 2.1.3 Types of rotors 2.1.4 Preparative centrifugation & its applications 2.1.5 Analytical centrifugation and its application **2.2 Chromatographic techniques [7L] – only Principle and Applications** 2.2.1 General Principles of chromatography, General techniques of chromatography (Column Chromatography, Thin Layer chromatography, Paper Chromatography). 2.2.2 Adsorption chromatography 2.2.3 Partition chromatography 2.2.4 Ion exchange chromatography 2.2.5 Exclusion chromatography 2.2.6 Affinity chromatography 2.2.7 High-performance liquid chromatography 2.2.8 Gas chromatography **2.3 Electrophoresis: [3L]** 2.3.1 General principles 2.3.2 Factors affecting electrophoresis 2.3.3 Nucleic Acid electrophoresis: AGE 2.3.4 Protein Electrophoresis: SDS-PAGE **2.4 U.V - Visible Spectroscopy: Principle, Instrumentation & Applications [2L]**		
	III	**Immunology and Epidemiology**		
		3.1 Host defense [8L] 3.1.1 Overview of hematopoiesis 3.1.2 Systems involved in immune defenses: The reticuloendothelial system (RES), the spaces surrounding tissue cells that contain extracellular fluid (ECF),the bloodstream, and the lymphatic system 3.1.3 Chemical barriers involved in immune response (cationic peptides, bacteriocins, cytokines, interferons, pyrogens, acute-phase proteins, and complement)	**1**	**15 L**

		3.1.4 Different stages of phagocytosis, PAMP, PRR & Inflammation: Dynamics of inflammatory mediators **3.2 Epidemiology [7L]** 3.2.1 Epidemiological terminologies: Epidemiology, Sporadic diseases, Endemic diseases, Hyperendemic diseases, Epidemic diseases, Index case, Pandemic disease, Outbreak, Morbidity rate, Prevalence rate, Mortality 3.2.2 Patterns of disease: Predisposing factors, development of disease, the spread of infection, the transmission of disease 3.2.3 Healthcare-associated infections microorganisms in the hospital, compromised host, chain of transmission, control of healthcare-associated infections 3.2.4 Emerging infectious diseases (List) 3.2.5 Bioterrorism- Biological warfare and biological weapons		

Paper I Self-Learning topics (Unit wise)

Unit	Topics
1	**1.1 Introduction to Enzymes**
2	**2.5 U.V Visible Spectroscopy**
3	**3.1 Host defense**
3	**3.2 Epidemiology**

Online Resources

Online module: Introduction to Enzymes
https://nptel.ac.in/courses/102/102/102102033/
Online module: Spectroscopy https://www.swayamprabha.gov.in/index.php/program/archive/9
Online module: Epidemiology
https://nptel.ac.in/courses/105/107/105107173/
Online module: Host Defense-Introduction to immune system
https://nptel.ac.in/courses/104/108/104108055/

SEMESTER IV

US-SMB-402

Course Code	Unit	Topics	Credits
US-SMB-402		**Food, Industrial and Dairy Microbiology**	**3**
	I	Food Microbiology	
	II	Industrial Microbiology	
	III	Dairy Microbiology	
	Practicals based on the above three courses in theory		**1**

US-SMB-402- Food, Industrial and Dairy Microbiology				
Course Code	**Unit**	**Topics**	**Credits**	**L / Sem**
US-SMB-402	**I**	**Food Microbiology** **1.1 Introduction: Significance, food as a substrate and sources [1L]** **1.2 Microbial growth in foods, Intrinsic and extrinsic factors influencing growth [2L]** **1.3 General Principles of spoilage [4L]** 1.3.1 Spoilage of fresh foods: fruits and vegetables, eggs, meat, poultry and seafood (a tabular form with examples) 1.3.2 Foodborne diseases and intoxications (tabular form **1.4 General principles of food preservation (principle of each method and example of foods only) [3L]** 1.1.1 High temperature 1.1.2 Low temperature 1.1.3 Drying 1.1.4 Radiations (UV, Gamma rays and Microwave processing) 1.1.5 Food additives and chemical preservatives with examples (Tabular Representation-Organic acids and their salts, Sugar, Salt) **1.4 Food control with an introduction to HACCP [1L]** **1.5 Food sanitation [3L]** 1.5.1 Food handling 1.5.2 Sanitation and hygiene, 1.5.3 Food laws and adulteration Consumer protection and guidance society **1.6 Advances in Packaging Methods, Processes and Systems[1L]**	**1**	**15 L**

