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

Microbiology

Curriculum –
First Year Undergraduate Programmes
Semester-I and Semester -II

2023-24

HSNC UNIVERSITY, MUMBAI

Board of Faculty of Science & Technology

Board of Studies in Microbiology Subject

1.) Name of Chairperson/Co-Chairperson/Coordinator: -

a.) Dr. Sejal Rathod (Assistant Professor and Head, Department of Microbiology, K.C college, Churchgate) sejal.rathod@kccollege.edu.in 9930082028

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. Pratibha Shah (Assistant Professor, Department of Microbiology, K.C college, Churchgate) pratibha.shah@kccollege.edu.in 9773321760

b.) Mrs. Rajitha Satish (Assistant Professor, Department of Microbiology, K.C college, Churchgate) rajitha.satish@kccollege.edu.in 9833716190

c.) Ms. Amina Dholkawala (Assistant Professor, Department of Microbiology, K. C college, Churchgate) amina.dholkawala@kccollege.edu.in 7208724194

3.) One Professor / Associate Professor from other Universities or professor / Associate Professor from colleges managed by Parent Body; nominated by Parent Body; -

a.) Dr Bela Nabar (Associate Professor, HOD of Microbiology, Department of Microbiology, CHM College, Ulhasnagar) belamsn23@gmail.com 9322760417

b.) Dr. S. Raut (Associate professor, Department of Microbiology, Bhavans college, Andheri West, Mumbai, Maharashtra 400058) svrmicro@yahoo.co.in 9869053676

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

a.) Mrs. Prabha Padmanabha (former Associate Professor, Department of Microbiology, KC College Mumbai- 400 020) prabhapadmanabha@hotmail.com 9820860049

b.) Dr. Sahayog Jamdar (Scientific Officer G, Food and Technology Division BARC) snjam2@gmail.com 2225595375

c.) Dr. Mehul Rajpurkar (Regional Medico Marketing Manager, SRL Diagnostics, Goregaon West) mehul.rajpurkar@gmail.com 9819107505

d.) Dr. Surekha Zingde (Former Dy. Director, Cancer Research Institute, ACTREC,) Tata Memorial Centre, Kharghar) surekha.zingde@gmail.com 9820633284

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.) Ms. Uzma Shaikh (Undergraduate student- 18-19) Contact – 9004718231 , uzma25.shaikh@gmail.com

b.) Ms. Soni Gupta (Postgraduate student -18-19) Contact - 9167147185 , sonigupta445@gmail.com

Dr. Sejal Rathod

Chairperson- BOS

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 FYBSc Microbiology syllabus (FMB) is a Choice based credit system comprising of one paper having three units each in both semesters. The course covers different disciplines like microbiology, immunology, biochemistry, healthcare, nutrition and Biocontainment. The course will concentrate on the detection and identification of infectious agents in the clinical laboratory, followed by the determination of susceptibility to antimicrobial agents.

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 Outcomes:

Semester I

US-FMB-101: Fundamentals of Microbiology

Learning Objectives

- To study the microbial cell structure.
- To understand the structure, roles and quantitative detection of different macromolecules.
- To understand principles and techniques of Staining and Microscopy
- To inculcate the importance of biosafety in laboratory
- To learn about microbial nutrition and cultivation
- To learn about different physical and chemical methods of controlling microbial growth.

Learning Outcomes

- The learner will understand the physiology of a microorganism with the details of its macromolecular structure.
- The learner will be able to prepare stained smears, methods to observe and culture micro-organisms.
- The learner will know the different physical and chemical methods of microbial control.
- The learner will be able to sterilize media using different types of methods.
- The learner will be able to carry out the qualitative detection of Macromolecules.
- The learner will know the handling of various instruments and equipments used in Microbiology laboratory. .
- The learner will be able to apply the norms of biosafety whilst working with microbes.
- The learner will acquire the skills required to work in a basic microbiological laboratory

Semester II

US-FMB-201: Microbial Diversity

Learning Objectives

- To study the significance of microorganisms in our environment.
- To holistically understand the role of microorganisms in the industries.
- To learn the principles of microbial growth and development.
- To develop and enhance laboratory techniques for microbial cultivation an analysis.
- To comprehensively study the infectious diseases caused by microbes.
- To learn about the microbial association, interaction and host defence mechanisms against infections.

