



# **HSNC University, Mumbai**

Ordinances and Regulations

With Respect to

Choice Based Credit System  
(CBCS)

For the Programmes under

**The Faculty of Science and Technology**

In the subject of

**Microbiology**

With effect from the Academic year 2020-2021

**R. \*\*\*\*: The Definitions of The Key Terms Used in The Choice Based Credit System and Grading System Introduced from The Academic Year 2020-2021 Are as Under:**

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

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. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement;

SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

### **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.

### **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 across three years essentially in Inter / Intra Disciplinary course.

A learner who joins Regular Undergraduate Program will have to opt for Honours Program in the first year of the Program. However, the credits for honours, though divided across three years can be completed within three years to become eligible for award of honours Degree.

### **Program:**

A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

### **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'.

### **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.

### **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.

### **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, field work, 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.

### **Credit Point:**

Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. **A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit is construed as corresponding to approximately 30 to 40 learning hours.**

### **Credit Completion and Credit Accumulation:**

Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus, the learner 'accumulates' course wise credits.

### **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.

### **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.

### **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.

**Note: The Ordinances and Regulations given below are applicable to Program of Microbiology under faculty of Science, unless and otherwise specified.**

**O\*\*\*\*\***

Minimum duration of the STATS programme will be of 3 years in the Semester pattern i.e. from Sem. I to Sem. VI.

The degree will be awarded to a learner who successfully completes 120 credits of the programme in period of 3 to 6 years from the year of enrollment to semester VI.

If a learner does not earn 120 credits in 12 semesters from the year of enrolment to semester I, he/she may at his/her option transfer his/her performance in the existing/new program after establishing equivalence between old and new syllabus. Such a performance transfer will be decided by the Board of Studies / Ad-hoc Board / Ad hoc Committee of the concerned subject. The admission to the program will be governed by the existing rules

**O\*\*\*\*\* The fees for transfer of credits or performance will be based on number of credits that a learner has to complete for award of the degree.**

**R \*\*\*\*** Credits earned at one institution for one or more courses under a given program will be accepted under another program either by the same institution or another institution either through Direct Performance Transfer or Course exemption.

**R\*\*\*\*\* The Scheme of Teaching and Examination:**

The Scheme of Teaching and Examination shall be divided into THREE components, SELF LEARNING, Internal assessment and External assessment (semester end examination) for each course of the program.

1) **SELF LEARNING** Assessment. Some methodology has been described in Definition of Self Learning. However Subject Teacher is authorized to devise newer methods of evaluation, which must essentially be documented and circulated through mail or written circular to the learners at least 7 days prior to its implementation. 10% of the marks shall be allocated for Self-Learning assessment.

2) **Internal Assessment** includes Assignments, Seminars, Core Practical, Practical, Commutative Test, Practical Record, Unit Tests etc. Subject Teacher is authorized to devise newer methods of evaluation, which must essentially be documented and circulated through mail or written circular to the learners at least 7 days prior to its implementation. For each course, there is a passing minimum for internal Assessment as 40% (16 out of 40 marks).

3) **Semester End Examination** 60% (24 out of 60 marks) overall 40% (40 out of 100 marks).

# **MICROBIOLOGY**



# 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.

## 1. Course objective

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

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, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

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, Diagnostics and healthcare to meet the increasing demand.

## **2. Process adopted for curriculum designing.**

The curriculum was designed in a stepwise manner, firstly on the basis of 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.

## **3. Salient features, how it has been made more relevant.**

While designing of the syllabus care has been taken to balance the fundamental techniques of Microbiology with some advance techniques of diagnostic and clinical microbiology.

The course would give students the opportunity to develop skills in areas which have direct relevance to employability in diagnostics, health, food and pharmaceutical industries, agriculture and environment-related job opportunities in Microbiology.

## **4. Learning Outcomes.**

The curriculum is designed to educate the learner about various fields of Microbiology like Genetics, Medical Microbiology and Diagnostics, pharmaceutical industry, molecular, environmental and biotechnology. The course would help students to apply their microbiological concepts to summarize, analyze, and inculcate problem solving approach in the newer developments and innovations in the future. The curriculum design and the teaching and the evaluation patterns would help students to develop skills and competencies to build a progressive and successful career in the field of Microbiology.

- The learner will learn to prepare stained smears, culturing micro-organisms, conducting experiments, performing tests to identify bacteria and fungi, and studying microbial growth control.
- The learner will learn about evolution of microbes and new emerging and re-emerging diseases. The learner will learn the handling of various instruments which will help them to understand the principle and working of the same.
- The learner will understand the physiology of a microorganism with the details of its macromolecular structure.
- The learner will know the role of microbes in the fields of environment, medicine and industrial microbiology. The course will help them to study of ability of microbes as decomposers, food supplements, energy source and infectious agents.
- The learner will also acquire skills to cultivate and identify microorganisms, study growth characteristics and prevent contamination.
- The learner will learn the handling of various instruments which will help them to understand its component parts, principle and working.
- The learner will learn about the skills required to work in a basic diagnostic and clinical laboratory.

## **5. Input from stakeholders (Which Sections have been modified) with relevant introduction.**

New topics were introduced at basic level which will be gradually included in more depth in second and third year B.Sc. Existing components were modified, practical applications of the fundamental techniques were incorporated as suggested by the industrial, research and academic experts.

The Missing links between different subtopics were introduced. Subtopics were more streamlined and made specific (depth of the content). Topics like Five kingdom classification – missing link between prokaryotes and eukaryotes (suggested by research expert) were introduced. Academic expert suggested streamline the fields of microbiology and be more specific regarding the content mitosis and meiosis- cell cycle missing all throughout three year syllabi of microbiology. Introduction of clinical and diagnostic microbiology – suggested by academic and research experts was also done.

Molecular identification of microorganisms- suggested by industrial expert as these are currently used in research and R& D departments of industries like imaging techniques were added , Biostatistics and Bioinformatics were introduced - suggested by research and industrial expert .Preparation of solutions (normality and molarity) – research expert suggested as students find it difficult during research as they not much importance is given to this during early graduation years was also introduced.