	II	**Industrial Microbiology**	**1**	**15 L**
		2.1 Introduction [3L] 2.1.1 An introduction to fermentation processes 2.1.2 The range of fermentation processes 2.1.3 The Component parts of a fermentation process **2.2 Desirable characteristics and strains of industrially important microorganisms [2L]** **2.2 Types of fermentations [1L]** 2.2.1 Aerobic fermentation 2.2.2 Anaerobic fermentation **2.3 Modes of fermentation [5L]** 2.3.1 Batch, continuous and fed-batch fermentation 2.3.2 Surface, Submerged and Solid-state fermentation. **2.4 Typical Fermenter design [4L]** 2.4.1 Design of a typical aerobic fermenter 2.4.2 Components of a typical fermenter		
	III	**Dairy Microbiology**	**1**	**15 L**
		3.1 Milk [2L] 3.1.1 Definition, composition 3.1.2 Sources of contamination of milk **3.2 Control of Microorganisms in Dairy products [2L]** 3.2.1 Centrifugation and filteration 3.2.2 Refrigeration 3.2.3 Heat Treatment (UHT, LTLT, HTST) **3.3. Milk products:- production and spoilage of** 3.3.1 Yoghurt [2L] 3.3.2 Butter [2L] 3.3.3 Cheese-Cheddar and Cottage cheese [2L] 3.3.4 Fermented milks [1L] 3.3.5 Concentrated and dry milk [1L] **3.4 Microbiological Quality of Milk & Milk Products [3L]** 3.4.1 SPC 3.4.2 Coliform count 3.4.3 LPC 3.4.4 Thermophilic 3.4.5 Psychrophilic counts 3.4.6 RPT (RRT, MBRT, DMC) 3.4.7 Standards used for Quality of Milk & Milk Products - ISO, FSSAI, BIS/ISI, AGMARK, FAO- Codex		

Paper 2 Self-Learning topics (Unit wise)

Unit	Topics
1	1.3 General principles of food preservation
1	1.2 Microbial growth in foods, Intrinsic and extrinsic factors influencing growth
2	2.1 Industrial Microbiology-Introduction
3	3.3 Milk products:- spoilage

Online Resources

Online module : General principles of food preservation
https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/134
Online module: Microbial growth in foods, Intrinsic and extrinsic factors influencing growth
https://onlinecourses.nptel.ac.in/noc19_ag07/preview
Online module: Industrial microbiological processes and fermentation in industry
https://www.swayamprabha.gov.in/index.php/program/archive/9
Online module: Milk products:- spoilage
https://www.digimat.in/nptel/courses/video/126105013/L39.html