Learning Outcomes

- The learner will understand the diverse nature of microorganisms
- The learner will be able to understand the significance of microbes in various fields like the medicine, ecology, and industries.
- The learner will inculcate the principles and analysis of microbial growth.
- The learner will develop the laboratory techniques and methods required for evaluation of microbial growth.
- The learner will learn the handling of various instruments and equipment which will help them to understand the principle and working of the same.
- Learner will be able to comprehend the variety of infections caused by microorganisms.
- The learner will be grasping the paradigm of host defence mechanisms and interactions of microbes within the ecological niches.
- The learner will learn about the skills required to work in a basic microbiological laboratory

Scheme of Examination

ASSESSMENT PATTERN:

Theory

Semester End Examination (60 M per paper)
Internal Assessment (40M per paper) [20 M SLE + 20M Assignment]

Practical

Semester End Practical examination: (50 M per paper)

US-FMB-101- Fundamentals of Microbiology

Sr No	Subject Code	Subject Unit Title		Hours /Lectures	Total No. of hours/lectures	Credit
1	**US-FMB 101- Fundamentals of Microbiology**	1	Introduction to Prokaryotic, Eukaryotic Cell Structure and Macromolecules	15	45L	3
		2	Staining techniques, Microscopy and Biosafety	15		
		3	Microbial Nutrition and Control	15		
2	**US-FMB 101-P1**		Practicals based on US-FMB-101-P1		30	1

Unit	Content	No. of Lectures
1	**Introduction to Prokaryotic, Eukaryotic Cell Structure and Macromolecules**	**15L**
	a) Prokaryotic Cell Structure i. Cell wall ii. Cell membrane iii. Components external to cell wall-Capsule, Slime layer, Flagella, Pili, Fimbriae (tabular) iv. Cytoplasmic matrix-Inclusion bodies, magnetosomes, ribosomes, gas vesicles v. Nucleoid, Plasmids, Bacterial endospores **b) Eukaryotic Cell Structure** i . Organelles of Eukaryotic Cell Structure (Endoplasmic reticulum, Golgi apparatus, ribosomes, Mitochondria, Chloroplasts, Nucleus, Cilia and Flagella - tabular) ii. Cytoplasmic matrix and Cytoskeleton iii. Comparison of Prokaryotic and Eukaryotic Cells **c) Study of Macromolecules** i. Types of bonds and their importance: Electrovalence, covalent, ester, phosphodiester, thioester, peptide, glycosidic (tabular). ii. Carbohydrates: Definition, Classification, Biological role iii. Lipids: Definition, Classification, Biological role iv Nucleic acids, Amino Acids and Proteins (tabular)	**8L** **3L** **4L**

Unit	Content	No. of Lectures
2	**Staining techniques, Microscopy and Biosafety**	**15 L**
	a) Stains i. Dyes and stains: Types (Tabular), Physicochemical basis, Fixatives, Mordants, Intensifier, Decolorizers ii. Simple and differential staining iii. Vital staining iv. Special staining (Cell wall, Capsule, Lipid granules, Spores, Metachromatic granules, nucleus & flagella- tabular)	**5L**
	b) Microscopy i. Simple and compound light microscope ii. Dark field Microscopy iii. Phase contrast Microscopy iv. Electron Microscope a. Principle and Application of Transmission Electron Microscope, Scanning Electron Microscope, b. Contrast enhancement for electron microscope v. Fluorescent Microscope vi. Confocal Microscope	**8L**
	c) Biosafety in Microbiology i. Means of laboratory infection ii. Potentially hazardous procedures iii. Risk Assessment and Levels of Containment iv. Training of personnel v. Indian standard: Code of Safety in Microbiological Laboratories	**2L**

Unit	Content	No. of Lectures
3	**Microbial Nutrition and Control**	**15**
	a) Microbial Nutrition i. Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors. ii. Nutritional types of microorganisms iii. Types of Culture media with examples iv. Isolation of microorganisms and pure culture techniques v. Preservation of microorganisms **b) Control of microorganisms** Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant **1) Physical methods of microbial control** i. Dry & moist heat – mechanisms, instruments used and their operations ii. Electromagnetic radiations- Ionizing radiations iii. Bacteria proof filters iv. Low temperature v. Osmotic pressure & Desiccation **2) Chemical methods of microbial control** - mechanism, advantages, disadvantages (if any) and applications. i. Phenolics , Alcohols & Aldehydes ii. Heavy metals and their compounds iii. Halogens iv. Quaternary ammonium compounds v. Dyes vi. Peroxygens vii. Sterilizing gases viii. Chemotherapeutic Agents	**8L** **7 L**