**The Scheme of Teaching and Examination is as under:**

**I Year Semester – I  
Summary**

Sr. No.	Choice Based Credit System		Subject Code	Remarks
1	Core Course (Microbiology)		US-FMB-101, US-FMB- 102, US-FMB- P1	
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)			
	Skill Enhancement Courses (SEC)			

**Detail Scheme**

Sr. No.	Subject Code	Subject Title	Periods Per Week						Credit	Seasonal Evaluation Scheme				Total Marks
			Units	S. L.	L	T	P	S. L. E		CT	TA	SEE		
1	US-FMB-101	Basics of Microbiology, Cell - structure and function	3	20% *	3	0	0	2	10	20	10	60	100	
2	US-FMB-102	Diagnostic and Clinical Microbiology	3	20% *	3	0	0	2	10	20	10	60	100	
3	US-FMB-P1	Practicals Based US-FMB--101 + Practical Based US-FMB--102			0	0	6	2				100 (80+20)	100	
Total Hours / Credit									06	Total Marks				300

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

## I Year Semester – I Units – Topics – Teaching Hours

Sr. No	Subject Code	Subject Unit Title		Hours /Lect ures	Total No. of hours/lec tures	Credit	Total Marks
<b>1</b>	US-FMB-101	I	Introduction to Microbiology and Prokaryotic Cell Structure	15	45 L	2	100 (60+40)
		II	Eukaryotic Cell Structure	15			
		III	Study of Macromolecules	15			
<b>2</b>	US-FMB-102	I	Diagnostic Microbiology I	15	45L	2	100 (60+40)
		II	Introduction to Clinical Microbiology	15			
		III	Cultivation of Microbes and Biocontainment	15			
<b>3</b>	US-FMB-P1	I	Practicals Based on Unit-I, II & III of FMB-101)	3	45x2=90L lectures per batch	2	100 (80+10+10)
		II	Practicals Based on Unit-I, II & III of FMB-102	3			
		TOTAL				6	300

- Lecture Duration – 45 Minutes = 0.75 Hours. (45 Lectures equivalent to 33.75 hours)
- One Credit =16.87 hours equivalent to 17 Hours

**Curriculum Topics along with Self-Learning topics** - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective Unit

Course Code: US-FMB-101

Unit	Content	No. of Lectures
<b>1</b>	<b>Introduction to Microbiology and Prokaryotic Cell Structure</b>	<b>15</b>
	<b>a. Introduction to Microbiology</b> <ol style="list-style-type: none"> <li>i. Five-kingdom system of classification</li> <li>ii. Discovery of microorganisms</li> <li>iii. Biogenesis v/s Abiogenesis</li> <li>iv. Introduction to different fields of Microbiology                             <ol style="list-style-type: none"> <li>1.Genetics and Virology</li> <li>2.Medical</li> <li>3.Immunology</li> <li>4.Industrial</li> </ol> </li> <li>v. Scope of Microbiology</li> </ol>	
	<b>b. Prokaryotic Cell Structure</b>	

- i. Cell wall
- ii. **Cell membrane**
- iii. Components external to cell wall-Capsule, Slime layer, Flagella, Pili, Fimbriae
- iv. Cytoplasmic matrix-Inclusion bodies, magnetosomes, ribosomes, gas vesicles
- v. Nucleoid, Plasmids
- vi. Bacterial endospores and their formation

## **2 Eukaryotic Cell Structure 15**

- a) Outline of Eukaryotic cell structure**
- b) The plasma membrane and membrane Structure**
- c) Cytoplasmic matrix and Cytoskeleton**
- d) Organelles of the Biosynthetic, Secretory and Endocytic pathways**
  - i. **Endoplasmic reticulum**
  - ii. **Golgi apparatus**
- iii. Definitions of Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome
- e) Eukaryotic ribosomes**
- f) Mitochondria**
- g) Chloroplasts**
- h) Nucleus –Nuclear Structure**
- i) Eukaryotic chromosome condensation**
- j) Cilia and Flagella**
- k) Comparison of Prokaryotic and Eukaryotic Cells**
- l) Multiplication and cell division – Mitosis and Meiosis**

## **3 Study of Macromolecules 15**

- a) Chemical Bonds in Macromolecules**
  - i. Biomolecules as compounds of carbon with a variety of functional groups.
  - ii. Universal set of small molecules.
  - iii. Macromolecules as the major constituents of cells.
  - iv. Configuration and Conformation with definitions and suitable examples only.
  - v. Types of Stereoisomers and importance of stereoisomerism in biology.
  - vi. Types of bonds and their importance: Electrovalence, covalent, ester, phosphodiester, thioester, peptide, glycosidic.
- b) Water - Structures and its Properties**
- c) Carbohydrates**
  - i. Definition, Classification, Biological role.
  - ii. Monosaccharides
  - iii. Oligosaccharides (maltose, cellobiose, sucrose, lactose)
  - iv. Polysaccharide (starch, glycogen, peptidoglycan, cellulose)
- d) Lipids**

- i. Fatty acids (as basic component of lipids and their classification).
  - ii. Storage and structural lipids-Types of lipids with general structure of each and mention examples.
- e) Nucleic acids**
- i. Nitrogenous bases- Purines, Pyrimidines Pentoses-Ribose, Deoxyribose.
  - ii. Nomenclature of Nucleosides and nucleotides, N- $\beta$ -glycosidic bond, polynucleotide chain to show bonding between nucleotides (Phosphodiester bonds).
  - iii. **Basic structure of RNA and DNA.**
- f) Amino acids and proteins**
- i. **General structure and features of amino acids (emphasis on amphoteric nature).**
  - ii. Classification by R-group, Uncommon amino acids and their functions.
  - iii. **Peptides and proteins- Definition and general features and examples with biological role.**
  - iv. Primary, secondary, tertiary, quaternary structures of proteins- Brief outline

**Self-Learning topics (Unit wise)**

Sr.no	Unit	Topics
1	1	1b Cell membrane
2	2	2d,2f Mitochondria, Golgi apparatus and Endoplasmic reticulum
3	3	2e Basic structure of RNA and DNA
4	3	2f General structure and features of amino acids (emphasis on amphoteric nature) and Peptides and proteins- Definition and general features and examples with biological role

**Online Resources**

**Online module :** Cell Membrane

[http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view\\_module\\_ug.php/41](http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/41)

**Online module:** Mitochondria, Golgi apparatus and Endoplasmic reticulum)

[https://swayam.gov.in/nd2\\_cec19\\_bt12/preview](https://swayam.gov.in/nd2_cec19_bt12/preview)

**Online module:** DNA double helix: Chemical parameters

<https://nptel.ac.in/courses/104/103/104103121/>

**Online module:** Amino acids and proteins

<https://nptel.ac.in/courses/104/103/104103121/>



Course Code: US-FMB-102

<b>Unit</b>	<b>Content</b>	<b>No. of Lectures</b>
<b>1</b>	<b>Diagnostic Microbiology I</b>	<b>15</b>
	<b>a)Microscopy</b>	
	i. History of microscopy	
	ii. Optical spectrum	
	iii. Lenses and mirrors	
	iv. Simple and compound light microscope	
	v. Dark field Microscopy	
	vi. Phase contrast Microscopy	
	<b>b)Stains</b>	
	i. Dyes and stains: Types, 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)	
<b>2</b>	<b>Introduction to Clinical Microbiology</b>	<b>15</b>
	<b>a) Laboratory analysis of clinical specimens</b> Microscopic, cultural, biochemical and Genomic analysis	
	<b>b) Introduction to Molecular identification of prokaryotes</b> –Nucleic acid extraction, Polymerase chain reaction (PCR), 16S r RNA	
	<b>c) Biosafety in Microbiology:</b>	
	i. Means of laboratory infection	
	ii. Potentially hazardous procedures	
	iii. Responsibility	
	iv. Risk Assessment	
	v. Restricted access	
	vi. Safety equipment's	
	vii. Immunization and medical records	
	viii. Training of personnel	
	ix. Laboratory procedures	
	x. Levels of Containment	