Detailed scheme Practicals

SEMESTER IV PRACTICALS

US-SMB P-4	Practicals based on the above three courses in theory	Credits	Time Duration
1	1. Screening of organisms producing enzymes of commercial significance -Isolation of amylase, protease, lipase producers. 2. Extracellular production of invertase from yeast and study of Enzyme kinetics – effect of various parameters on activity of invertase. a) Effect of pH b) Effect of Temperature c) Effect of enzyme concentration d) Effect of substrate concentration - Determination of Km and Vmax by Michaelis Menton's graph. 3. Separation and identification of amino acids by ascending paper chromatography. 4. Thin Layer Chromatography- a tool for separation and identification of sugars. 5. Application of density gradient centrifugation to carry out sizing of yeast cells. 6. Isolation of genomic DNA from eukaryotic, prokaryotic cells and using Agarose gel electrophoresis (AGE) for their visualization. 7. Quantitation of DNA by UV-VIS spectroscopy.	**1**	**30 hrs**
2	1. Rapid tests to check quality of raw and pasteurized milk 2. Microbiological analysis of raw and pasteurized milk 3. Microbiological analysis of butter and cheese 4. Screening of antibiotic producers from soil 5. Isolation of microorganisms causing food spoilage - pectinolytic 6. Inhibition of spoilage causing organisms using physical and chemical agents - a. Physical agent - Heat, Determination of TDT and TDP b. Chemical agent - Natural preservative -Salt, Determination of Salt tolerance 7. Screening for Food adulterants from different samples. 8. Design a seven-step HACCP plan for a particular food product 9. Visit to industry	**1**	**30 hrs**

References

Course: US-SMB-301

1. Methods in Microbiology, Vol.5B, Norris & Ribbon, Academic Press.
2. Laboratory Manual in Biochemistry, J. Jayaraman, (2011), 2nd edition, New Age International.
3. Peter J. Russell (2006), I Genetics- A molecular approach, 3rd edition.
4. Benjamin A. Pierce (2020), Genetics a conceptual approach, 7th edition, W. H. Freeman and company.
5. R. H. Tamarin, (2017), Principles of genetics, 7th Edition, Tata McGraw Hill.
6. Robert Weaver, (2011), Molecular biology, 5th edition, Mc Graw Hill international edition.
7. Brock biology of microorganisms / Michael T. Madigan. (*et al.)*— 15th edition, Pearson.
8. Prescott Harley Kleins Microbiology, 7th Edition, McGraw-Hill.
9. Tortora, Funke, and Case's Microbiology: An Introduction, 13th Edition.
10. A textbook of biotechnology R. C. Dubey 4th edition. S. Chand.
11. Nanotechnology: Principles and practices, 3rd edition by Sulabha K. Kulkarni
12. Medical Biotechnology, 1st Edition (2013) by Bernard R. Glick, Cheryl L. Pattern, T. L. Delovitch.
13. Gerhardtova, I.; Jankech, T.; Majerova, P.; Piestansky, J.; Olesova, D.; Kovac, A.; Jampilek, J. Recent Analytical Methodologies in Lipid Analysis. Int. J. Mol. Sci. 2024, 25, 2249. https://doi.org/10.3390/ijms25042249
14. CUSABIO team. Approaches to Determinate Protein Concentration. https://www.cusabio.com/c-21049.html
15. https://www.lifeasible.com/custom-solutions/food-and-feed/food-testing/chemical-and-nutritional-analysis/carbohydrate-analysis/

Course: US-SMB-302.

1. Fundamental Principles of Bacteriology, 7th Edition; A.J. Salle, Tata Mc Graw Hill Publishing Company.
2. Air Quality Standards- NAAQS Manual, Volume I.
3. Environmental microbiology by Ian L. Pepper Charles, P Gerba Terry J, 3rd edition.
4. Prescott Harley Klein's Microbiology, 7th Edition, McGraw-Hill.
5. Fundamentals of Microbiology, Martin Frobisher, 9th Edition.
6. Introduction to Environmental Microbiology, Barbara Kolwzan, Waldemar Adamiak, 6th edition.
7. Soil Microbiology- 4th Edition, N.S Subba Rao, 2000, Oxford and IBH Publishing Co. Pvt Ltd.
8. Environmental Biotechnology- 2nd Edition (2005), Alan Scragg.