	Practicals based on US-FMB-101-P1	Reference Books
	Content	
	1. Introduction to Laboratory equipment, disinfection & discarding techniques in laboratory 2. Study of parts of microscope. 3. Monochrome and Gram staining 4. Special staining: i. Cell wall ii. Capsule iii. Lipid iv. Metachromatic granule 5. Permanent slides of Eukaryotes & its organelles 6. Preparation of Culture Media for sterilization. 7. Preparation and Inoculation techniques of Liquid Medium and Solid Media (Broth, Slants, Butts and Plates) 8. Study of cultural and morphological characteristics of bacteria on 9. i) General purpose media - Nutrient Agar 10. ii) Selective and Differential media - Macconkey Agar and Salt mannitol Agar. iii) Enriched medium- Superimposed Blood Agar (SIBA) 11. Demonstration of microbes in air, cough, on table surface, fingertips. 12. Effect of Osmotic Pressure, heavy metals (Oligodynamic action) on the growth of organisms 13. Effect of dyes, phenolic compounds on the growth of organisms. 14. Qualitative detection: 15. Nucleic acid-DPA, Orcinol test 16. Carbohydrates- Benedicts, Molisch's test. 17. Proteins, amino acids- Biuret, Ninhydrin. 18. Assignment: Applications of Microorganisms in Industries/ Eukaryotic organelles/ Contributions of scientist in the field of microbiology	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company Microbiology Laboratory Manual: Cappuccino and Sherma Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman and Company. New York 2005

Self-Learning topics (Unit wise)

Sub- Unit	Topics
1.2.1	Comparison of Prokaryotic and Eukaryotic Cells
3.a.1	Nutritional requirements- Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors.
3.b	Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant

Online Resources
Online module: Comparison of Prokaryotic and Eukaryotic Cells http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/44 Online module: Nutritional requirements http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/44 Online module: Control of microorganism https://swayam.gov.in/nd2_cec19_bt11/preview http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/44

References (Semester-1)

1. Prescott ,Harley.Klein-Microbiology, 7th edition, International edition, McGraw Hill.

2. Kathleen Park Talaro& Arthur Talaro - Foundations in Microbiology International edition 2002 McGraw Hill.

3. Michael T.Madigan &J.M.Martin, Brock ,Biology of Microorganisms 12th Ed. International edition 2006 Pearson Prentice Hall.

4. A.J.Salle,Fundamental Principles of Bacteriology.

5. Stanier.Ingraham et al ,General Microbiology 4th & 5th Ed. 1987, Macmillan Education Ltd

6. Microbiology TMH 5th Edition by Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg

7. BIS:12035.1986: Code of Safety in Microbiological Laboratories

8. Outlines of Biochemistry 5/E, Conn P. Stumpf, G. Bruening and R. Doi. John Wiley & Sons. New York 1995

9. Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman And Company. New York 2005

10. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Addison Wesley Longman Inc. 1998.

11. Microbiology Laboratory Manual: Cappuccino and Sherman

Semester II

US-FMB-201: Microbial Diversity

Sr No	Subject Code	Subject Unit Title		Hours/Lectures	Total No. of hours/lectures	Credit
1	US-FMB 201 Microbial Diversity	1	Microorganisms significant in Environment, Industrial and Medical Microbiology	15	45L	3
		2	Microbial Growth	15		
		3	Infections and Microbial Interactions	15		
2	US-FMB 201-P2		Practical based on US-FMB 201-P2		30	1