**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 Microorganism**

- i. **Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant**
- ii. Physical methods of microbial control
  1. Dry & moist heat – mechanisms, instruments used and their operations
  2. Electromagnetic radiations – Ionizing radiations, mechanisms –advantages & disadvantages
  3. Bacteria proof filters
  4. Low temperature
  5. Osmotic pressure
  6. Desiccation

**c) Chemical methods of microbial control** - mechanism & advantages & disadvantages (if any) applications.

- i. Phenolics
- ii. Alcohols
- iii. Heavy metals and their compounds
- iv. Halogens
- v. Quaternary ammonium compounds
- vi. Dyes
- vii. Surfaces active agents/Detergents
- viii. Aldehydes
- ix. Peroxygens
- x. Sterilizing gases
- xi. Antibiotics - List types of antibiotics active against various groups & mention the site of action (Detailed mode of action not to be done)

**Self-Learning topics (Unit wise)**

Sr. no.	Unit	Topics
1	1	1a Lenses and mirrors
2	1	1a Phase contrast Microscopy
3	2	2b Polymerase chain reaction (PCR), 16S r RNA
4	3	3a Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors
5	3	3b 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:** Ray tracing with mirrors; basic optical systems: single lens magnifier, eyepiece, microscope.

<https://nptel.ac.in/courses/102/107/102107028/>

**Online module:** Phase contrast microscope

[https://swayam.gov.in/nd1\\_noc20\\_mm14/preview](https://swayam.gov.in/nd1_noc20_mm14/preview)

**Online module:** PCR <https://nptel.ac.in/courses/104/103/104103121/>

**Online module:** 16srRNA sequencing [https://swayam.gov.in/nd1\\_noc19\\_bt24/preview](https://swayam.gov.in/nd1_noc19_bt24/preview)

**Online module:** Nutritional requirements

[http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view\\_module\\_ug.php/44](http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/44)

**Online module:** Control of microorganism [https://swayam.gov.in/nd2\\_cec19\\_bt11/preview](https://swayam.gov.in/nd2_cec19_bt11/preview)

**Course Code: US-FMB-P1**

Paper-I-Practical

Total Credits: 01

Title of Paper: **Basics of Microbiology, Cell - structure and function**

Unit	Content	Reference Books
I	1. Assignment: Applications of Microorganisms in Industries. 2. Special staining: i. Cell wall ii. Capsule iii. Endospore iv. Flagella (demonstration) v. Lipid vi. Metachromatic granules	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company

	vii. Nucleus staining (demonstration)	
II	<p>3. Discard of highly infectious pathogenic samples like T.B, sputum etc.</p> <p>4. Explain safety inoculation hood for infection inoculations and laminar air flow.</p> <p>5. On accidental spillage of/ breakage of culture containers-precautions to be taken.</p> <p>6. Demonstration of microbes in air, cough, on table surface, fingertips.</p> <p>7. Permanent slides of Eukaryotes &amp; its organelles:</p> <p>8. Assignment: Eukaryotic organelles</p>	Microbiology Laboratory Manual: Cappuccino and Sherman
III	<p>9. Qualitative detection:</p> <p>i. Nucleic acid-DPA, Orcinol test</p> <p>ii. Carbohydrates- Benedicts, Molisch's test.</p> <p>iii. Proteins, amino acids- Biuret, Ninhydrin.</p> <p>10. Handling corrosive chemical using rubber teat method for pipetting. Prevention of mouth pipetting and use of auto-pipettes.</p>	Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman and Company. New York 2005

Paper-II-Practical

Total Credits: 01

Title of Paper: **Diagnostic and Clinical Microbiology**

Unit	Content	Reference Books
I	<p>1. Study of parts of a microscope</p> <p>2. Micrometry</p> <p>3. Dark field and Phase contrast: Demonstration</p> <p>4. Monochrome and differential staining procedures, Gram staining &amp; Negative Staining.</p>	<p>Prescott, Harley.</p> <p>Klein-Microbiology, 7th edition, International edition, McGraw Hill</p>

II	<p>5. Introduction to Laboratory equipment's, disinfection &amp; discarding techniques in laboratory</p> <p>6. Methods of preparation of glassware for Sterilization (Pipettes, Petri Plates, Plastic wares, Flasks, Micropipettes, microtiter plates) &amp; Control of microorganisms using moist heat &amp; dry heat sterilization (Sterilization of Dry powders, Rubber gloves, Bandages, Screw capped tubes, Sterilizable plastic wares)</p> <p>7. Effect of UV Light, Desiccation, surface tension, Osmotic Pressure, heavy metals (Oligodynamic action)</p> <p>8. Effect of dyes, phenolic compounds and chemotherapeutic agents (disc inhibition method)</p>	<p>Microbiology TMH 5<sup>th</sup> Edition by Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg</p>
III	<p>9. Preparation of Culture Media:</p> <ol style="list-style-type: none"> <li>i. Liquid medium (Nutrient Broth)</li> <li>ii. Solid Media (Nutrient agar, Sabouraud's agar)</li> <li>iii. Minimal media</li> <li>iv. Preparation of slant, butts &amp; plates</li> </ol> <p>10. Inoculation techniques and Study of Growth:</p> <ol style="list-style-type: none"> <li>i. Inoculation of Liquid Medium</li> <li>ii. Inoculation of Solid Media (Slants, Butts and Plates)</li> <li>iii. Study of Colony Characteristics of pigment &amp; non - pigment producing bacteria.</li> <li>iv. Study of Motility (Hanging Drop Preparation)</li> </ol> <p>11. Use of Differential &amp; Selective Media</p> <p>12. Determination of Optimum growth conditions:</p> <ol style="list-style-type: none"> <li>i. Temperature</li> <li>ii. pH</li> </ol> <p>13. Methods of Preservation of culture</p> <p>14. Preparation of solutions (Normality and Molarity)</p>	<p>A. J. Salle, Fundamental Principles of Bacteriology</p> <p>Conn E and Stumpf P. Outlines of biochemistry. John Wiley and Sons.</p>