Course: US-SMB-401

1. Harper's illustrated biochemistry. Rodwell, V. 31st edition. New York: Lange Medical Books/McGraw-Hill.
2. Fundamentals of Biochemistry. D. Voet and J. Voet Publisher Wiley Plus Edition 5th.
3. The physiology and biochemistry of prokaryotes, White D., 4th edition Oxford University Press, 2011.
4. Lehninger- Principles of Biochemistry- David Nelson, Michael Cox. 7th edition W.H. Freeman & Company.
5. Principles & techniques of Biochemistry & Molecular biology, 7th edition, Keith Wilson & John Walker, Cambridge University Press, 2010.
6. Williams B.L. & Wilson K., A Biologist's Guide to Principles and Techniques of Practical Biochemistry, American Elsevier Pub. Co. 1975.
7. Brock biology of microorganisms / Michael T. Madigan. [et al.], 15th edition, Pearson.
8. Talaro: Foundations in Microbiology, 11th edition.
9. Prescott Harley Kleins Microbiology, 7th edition, McGraw-Hill.
10. Tortora, Funke, and Case's Microbiology: An Introduction, 13th edition

Course: US-SMB-402

1. Outlines of Dairy Technology, Sukumar De, Oxford University Press.
2. Modern Food Microbiology. James Jay, 7th edition.
3. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill, 5th edition.
4. Food Science by Sumati R. Mudambi, Shalini Rao, M.V. Rajagopal, revised 2nd edition, (2006), New Age international publications.
5. HACCP Principles & Application Guidelines by FDA.
6. Managing Food Safety: A Manual for the Voluntary Use of HACCP Principles for Operators of Food Service and Retail Establishments.
7. Stanbury, P.F., Whitaker, A. and Hall, S.J. (2003) Principal of Fermentation Technology. 2nd Edition, Butterworth-Heinemann, Oxford.
8. Industrial Microbiology- A. H. Patel
9. Industrial Microbiology- L. E. Casida- John Wiley & Sons

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

For the Skill Enhancement Course (Microbiology department)

Curriculum – Second Year
Undergraduate Programme Semester-III
and Semester -IV

(Under NEP)

2024-25

Course Objectives and Learning Outcomes:

SEC - Semester III

Clinical Diagnostics and Taxonomy

Learning Objectives

The course aims -

1. To explain the process of collection and importance of different types of specimens useful in clinical diagnosis.
2. To introduce the process of identification of pathogens using microscopic, cultural, biochemical characteristics and molecular methods.
3. To understand the principle and applications of Antigen-Antibody assay.

Learning Outcome

After completion of the course the learner will be able

1. To acquire knowledge regarding the identification of pathogens in clinical microbiology laboratory.
2. To develop skills required to perform Antigen-Antibody assays.
3. To develop understanding of molecular methods of diagnosis.

Scheme of Examination

ASSESSMENT PATTERN:

Theory

Summative (30 M per paper)

Formative (20M per paper)

Practical

Semester End Practical examination: (25 M per paper)

SEC - Semester IV

Data Analytics

Learning Objectives

The course aims -

1. To enable the students to collect data, classify and collate the quantitative and qualitative data.
2. Enable the learner to analyze the results of the experiments by different statistical tests.
3. To explain different types of databases for genomics and proteomics.
4. To differentiate between the various softwares and their applications in Bioinformatics

Learning Outcomes:

After the completion of the course, the learner will be able to-

1. Understand the criteria that can be used to select an appropriate statistical test in a research problem and present statistically validated conclusions.
2. Compare results of different samples in a population by using Statistical tests.
3. Comprehend the concepts and tools used in Sequence alignment, phylogenetic analysis.
4. Analyse and compute all types of biological data using tests and softwares.