Unit	Content	No. of Lectures
1	**Microorganisms significant in Environment, Industrial and Medical Microbiology**	**15**
	Characteristics, Classification(tabular) and Importance (Biological, Economic and Medical) of a) Algae b) Rickettsia, Coxiella, Chlamydia, Mycoplasma c) Actinomycetes d) Archaea e) Protozoa f) Fungi and Yeast, Slime molds g) Beneficial Bacteria (Industry, Human health , Environment) - tabular a) Viruses i) General properties and structure of virus ii) Bacteriophage – Life cycle of a lytic and temperate phage b) Prions, Viroid's (definition only)	**2L** **2L** **2L** **1L** **1L** **2L** **1L** **4L**

Unit	Content	No. of Lectures
2	**Microbial Growth**	**15**
	a) Definition of growth and Growth curve b) Mathematical Expression of growth c) Measurement of growth: Direct microscopic count – Breed's count, Petroff – Hausser counting chamber-Haemocytometer. d) Viable count – Spread plate and Pour plate technique e) Measurement of cellular constituents. f) Turbidity measurements- Nephelometer and spectrophotometer techniques g) Synchronous growth, Continuous growth (Chemostat and Turbidostat) h) Influence of environmental factors on growth. i) Quorum sensing and Viable but non-culturable organisms (only definition)	**2L** **1L** **2L** **3L** **1L** **1L** **2L** **2L** **1L**

Unit	Content	No. of Lectures
3	**Infections and Microbial Interactions**	**15**
	a) Definition with an example- Primary infection, secondary infection. Contagious infection, occupational disorder, clinical infection, subclinical infection, Zoonosis, genetic disorder, vector borne infection.	**1L**
	b) Factors affecting infection: i) Microbial factors: adherence, invasion, role of virulence factors in invasion, colonization & its effects. ii) Host factors: : natural resistance, species resistance, racial resistance iii) Individual resistance: Factors influencing individual resistance: Age, nutrition, personal hygiene, stress, hormones, Addiction to drugs/ alcohol.	**4L**
	c) Overview of Host Defense Mechanisms i) First line of defense including the role of Normal flora –For Skin, Respiratory tract, Gastrointestinal tract, genitourinary tract, eyes. ii) Introduction to second and third line of Defense ii) Gnotobiotic animals and its importance	**5L**
	d) Microbial Interactions and its types (Definition and examples in tabular form) i. Mutualism, Cooperation, Commensalisms, Predation, Parasitism, Amensalism, Competition ii. Symbiotic and Non symbiotic associations (Nitrogen fixation)	**5L**

	Practicals based on US-FMB-201-P2	**Reference books**
	1. Spot assay / plaque assay of Bacteriophage (Demonstration) 2. Slide Culture technique (Actinomycetes & Fungi) 3. Isolation of yeast and other fungi on Sabourauds agar *4.* Fungal Wet mounts & Study of Morphological Characteristics: *Mucor*, *Rhizopus*, *Aspergillus*, *Penicillium.* 5. Study of microbial growth using Growth curve (under Static & Shaker conditions) 6. Viable count: Spread plate and pour plate technique 7. Effect of pH on growth 8. Effect of temperature on growth 9. Study of motility of organisms by hanging drop method 10. Normal Flora of Skin and Gastrointestinal tract *11.* Bacteroid Staining and Isolation of *Rhizobium* 12. *Azotobacter* isolation and staining	A.J. Salle, Fundamental Principles of Bacteriology Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company Prescott, Harley. Klein-Microbiology, 7th edition, International edition, McGraw Hill

Self-Learning topics (Unit wise)

Sub-Unit	Topics
2.a	Growth curve
3.c.2	Introduction to cell mediated immunity (Third line of defense)
3.d.1	Mutualism and Commensalism

Online Resource
Online module: Enumeration of bacteria and determination of growth phasehttp://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/78 Online module: Introduction to cell mediated immunity http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/46 Online module: Mutualism and Commensalism http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/156

References – Semester II

1. Prescott ,Harley.Klein-Microbiology, 7th edition, International edition, McGraw Hill.

2. Kathleen Park Talaro& Arthur Talaro - Foundations in Microbiology International edition 2002| McGraw Hill.

3. Michael T.Madigan &J.M.Martin, Brock ,Biology of Microorganisms 12th Ed. International edition 2006 Pearson Prentice Hall.

4. A.J.Salle,Fundamental Principles of Bacteriology.

5. Stanier.Ingraham et al ,General Microbiology 4th & 5th Ed. 1987, Macmillan Education Ltd

6. Microbiology TMH 5th Edition by Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg

7. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. AddsisonWeseley Longman Inc. 1998.