## REFERENCES

(US-FMB-101, US-FMB- 102)

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 andCompany. New York 2005
10. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. AddisonWeseley Longman Inc. 1998.
11. Microbiology Laboratory Manual: Cappuccino and Sherman

## I Year Semester – II Summary

Sr. No.	Choice Based Credit System		Subject Code	Remarks
1	Core Course (Microbiology)		US-FMB-201, US-FMB- 202, US-FMB- P2	
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)			
	Skill Enhancement Courses (SEC)			

### Detail Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week					Credit	Seasonal Evaluation Scheme				Total Marks
			Units	S. L.	L	T	P		S. L. E	CT	TA	SEE	
1	US-FMB-201	Study of Microbial diversity, Growth, Bioinformatics and Biostatistics	3	20%*	3	0	0	2	10	20	10	60	100
2	US-FMB-202	Microbial interactions and Instrumentation	3	20%*	3	0	0	2	10	20	10	60	100
3	US-FMB-P2	Practicals Based US-FMB--201 + Practical Based US-FMB--202			0	0	6	2				100 (80+20)	100

	Total Hours / Credit		06	Total Marks	300
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**\*One to two lectures to be taken for self -learning Evaluation.**

### I Year Semester – II Units – Topics – Teaching Hours

S.N	Subject Code	Subject Unit Title		Hours /Lect ures	Total No. of hours/lec tures	Credit	Tot al Marks
<b>1</b>	US-FMB-201	I	Microorganisms significant in environment and Bioinformatics	15	45	2	100 (60+40)
		II	Microorganisms significant in Industrial and Medical Microbiology	15			
		III	Microbial Growth and Biostatistics	15			
<b>2</b>	US-FMB-202	I	Human Health and Microbial Interaction	15	45	2	100 (60+40)
		II	Microbial Ecology and Infections in humans	15			
		III	Diagnostic Microbiology II and Instrumentation	15			
<b>3</b>	US-FMB-P2	I	Practicals Based on Unit-I, II & III of US-FMB-201	3	45x2= 90 lectures per batch	2	100 (80+10+10)
		II	Practicals Based on Unit-I, II & III of US-FMB-202	3			
TOTAL						6	300

**Curriculum Topics along with Self-Learning topics** - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective Unit

Course Code: US-FMB-201

Unit	Content	No. of Lectures
I	<b>Microorganisms significant in environment and Bioinformatics</b> a) <b>Algae</b> i. Characteristics of algae: morphology, Pigments, reproduction ii. Cultivation of algae.	<b>15</b>



- iii. Major groups of Algae –an overview
- iv. Biological, Medical and Economic importance of Algae.
- v. Differences between Algae and Cyanobacteria

**b) Rickettsia, Coxiella, Chlamydia, Mycoplasma**

- i. General features
- ii. Medical significance

**c) Actinomycetes:**

- i. General features of Nocardia and Streptomyces
- ii. Importance: ecological, commercial and medical

**d) Archaea**

- i. Introduction- Major Archaeal physiological groups
- ii. Archaeal cell wall, lipids and membranes
- iii. Ecological importance
- iv. Genetic characters
- v. Differences between Archaeobacteria, Eubacteria and Eukaryotes

**e) Introduction to Bioinformatics**

- i. Definition, aims, tasks and applications of Bioinformatics.
- ii. Importance, Types of databases

**2 Microorganisms significant in Industrial and Medical microbiology**

**a) Viruses:**

- i. Historical highlights,
- ii. General properties of viruses, prions, viroid's
- iii. Structure of viruses
- iv. Bacteriophage, animal and plant virus
- v. Life cycle of T4 and  $\lambda$  phage

**b) Protozoa-**

- i. Major Categories of Protozoa Based on motility, reproduction. 15  
Medically important
- ii. Protozoa Life cycle of Entamoeba

**c) Fungi and Yeast**

- i. Characteristics: structure, Reproduction.
- ii. Cultivation of fungi and yeasts.
- iii. Major fungal divisions- overview. Life cycle of yeast
- iv. Biological and economical importance

**d) Slime molds and Myxomycetes**

**e) Overview of Bacterial classification**

i. Phenotypic- morphology and biochemical classification, concept of culture collections

Genotypic- sequence based techniques

### 3 Microbial Growth and Biostatistics

#### a) Microbial Growth

i. Definition of growth

ii. Mathematical Expression

iii. Growth curve

iv. Measurement of growth: Direct microscopic count – Breed's count, Petroff – Hauser counting chamber-Haemocytometer.

v. Viable count – Spread plate and Pour plate technique

vi. Measurements of cell constituents.

vii. Turbidity measurements – Nephelometer and spectrophotometer techniques

viii. Synchronous growth, Continuous growth (Chemostat and Turbidostat)

ix. Influence of environmental factors on growth.

x. Microbial growth in natural environment with examples.

xi. Counting viable non-culturable organisms-Quorum sensing techniques

**b) Introduction to Biostatistics** – Types of data, data presentation, Measuring central tendencies, standard deviation

#### Self-Learning topics (Unit wise)

Sr no	Unit	Topics
1	1	1e Definition, aims, tasks and applications of Bioinformatics
2	2	2a General properties of viruses
3	3	3a Growth curve

#### Online Resources

**Online module:** Concepts and importance of Bioinformatics

<https://nptel.ac.in/courses/102/106/102106065/>

**Online module:** Virus – Introduction, Virus- host interaction, Lytic cycle of viruses,

Lysogenic cycle of viruses [https://swayam.gov.in/nd2\\_cec19\\_bt11/preview](https://swayam.gov.in/nd2_cec19_bt11/preview)

**Online module:** Enumeration of bacteria and determination of growth

phase [http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view\\_module\\_ug.php/78](http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/78)

Course Code: US-FMB-202

Unit	Content	No. of Lectures
1	Human Health and Microbial Interaction	15

### **a. Host defense and basics of immunology**

- 1 Difference between infection & disease.
- 2 **Important terminology:** Primary infection, secondary infection. Contagious infection, occupational disorder, clinical infection, subclinical infection, Zoonosis, genetic disorder, vector borne infection.
- 3 Factors affecting infection: Microbial factors: adherence, invasion, role of virulence factors in invasion, colonization & its effects. Host factors: natural resistance, species resistance, racial resistance
- 4 Individual resistance: Factors influencing individual resistance: Age, nutrition, personal hygiene, stress, hormones, Addiction to drugs/ alcohol. Interaction between Microbes & host is dynamic.
  - i. Individual resistance: Factors influencing individual resistance: Age, nutrition, personal hygiene, stress, hormones, Addiction to drugs/ alcohol. Interaction between Microbes & host is dynamic.
  - ii. **Host defense against infection: Overview**
    1. First line of Defense: for skin, respiratory tract, gastrointestinal tract, genitourinary tract, eyes.
    2. Second line of defense: Biological barriers: Phagocytosis, Inflammation
    3. Third line of defense: Brief introduction to antibody mediated & cell mediated immunity