Scheme of Examination

ASSESSMENT PATTERN:

Theory

Summative (30 M per paper)

Formative (20M per paper)

Practical

Semester End Practical examination: (25 M per paper)

Skill Enhancement Course

SEMESTER – III

	Clinical Diagnostics and Taxonomy		
Unit I	**Clinical and molecular diagnosis in healthcare**	**Credit**	**L/Sem**
	1.1 Overview of the Clinical microbiology laboratory [1L] **1.2 Different types of specimens in clinical diagnosis - Collection and processing of samples correlating with type of infections (blood, pus, sputum, Urine and feces [2L]** **1.3 Identification of microorganisms from clinical samples - Microscopic, cultural and biochemical characteristics [4L]** 1.3.1 Growth on Selective and Differential Media 1.3.2 Specialized biochemical identification systems 1.3.3 Direct Observation (Microscopic Analysis) 1.3.4 Rapid Methods of Identification **1.4 Bergey's manual of Systematic Bacteriology [1L]** 1.4.1 Understanding classification and identification schemes for bacteria using Bergey's manual **1.5 Immunological Methods of Diagnosis- Based on Antigen - Antibody reactions [5L]** 1.5.1 Precipitation 1.5.2 Agglutination- Direct and Passive Agglutination 1.5.3 Flocculation 1.5.4 Serology 1.5.5 Radioimmunoassay 1.5.6 Enzyme Immunoassays 1.6 **Molecular Methods of diagnosis [2L]** 1.6.1 Immunofluorescence 1.6.2 Fluorescent In Situ Hybridization (FISH)	**1**	**15**

II	**Diagnostics and Taxonomy**	**1**	**15**
	2.1 Growth-Independent Diagnostic Methods [10L] 2.1.1 Phage typing 2.1.2 Fatty Acid Profiles 2.1.3 Flow cytometry 2.1.4 DNA fingerprinting 2.1.5 DNA sequencing 2.1.6 Nucleic acid hybridization 2.1.7 Nucleic Acid–Based Diagnostic Methods- PCR : Principle and Applications 2.1.8 Southern blotting 2.1.9 Ribotyping and Ribosomal RNA sequencing **2.2 Molecular Phylogeny- Making sense of molecular sequences [2L]** 2.2.1 Obtaining DNA sequences 2.2.2 Role of 16S rRNA in phylogeny 2.2.3 Sequence Alignment (ex 16S rRNA) **2.3 Phylogenetic Trees [2L]** 2.3.1 Tree Construction 2.3.1 Limitations of Phylogenetic Trees **2.4 Numerical Taxonomy [1L]**		
	Practical's based on above course	1	**30 hrs**
	1. Differential staining of Blood by Field's staining method 2. Use of Selective and Differential Solid Media: Mac Conkey's Agar, Superimposed Blood Agar, Salt Mannitol agar. 3. Use of Biochemical Media/Tests for Identification of Pathogens: a) Carbohydrate fermentation b) Indole test c) Methyl Red test d) Voges Proskauer test e) Citrate Utilization f) Nitrate Reduction, g) Urease test, h) Catalase test, i) Gelatin Liquefaction 4. Identification of bacteria using Bergey's manual of Determinative Bacteriology (9th edition)		

	5. Construction/Interpretation of phylogenetic tree 6. Pyocin Typing 7. Rapid Identification of a Pathogen using a Kit: e.g. The API 20 E system 8. Antigen Antibody reactions a) Direct Agglutination- Identification of Blood group by Forward Typing b) Single Immunodiffusion [qualitative] c) Double Immunodiffusion		

Skill Enhancement Course

SEMESTER – IV

	Data Analytics		
Unit-I	**Data Analytics - I**	**Credit**	**L/Sem**
	1.1 Introduction to Data analytics and Research Methodology - [4L] 1.1.1 Concepts and applications of data analysis techniques - machine learning. 1.1.2 Action research, fundamental research - Difference between action research and fundamental research 1.1.3 Research design – Experimental and Non-experimental research design 1.1.4 Field research 1.1.5 Survey research **1.2 Methods of data collection [4L]** 1.2.1 Primary and Secondary data collection methods **1.3 Sampling techniques [2L]–** The nature of sampling, sampling design, Determination of sample size **1.4 Hypothesis testing [1L]** **1.5 Types of errors [2L]** **1.6 Scientific Writing Skills - Report generation [2L]**	1 credit	15