8. Teri Shors,.(2009), “Understanding viruses”, Jones and Bartlett publishers

Vocational Course for FYBSc Microbiology

	Semester - I	
	Basics of Clinical Microbiology	**No of hours- 15**
	Practicals	**Reference Books**
	1. Explain safety inoculation hood for infection inoculations and laminar air flow. 2. Discard of highly infectious pathogenic samples like T.B, sputum etc. 3. Handling of hazardous laboratory waste (ethidium bromide containing gels). 4. Handling corrosive chemicals using rubber teat method for pipetting 5. Prevention of mouth pipetting and use of auto-pipettes 6. Good Laboratory Practice - Preventing and treating microbiology laboratory accidents. 7. Control of microorganisms using moist heat & dry heat sterilization 8. Special staining: Endospore, and Flagella 9. Negative Staining 10. Effect of chemotherapeutic agents (disc inhibition method) 11. Effect of UV light on the growth of organisms	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company Microbiology Laboratory Manual: Cappuccino and Sherma Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman and Company. New York 2005
	Semester - II	
	Content	**No of hours- 15**
	Techniques in Bacteriology and Instrumentation **Practicals**	**Reference Books**

	1. Isolation of yeast and other fungi on Sabourauds agar 2. Microscopic cell count (Haemocytometer) 3. Measurement of cell dimensions (Micrometry) 4. Brown's opacity tubes method (demonstration) 5. Preparation of solutions (Normality and Molarity) 6. Use of standard buffers for calibration and determination of pH of a given solution 7. Determination of λmax 8. Handling and calibration of a weighing balance.	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company Microbiology Laboratory Manual: Cappuccino and Sherma

OPEN ELECTIVE

FOOD TECHNOLOGY

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 1- Fermented foods:

Unit1	**Introduction to Fermented food Products**	**No of lectures-15**
	● Fermented Foods – Types, Advantages and Health Benefits	
	● Microorganisms used in food fermentations: yeasts, molds and lactic acid bacteria	
	● Prebiotics, Probiotics, Synbiotics and Nutraceutical Foods	
	● Food ingredients of microbial origin: SCP, sweeteners , stabilizers, thickening agents, amino acids, vitamins, colours, and flavours	

Unit2	**Preparation of Fermented Products**	**No of lectures-15**
	● Preparation of Fermented Products - bread, cheese, idli, butter, yogurt, soy products.	
	● Preparation of Fermented alcoholic beverages (beer, wine, vinegar) and non-alcoholic beverages, Fruit fermented drinks	
	● Preparation of fermented food- pickled cucumber, sauerkraut	
	a) Microbiology of fermented food- tea, coffee and Chocolates (cocoa)	

Semester 2 - Food spoilage and Food Preservation techniques

Unit1	**Understanding Food spoilage and preservation**	**No of lectures-15**
	a) Factors affecting food spoilage	
	b) Important Food spoilage causing organisms (General characteristics of the enlisted organisms to be studied wrt spoilage and transmission of infection/intoxication)	

	c) General Principles of spoilage: Spoilage of fresh foods: fruits and vegetables, eggs, meat, poultry and seafood:	
	d) General principles of Preservation of Food	
	e) Significance of Food Processing and Preservation	
	f) List, category and uses of Permitted Food additives and Preservatives	

Unit2	**Food Preservation techniques**	**No of lectures-15**
	a) Preservation Technology of Eggs, Poultry, Meat and Seafood	
	b) Preservation Technology of Beverages	
	c) Preservation Technology of Fruits and Vegetables	
	d) Emerging trends in food Preservation and packaging techniques	

REFERENCES

1) Outlines of Dairy Technology, Sukumar De, Oxford University Press.
2) Modern Food Microbiology. James Jay, 7 th edition.
3) H. A. Modi, 2009. ‘’Fermentation Technology’’ Vol 2, Pointer Publications, India
4) Outlines Of Dairy Technology,Sukumar De,Oxford University Press
5) Şanlier, N., Gökcen, B. B., & Sezgin, A. C. (2017). Health benefits of fermented foods. Critical Reviews in Food Science and Nutrition, 1–22. doi:10.1080/10408398.2017.1383355