## **2 Microbial Ecology and Infections in humans**

15

### **a) Types of Microbial Interactions**

- i. Mutualism
- ii. Cooperation
- iii. Commensalisms
- iv. Predation
- v. Parasitism
- vi. Amensalism
- vii. Competition

### **b) Human Microbe Interactions**

- i. Normal flora of the human body: Skin, Nose & Nasopharynx, Oropharynx, Respiratory tract, Eye, External ear, Mouth, Stomach, Small intestine, Large intestine, Genitourinary tract.
- ii. Infections in humans with examples (TB, Typhoid, HIV, Swine Flu, Malaria)
- iii. Relationship between microbiota & the host
- iv. Gnotobiotic animals – Cultivation, Applications and examples

### **c) Microbial associations with vascular plants**

- i. Phyllosphere
- ii. Rhizosphere & Rhizoplane
- iii. Mycorrhizae
- iv. Nitrogen fixation: Rhizobia, Actinorhizae, Stem Nodulating Rhizobia
- v. Fungal & Bacterial endophytes
- vi. Agrobacterium & other plant pathogens

**d) Genetic Engineering**

- i. Role of Ti plasmid
- ii. Genetically Modified crops- Bt Cotton

**3 Diagnostic Microbiology II and Instrumentation**

**15**

**a) Instrumentation**

- i. pH meter
  - ii. Colorimeter
  - iii. Spectrophotometer
  - iv. Centrifuge
  - v. Weigh Balance and Anoxic gas chamber
  - vi. Autoclave
  - vii. Hot air Oven
  - viii. Electron Microscope: TEM, SEM
  - ix. Contrast enhancement for electron microscope
  - x. Fluorescent Microscope
  - xi. Confocal Microscope
  - xii. Application of electron microscopy in diagnostics
  - xiii. Applications Scanning probe Microscopy –Atomic force Microscope
- Significance of imaging in diagnostics – Role of computed tomography (CT), Magnetic resonance imaging (MRI) and positron emission tomography (PET) in bacterial detection.

**Self-Learning topics (Unit wise)**

Sr no	Unit	Topics
1	1	1a Host defense and basics of immunology: Important terminology
2	2	1a Host defense against infection: Overview
3	2	2a Types of Microbial Interactions
4	3	3a Instrumentation: Colorimeter and Spectrophotometer
5	3	3a Instrumentation: Confocal Microscope

**Online Resources**

<b>Online module:</b>	Introduction to immune system
	<a href="http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/46">http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/46</a>
<b>Online module:</b>	Natural Barriers in Human body
	<a href="http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/69">http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/69</a>

**Online module:** Types of Microbial Interactions, Normal flora  
[http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view\\_module\\_ug.php/78](http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/78)  
**Online module:** Colorimetry and UV-Visible Spectroscopy  
[http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view\\_module\\_ug.php/141](http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/141)  
**Online module:** Confocal Microscopy  
[http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view\\_module\\_ug.php/141](http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/141)

Course Code: **US-FMB-P2**

Paper-I-Practical

Total Credits: 01

Title of Paper: **Study of Microbial diversity, Growth, Bioinformatics and Biostatistics**

Unit	Content	Reference Books
I	1. Spot assay and plaque assay of Bacteriophage (Demonstration) 2. Slide Culture technique (Actinomycetes & Fungi)	A.J. Salle, Fundamental Principles of Bacteriology
II	3. Isolation of yeast and other fungi on Sabourauds agar 4. Study of microbial growth under Static & Shaker Cultures 5. Fungal Wet mounts & Study of Morphological Characteristics: Mucor, Rhizopus, Aspergillus, Penicillium. 6. Permanent slides of Algae, Protozoa	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company
III	7. Growth curve (Demonstration) only in complex media. 8. Breed's Count 9. Haemocytometer 10. Viable count: Spread plate and pour plate 11. Viable count calculations with Mean, median and Mode 12. Brown's opacity 13. Effect of pH and temperature on growth 14. Measurement of cell dimensions-Micrometry 15. Calculation of central tendency 16. Introduction to Databases	Prescott, Harley. Klein-Microbiology, 7th edition, International edition, McGraw Hill

Title of Paper: **Microbial interactions and Instrumentation**

Unit	Content	Reference Books
I	1. Normal flora of the Skin & Saliva 2. Wet Mount of Lichen 3. Bacteroid Staining & Isolation of Rhizobium 4. Azotobacter isolation & staining	Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company
II	5. Study of virulence factors – Enzyme Coagulase 6. Study of virulence factors – Enzyme Hemolysin 7. Study of virulence factors – Enzyme Lecithinase	Microbiology An Introduction. 6 <sup>th</sup> Edition. Tortora, Funke and Case. Adisson Wesley Longman Inc. 1998.
III	8. Use of standard buffers for calibration and determination of pH of a given solution 9. Determination of $\lambda_{max}$ 10. Verification of Beer Lambert's law 11. Determination & efficiency of Autoclave, Hot air oven, Laminar Air Flow 12. Writing of SOP's for Instruments 13. Visit to a Microbiology laboratory in a research Institute/Industrial visit	An Introduction to Practical Biochemistry / Plummer David (1979) TMH

## REFERENCES

(US-FMB-201, US-FMB- 202)

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. AddisonWeseley Longman Inc. 1998.
8. Methods in Biostatistics- B.K.Mahajan, 7th edition
9. Biostatistics- Basic concepts and methodology for health sciences, Wayne Daniel, 10th edition
10. Teri Shors,(2009), "Understanding viruses", Jones and Bartlett publishers
11. S.Ignacimuthu, (2005), "Basic Bioinformatics", Narosa publishing house.

L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, CT-Commutative Test, TA-Teacher Assessment

The semester end examination (external component) of 60% will be as follows:

1) Duration – 2 Hours

2) i) Theory Question Paper Pattern: -

Evaluation Scheme (60:40)

- a) Semester End Theory Assessment - 60 Marks
- i. Duration - These examinations shall be of 2 1/2 Hours duration.
  - ii. Theory question paper pattern:-
    1. There shall be four questions. On each unit there will be one question with 15 Marks each & fourth one will be based on all the three units with 15 Marks.
    2. All questions shall be compulsory with internal choice within the questions. Question 1 (Unit-I), Question 2 (Unit-II) & Question 3 (Unit-III) & Question 4 (combined units) will be of 60 Marks with internal options.
    3. Questions I, II and III may be sub divided into sub questions of short or long questions of 5 marks each. Please note that the allocation of marks depends on the weightage of the topic.
    4. Question IV will be objective questions.
- b) Continuous evaluation- 40 Marks
- 20 Marks Test
  - 15 Marks Projects/Presentations (On Current topics/Syllabus)
  - 5 Marks Overall Conduct and Active Participation.