Unit 2	**Data Analytics- II**	**1**	**15**
	2.1. Measures of Central tendency [4L]– mean, median, mode, Standard deviation, Variance, Standard error. **2.2. Validation of analytical data [3L]-** Confidence limit and confidence interval; Students t-test, F test. **2.3. Bioinformatics Terminologies [1L]-** Introduction- Definition, aims, tasks and applications of Bioinformatics. **2.3.1** Genomics, proteomics, Transcriptomics, Metabolomics, Pharmacogenomics **[2L]** **2.3.2 Database, tools and their uses [4L]-** 2.3.2.1 Importance, Types and classification of databases 2.3.2.2 Nucleic acid sequence databases- EMBL, DDBJ, GenBank 2.3.2.3 Protein sequence databases-PIR, SWISS-PROT, TrEMBL 2.3.2.4 Indian Biological Data Centre (IBDC) **2.3.3** Sequence alignment (global, local), FASTA, BLAST and its types. **[1L]**		
	Practical's based on above course	1	**30 hrs**
	1. Questionnaire designing for Survey 2. Assignment – Collection of secondary data. 3. Writing a Review paper/ report writiing 4. Calculation of Mean, Median, Mode and Standard deviation (using Excel and Jamovi) 5. Problems on Students t-test, F test. 6. Screening Nucleic Acid Sequence Databases – EMBL, GenBank, DDBJ 7. Screening Protein Sequence Databases - PIR, Uni-Prot 8. Fishing homologues using NCBI 9. Using blastn and blastp for sequence alignment.		

References:

Semester III

1. Foundations in Microbiology, Seventh Edition, Talaro, McGraw-Hill International Edition
2. The Elements of Immunology, Fahim Khan. Pearson Education
3. Immunology Essential and Fundamental, Third Edition, Pathak and Palan. Capitol Publishers.
4. Prescott's Microbiology: 8th Edition; Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, Mc Graw Hill International Edition
5. Prescott, Harley, and Klein's Microbiology: 7th Edition; Willey, Sherwood and Woolverton, Mc Graw Hill International Edition
6. Brock Biology of Microorganisms: 12th Edition; Madigan Martinko Dunlap Clark Pearson International Edition
7. Microbiology An Introduction: 9th Edition; Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Pearson Education

Semester IV

1. Singh Y.K., Fundamental of Research Methodology and Statistics. New age international publishers, 2006.
2. Kothari C.R. & Garg G., Research methodology methods and techniques, New age international publishers, 4th Edition, 2019.
3. Mahajan B.K., Methods in Biostatistics, Jaypee brothers medical publishers, 7th edition, 2010.
4. S. Ignacimuthu, ―Basic Bioinformatics, 2nd edition, Narosa publishing house, 2012.
5. Arthur Lesk -Introduction to Bioinformatics, 5th edition 2019, OUP Oxford publications

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

For the Course of General Elective (Microbiology)

Curriculum – Second Year
Undergraduate Programme
Semester-III and Semester -IV

(Under NEP)

2024-25

Course Objectives and Learning Outcomes:

Semester III

Learning objectives

The course aims -

1. To discuss the properties of milk and milk products.
2. To elaborate on the steps involved in preparation of various milk products.
3. To explain principles of test involved in checking the quality of milk.

Learning Outcome

After the completion of the course, the learner will be able -

1. Explain the properties of milk and milk products.
2. Discuss the preparation of various milk products.
3. Acquire practical skills involved in testing the quality of milk.

Semester IV

Learning objectives

The course aims

1. To discuss the various sources of contamination of food.
2. To strengthen the knowledge of bacterial, non- bacterial pathogens and toxins involved in food borne illness
3. To explain the different means and principles of test to detect food adulteration.
4. To introduce the concept of HACCP, GMP, food sanitation and hygiene
5. To understand the role of different enforcement and regulatory agencies for food.

Learning Outcome

After the completion of the course, the learner will be able to-

1. Acquire skills required to test infected milk.
2. Plan experiments to detect food adulteration.
3. Design HACCP plan for food products.
4. Understand the role of different food regulatory agencies.