2) ii) Practical Question Paper Pattern: -

Semester End Examination-50 Marks per Paper

Paper-I based on Course-I & Paper-II based on Course-II in each semester.

Internal Assessment-10 Marks per Paper



<b>Sr. No.</b>	<b>Particulars</b>	<b>Marks</b>	<b>Total</b>
1	Laboratory work (Paper I and II)	40 + 40	80
2	Journal (Paper I and II)	05 + 05	10
3	Viva (Paper I and II)	05 + 05	10
	<b>Grand Total</b>	<b>50+50</b>	<b>100</b>

### **PRACTICAL BOOK/JOURNAL**

#### **Semester I:**

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / In charge of the department; failing which the student will not be allowed to appear for the practical examination.

#### **Semester II:**

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / In charge of the department; failing which the student will not be allowed to appear for the practical examination.

3) 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,

4) The assessment of Part 'A' i.e. Internal Assessment as mentioned above for the Semesters I & VI shall be processed by the Colleges / Institutions of their learners admitted for the programme while the University shall conduct the assessment of Part 'B' i.e. Semester End Examination for Semesters I & VI.

The Internal Assessment marks of learners appearing for Semesters I & VI shall be submitted to the University by the respective colleges/ Institutions before the commencement of respective Semester End Examinations. The Semester End Examinations for Semesters I & VI shall be conducted by the University and the results shall be declared after processing the internal assessment and the marks

awarded to the learners. The grade card shall be issued by the University after converting the marks into grades.

5) The marks of the internal assessment should not be disclosed to the students till the results of the corresponding semester is declared.

### **R.\*\*\*\*\* Passing Standard and Performance Grading:**

#### **PASSING STANDARD:**

The learners to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment & Semester End Examination. The learners shall obtain minimum of 30% marks (i.e. 12 out of 30) in the Internal Assessment and 70% marks in Semester End Examination (i.e. 24 Out of 60) separately, to pass the course and minimum of Grade E in each project, wherever applicable, to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment & Semester End Examination together.

#### **PERFROMANCE GRADING:**

The Performance Grading of the learners shall be on the TEN-point ranking system as under:

Grade	Marks Grade	Points
O+	90 & above	10
O	80 to 89.99	9
A+	70 to 79.99	8
A	65 to 69.99	7
B+	60 to 64.99	6
B	55 to 59.99	5
C	50 to 54.99	4
D	45 to 49.99	3
E	40 to 44.99	2
F	(Fail) 39.99 & below	1

**The performance grading shall be based on the aggregate performance of Internal Assessment and Semester End Examination.**

**R. \*\*\*\* Carry Forwards of Marks: In Case of a Learner Who Fails in The Internal Assessment And /Or Semester End Assessment in One Or More Subjects:**

1) A learner who PASSES in the Internal Examination but FAILS in the Semester End Examination of the course shall re-appear for the Semester End Examination of that course. However, his/her marks of the Internal Examinations shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

2) A learner who PASSES in the Semester End Examination but FAILS in the Internal Assessment of the course shall re-appear for the Internal Examination of that course. However, his/her marks of the Semester End Examination shall be carried over and he/she shall be entitled for grade obtained by him/her on passing.

**R.\*\*\*\* ALLOWED TO KEEP TERMS (ATKT):**

a. A learner shall be allowed to keep term for Semester II irrespective of number of heads of failure in the Semester I.

b. A learner shall be allowed to keep term for Semester III if he/she passes each of Semester I and Semester II

OR

learner who fails in not more than two courses of Semester I and Semester II taken together.

c. A learner shall be allowed to keep term for Semester IV irrespective of number of heads of failure in Semester III. However, the learner shall pass each course of Semester I and Semester II in order to appear for Semester IV.

d. A learner shall be allowed to keep term for Semester V if he/she passes Semester I, Semester II, Semester III and Semester IV

OR

learner shall pass Semester I and Semester II and fails in not more than two courses of Semester III and Semester IV taken together.

e. A learner shall be allowed to keep term for Semester VI irrespective of number of heads of failure in the Semester V. However, the learner shall pass each course of Semester III and Semester IV in order to appear for Semester VI.

f. The result of Semester VI of a learner, in regular program, shall be kept in abeyance until the learner passes each of Semester I, Semester II, Semester III, Semester IV and Semester V.

g. The result of Semester VI of a learner, in Honours program, shall be kept in abeyance until the learner passes each of Semester I, Semester II, Semester III, Semester IV and Semester V and additional

**R. \*\*\*\* ADDITIONAL EXAMINATION:  
INTERNAL ASSESSMENT:**

**Eligibility norms to appear for the additional class test or assignment or project for learners who remained absent:**

- a. The learner must apply to the Head of the Institution / School / Department giving the reason(s) for absence within 8 days of the conduct of the examination along with the necessary documents and testimonials.
- b. If the learner is absent, on sanctioned leave from head of Institution / School / Department, for participation in Inter Collegiate events, State or National or International level events, Training camp or coaching camp organized by authorized university or state or national or international bodies, NSS / NCC Events / Camps / cultural activities / sports activities / research festival or any other activities authenticated by the head of the institution, the head of the Institution shall generally grant permission to the learner to appear for the additional class test or assignment.
- c. The Head of the Institution, on scrutiny of the documents and testimonials, may grant the permission to the learner to appear for the additional examination.

**Class test or assignment for Internal Assessment:**

- a. A learner who is absent for the class test and for all the assignment/s will be declared fail in the Internal Assessment Scheme.
- b. A learner who is absent for the class test and has appeared for all the assignment/s will be allowed to appear for the additional class test
- c. A learner who has appeared for the class test but remains absent for all the assignment/s will be allowed to appear for only one additional assignment.
- d. A learners who is absent for the class test or one assignment as the case may be the learner will be allowed to appear for the additional class test/assignment. The Additional Class Test (or viva examination) or Assignment must be conducted 15 days prior to the commencement of the Semester End Examination after following the necessary procedure and completing the formalities.

## **SEMESTER END EXAMINATIONS**

### **Eligibility to Appear for Additional Semester End Examination:**

a. A learner who does not appear i.e. remains absent in some or all the courses on medical grounds or for representing the college / university in sports, cultural activities, activities of NSS, NCC or sports training camps conducted by recognized bodies / competent authorities or for any other reason which is considered valid under exceptional circumstances and to the satisfaction of the Principal or the Head of the Institute OR fails in some or all the subjects is eligible to appear for the additional examination.

A learner who does not appear for both the Internal Assessment and Semester End Examination shall not be eligible to appear for the additional Semester End Examination.

The additional Semester End Examination shall be of two and half hour's duration and of 70 marks. The learner shall appear for the course of the Semester End Examination for which he/she was absent or has failed.

### **MODE OF CONDUCT OF SEMESTER END ADDITIONAL EXAMINATION:**

a) There will be one additional examination for semester I, II, III and IV for those who have failed or remained absent.

b) The absent learner will be allowed to appear for the examination by the head of the institution after following the necessary formalities subject to the reasons to the satisfaction of the head of the institution.

c) This examination will be held 20 days after the declaration of results but not later than 40 days.

### **PROJECT EVALUATION**

1. A learner who PASSES IN ALL THE COURSES BUT DOES NOT secure minimum grade of E in project as applicable has to resubmit a fresh project till he/she secures a minimum of grade E.

2. The credits and grade points secured by him/her in the other courses will be carried forward and he/she shall be entitled for grade obtained by them on passing of all the courses.

3. The evaluation of project and viva/voce examination shall be done by marks only and then it will be converted into grade in the Ten-point scale and award the same to the learner.

4. A learner shall have to obtain minimum of grade E (or its equivalent marks) in project evaluation and viva/voce taken together to obtain 30% marks in project work.

**R.\*\*\*\*: Grade Cum Marks Cards:**

The result gazette and the format of the Grade Cards for the semesters conducted by colleges on behalf of the University will be uniform for all the Colleges / Institutions as indicated in the manual for the faculty.

**R.\*\*\*: Semester wise Credit allocation:**

course	Sem-1	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Total credit
B.Sc. Microbiology	20	20	20	20	20	20	120

**R.\*\*\*\*\* GRACING:** The gracing shall be carried out as per existing ordinances of the University in force.

**R.\*\*\*\* Question Papers Setting, Assessment Pattern:**

1. The question papers shall be set and assessed by the teacher, teaching the course. If the course is taught by more than one teacher, the question paper shall preferably be set jointly and assessment of the sections / questions shall be done by the respective teacher.

2. The College authorities may request the teachers from other institutes teaching the course to set the question paper and/or assess the answer papers. However, for such actions the university authorities may seek proper reasons and justifications from the concerned Head of the Institute.

3. The question paper set by the college in different courses shall be forwarded to the University within 15 days of the declaration of the results for the semester for being placed before the respective Board of Studies, which shall report their observations to the Academic Council and inform the observations of the Board and the Academic Council to the concerned colleges.

**R.\*\*\*\* Centralized Assessment:**

The entire work of assessment of the answer papers at the Semester End Examinations shall be centralized within the premises of the concerned college

as per the provisions of the University Act and shall be open to inspection by the University. The College can appoint a Committee of 5 members to plan and conduct the CAP Center to ensure smooth, efficient and effective conduct of CAP and Completion of the Assessment.

**R.\*\*\*\* Verification and Revaluation:**

Shall be as per the existing ordinances and regulation / & VCD of the University.

**R.\*\*\*\* Ex-student:** Learners who are declared failed, on account of failure at the Internal Assessment and/or Semester End Examinations or who have been allowed to keep terms for the higher class shall appear as ex-student for the Internal Assessment and/or the Semester End Examination in the failed course at the examinations held by their respective college. Examination for the ex-students will be held at least 15 days prior to the Semester End Examination of the next Semester as per the pattern of the course in the respective (failed) semester examination. The examinations for the ex-students shall be held in every semester.

**R.\*\*\*\* College Examination Committee:** The College Examination Committee shall consist of not more than 10 members, nominated by the Principal / Head of the Institute. One of the members shall be the Chairman of the Committee. The Committee will act as the custodian and shall be In-charge of all the matters pertaining to the Internal Assessment, Semester End Examination of regular as well as ex-students for all the examination at Semester I to IV and for the Internal Assessment for Semester V and VI including preparation of time table, setting of the question paper, arrangement for assessment of the answer books, the declaration of the results, attending to and resolving the grievances/queries of the learners which are not part of Unfair Means Inquiry Committee, keeping records of the assessment of all the assessments and examinations, scrutiny of the student's eligible to appear for the additional examination and any other matter pertaining to the conduct of the additional and examination for the ex-students. The committee shall work as per the rules & regulation of the University and under the superintendent of the Principal/ Head of the Institution but as per direction of University Examination authority from time to time.

**R.\*\*\*\* College Unfair Means Inquiry Committee:** The College Unfair Means Inquiry Committee as per the prevailing ordinances of the University. The term of the committee shall be for five years subject to the provision of the

Maharashtra Universities Act. The proceedings and working of the committee shall be maintained in the form of documents and minutes.

**R.\*\*\*\* Sets of Question papers:** Three different sets of question papers shall be drawn with the model answer paper and assessment scheme per course for every Semester End Examination one of which shall be used for the regular examination, the second set can be used for the additional examination and the third set can be used for the examination for the ex-student. Similarly, two sets of question papers shall be drawn for every test/assignment conducted per course one of which shall be used for the examination and the other for the additional examination.

**R.\*\*\*\* Remuneration to Paper Setters / Examiners / Teaching and Non-**

**Teaching Staff:** The remuneration payable to the paper setters and examiners will be as prescribed by the University Statute from time to time. The remuneration payable to the teaching and non-teaching staff appointed for the conduct of the examinations will be as per the rates prescribed by the University for the conduct of the Third Year Examinations by the University in the concerned faculty

**R.\*\*\*\*\* GRACING:** The gracing shall be carried out as per existing ordinances of the University in force

**O.\*\*\*\*\*: - Grace Marks passing in each head of passing:** Grace Marks passing in each course/ head of passing (Theory/ Practical/ Oral/ Sessional/ TW/ External / Semester End Exam / Internal Assessment) The examinee shall be given the benefit of grace marks only for passing in each course / head of passing (Theory / Practical / Oral / Sessional/ TW) in External / Semester End Examination or Internal Examination Assessment as follows:

Head of Passing	Grace Marks Up to
up to - 50	2
051 - 100	3
101 - 150	4
151 - 200	5
201 - 250	6



251 - 300	7
301 - 350	8
351 - 400	9
401 and above	10

Provided that the benefit of such gracing marks given in microbiology courses head of passing shall not exceed 1% of the aggregate marks in that examination. Provided further that the benefit of gracing of marks under this Ordinance, shall be applicable only if the candidate passes the entire examination of semester / year. Provided further that this gracing is concurrent with the rules and guidelines of professional statutory bodies at the All India level such as AICTE, MCI, Bar Council, CCIM, CCIH, NCTE, UGC etc.