Scheme of Examination

ASSESSMENT PATTERN:

Theory

Summative (30 M per paper)

Formative (20M per paper)

Practical

Semester End Practical examination: (25 M per paper)

FOOD TECHNOLOGY

Semester III

Semester	Title of the Module	No of lectures
I	Introduction to Fermented food Products	30
II	Food spoilage and Food Preservation techniques	30
III	Dairy Technology	30
IV	Food borne Diseases	30

FOOD TECHNOLOGY

Semester 3- Dairy Technology

Unit1	**Production of Milk Products - I**	No of lectures
	a) Properties of milk and coagulation	3
	b) Fermented milk and Cream	3
	c) Preparation of powdered and sweetened condensed milk	3
	d) Concentrated and dry milk products, whey	3
	e) Yoghurt	3

Unit2	**Production of Milk Products - II**	No of lectures
	a) Butter	2
	b) Cultured Buttermilk	2
	c) Cheese: Cheddar, Cottage, Processed Cheese (Enlist other cheese products)	4
	d) Kefir	2
	e) Koumiss	2
	f) Other Fermented Milk products of India	3

	Practicals based on above course
1.	Organoleptic tests for milk sample
2.	To check the acidity of milk sample by a)Alcohol Test b) Clot on boiling Test for milk sample
3.	Preparation of paneer
4.	Preparation of yoghurt
5.	Visit to a Dairy/ food industry.

Semester IV

Food borne Diseases

Unit1	**Food borne Diseases**	No of lectures
	a) Sources of food contamination	2
	b) Food-borne Illness associated with Microorganisms:	2
	c) Non-bacterial sources of Food-borne infection	1
	d) Details of : 1) Staphylococcal gastroenteritis 2) Salmonellosis 3)Shigellosis 4) Listeriosis 5) Travellers' diarrhea 6) Campylobacteriosis (organism, source, incidence, foods involved, outbreak conditions & prevention)	6
	e)Toxins from plants, toxins from animals, Mycotoxins, Toxic Agricultural Residues, Poisoning by chemicals, shell fish poisoning	4

Unit2	**Control of Food borne Diseases**	
	a) Food sanitation and hygiene	3
	b) Investigation of food borne disease - cultural, microscopic, physical, chemical and bioassay methods (tabular)	3
	c) Good manufacturing practices	1
	d) Food laws and food adulteration	2
	e) Consumer protection & consumer guidance society	2
	f) Enforcement & Control Agency: International agencies, Federal agencies (FDA, USDA), FSSAI[website]	2
	g) Introduction to HACCP and its principles	2

	Practicals based on above course
1	Tests For Detection Of Mastitis Milk a) Chloride test b) Catalase Test c) Bromothymol blue test
2	Microbiological Grading of Milk sample –Resazurin Dye Reduction Test (Demonstration)
3	Study of Food adulteration a) Milk b) Honey c) turmeric powder d) chilly powder e) burra sugar f) coffee
4	Design a seven-step HACCP plan for a particularfood product

REFERENCES

1) Outlines of Dairy Technology, Sukumar De, Oxford University Press.
2) Modern Food Microbiology. James Jay, 7 th edition.
3) Frazier and Westhoff, Food Microbiology, Tata McGraw Hill, 5 th edition.
4) Food Science by Sumati R. Mudambi, Shalini Rao, M.V. Rajagopal, revised 2 nd edition, (2006), New Age international publications.
5) HACCP Principles & Application Guidelines by FDA.
6) Managing Food Safety: A Manual for the Voluntary Use of HACCP Principles for Operators of Food Service and Retail Establishments.
7) Shiby, V. K., & Mishra, H. N. (2013). Fermented Milks and Milk Products as Functional Foods—A Review. Critical Reviews in Food Science and Nutrition, 53(5), 482–496. doi:10.1080/10408398.2010.547398