**O \*\*\*\*\* Grace Marks for getting Higher Class / Grade**

A candidate/learners who passes in all the subjects / courses and heads of passing in the examination without the benefit of either gracing or condonation rules and whose total number of marks falls short for securing Second Class / Higher Second Class/ First Class or next Higher Grade by marks not more 1% of the aggregate marks of that examination or up to 10 marks, whichever is less, shall be given the required marks to get the next higher or grade as the case may be.

**O.\*\*\*\*\*: - Grace Marks for getting Higher Class / Grade**

A candidate/learner who passes in all the subjects / courses and heads of passing in the examination without the benefit of either gracing or condonation rules and whose total number of marks falls short for securing Second Class / Higher Second Class/ First Class or next Higher Grade by marks not more 1% of the aggregate marks of that examination or up to 10 marks, whichever is less, shall be given the required marks to get the next higher or grade as the case may be.

Provided that benefits of above-mentioned grace marks shall not be given, if the candidate fails to secure necessary passing marks in the aggregate course / head of passing also, if prescribed, in the examination concerned.

Provided further that benefits of above-mentioned grace marks shall be given to the candidate for such examination/s only for which provision of award of Class / Grade has been prescribed.

Provided further that this gracing is concurrent with the rules and guidelines of professional statutory bodies at the All India level such as AICTE, MCI, Bar Council, CCIM, CCIH, NCTE etc.

**O.\*\*\*\*Grace Marks for getting distinction / Grade 'O' in the subject / course only.**

A candidate/learners who passes in all the Courses or Subjects/ Heads of passing in the examination without benefit of either gracing or condonation rules and whose total number of marks in the courses/ subject/s falls short by not more than three marks for getting Grade 'O'/ distinction in the courses / subject/s respected shall be given necessary grace marks up to three (03) in maximum two subjects, courses subject to maximum 1% of the total marks of that Head of Passing whichever is more, in a given examination.

Provided that benefits of above-mentioned grace marks shall not be given to the candidate only for such examination/s for which provision for distinction in a course /subject has been prescribed.

Provided further that this gracing is concurrent with the rules and guidelines of professional statutory bodies at the All India level. such as AICTE, MCI, Bar Council, CCIM, CCIH, NCTE etc.

**O. \*\*\*\*\* Condonation**

If a candidate/learners fails in only one course/ head of passing, having passed in all other courses/ heads of passing, his/her deficiency of marks in such head of passing may be condoned by not more than 1% of the aggregate marks of the examination or 10% of the total number of marks of that course / head of passing in which he/she is failing, whichever is less. However, condonation, whether in one head of passing or aggregate head of passing be restricted to maximum up to 10 marks only.

Condonation of deficiency of marks be shown in the Grade Card/ Statement of Marks in the form of asterisk and Ordinance number. Provided that this condonation of marks is concurrent with the rules and guidelines of professional statutory bodies at the All India level such as AICTE, MCI, Bar Council, CCIM, CCIH, NCTE etc.

**O.\*\*\*\*\* Moderation**

1. The Moderation System shall be application to all the faculties for Under Graduate and Post Graduate Semester End Examination / External Theory Examination.

2.100% moderation of the answer book shall be carried out in the case of candidates failing by 10% of marks of the aggregate marks of that course / paper.

3. In case of Microbiology course, 100% moderation shall be carried out in case of candidates obtaining 70% and above marks or Grade 'O'.

4. The moderation of answer books of at least 5% of total number of candidates obtaining marks between Grade 'E' / minimum passing marks and marks required for Grade 'A' and above First Class/ distinction shall be carried out on random sample basis.

5. One moderator shall be appointed per five examiners. However, Chairman, Board of paper setters will act as the moderator, where there are less than five examiners.

6. Moderation work shall be carried out simultaneously with the central assessment of answer books at CAPs.

7. Where marks awarded by the moderator vary from those awarded by original examiner, the marks awarded by the moderator shall be taken as final.

8. University shall formulate detailed scheme of moderation on the basis of guidelines given above.

### **O.\*\*\*\*\*: Vigilance Squad**

1. The Vigilance Squad/s of not less than three and not more than four members shall be appointed by the Vice Chancellor to visit the Centre's of University Examinations to:

i. Ensure that the University Examinations are conducted as per norms laid down.

ii. Observe whether the Senior Supervisors and Block Supervisors are following scrupulously instructions for conduct of the University Examinations.

iii. Check the students who try to resort to malpractices at the time of University Examinations and report such case to the University.

2. The Vigilance Squad is authorized to visit any Examination Centre without prior intimation and enter office of the In-charge of the Examination Centre to

check the record and other material relating to the conduct of Examination. They can enter in any block of Examination for checking the candidates identify card, fee receipt, hall tickets etc. to ascertain the authenticity of the Candidate. The Vigilance Squad shall be authorized to detect use of malpractices and unfair means in the University Examination.

3. The Vice Chancellor shall appoint Vigilance Squad which may include: Senior Teachers of Affiliated College/Recognized Institution/ University Departments /Teachers and desirably one lady teacher; and any other person as the Vice Chancellor considers appropriate.

4. The Chairman of Vigilance Squad/s shall submit the report on surprise visit directly to the Vice Chancellor with a copy to the concerned Principal. The Vigilance Squad/s may make suggestions in the matter of proper conduct of examinations, if necessary.

5. The Principal of the College where the center of examination is located shall be responsible for the smooth conduct of examination. He/ She shall ensure strict vigilance against the use of unfair means by the students and shall be responsible for reporting such cases to the University as well as the law of enforcing authority.

## **O. \*\*\*\*\*Amendments of Results**

1)**Due To Errors** In any case where it is found that the result of an examination has been affected by errors, the Controller of Examinations shall have power to amend such result in such manner as shall be in accordance with the true position and to make such declaration as is necessary, with the necessary approval of Vice Chancellor, provided the errors are reported / detected within 6 months from the date declaration of results. Errors detected thereafter shall be placed before the Board of Examinations.

Error Means: -

i) Error in computer/data entry, printing or programming and the like.

ii) Clerical error, manual or machine, in totaling or entering of marks on ledger/register.

iii) Error due to negligence or oversight of examiner or any other person connected with evaluation, moderation and result preparation.

2. Due to fraud, malpractices etc.

In any case where the result of an examination has been ascertained and published and it is found that such result has been affected by any malpractices, fraud or any other improper conduct whereby an examiner has benefited and that such examinee, has in the opinion of the Board of Examination been party of privy to or connived at such malpractice, fraud or improper conduct, the Board of Examination shall have power at any time notwithstanding the issue of the Certificate or the award of a Prize or Scholarship, to amend the result of such examinee and to make such declaration as the Board of Examination considers necessary in that behalf

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