Progressive Education Society's

Modern College of Arts, Science & Commerce, Ganeshkhind, Pune-16

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Framework of Syllabus

F.Y.B.Sc. Microbiology

(2021-2022)

(To be implemented from 2022-2023)

Title of the Course: B. Sc. (Microbiology)

Preamble:

Microbiology is a broad discipline of biology involving study of five types of microorganisms i.e., bacteria, protozoa, algae, fungi and viruses. It deals with the interaction of microorganisms with each other and with plants, animals and the environment. Microorganisms were discovered over three fifty years ago and it is thought that a huge diversity still remains to be explored. Since the inception of microbiology as a branch of science, it has remained an ever-expanding field of active research, broadly categorized as pure and applied science.

Knowledge of different aspects of Microbiology has become crucial and indispensable to society. Microbes can be harnessed for human welfare. They find applications in the fields such as nanotechnology, genetic engineering, pharmaceutical, fermentation, food and agriculture industries and as study models. Some microorganisms cause important diseases of plants and animals including humans. Microbiologists play a significant role in diagnosis, prevention and control of these diseases. There is a continuous demand for microbiologists as a work force in the fields of education, industry and research. Career opportunities for the graduate students are available in industry and research equally.

Introduction:

In the post globalization world higher education has to play a significant role in creation of skilled human resources for the well-being of humanity. The barriers among the academic fields seem to have dissolved. However, the disparities in the field of curriculum aspect, evaluation and mobility exist. With the changing scenario at local and global level, the syllabus restructuring should keep pace with developments in the education sector. Choice Based Credit System (CBCS) is being adopted and implemented to address the issues related to traditional systems and it also aims to maintain the best of earlier curriculum. The student is at the centre of CBCS. The present curriculum focuses on students' needs, skill development, interdisciplinary approach to learning and enhancing employability. The college provides an environment for the overall development of students into responsible citizens with multi-dimensional personalities by inculcating among students a blend of scientific insights, compassionate and progressive attitude, cultural awareness, and time-tested traditional values.

Microbiology curricula are offered at two levels viz. undergraduate and postgraduate. The undergraduate curricula are prepared to impart basic knowledge of the respective subject from all possible angles. In addition, students are to be trained to apply this knowledge in day-to-day applications and to get a glimpse of research.

Objectives to be achieved:

- To enrich students' knowledge and train them in the pure microbial sciences.
- To introduce the concepts of application and research in Microbiology.
- To inculcate a sense of scientific responsibilities and social and environment awareness.
- To help students build-up a progressive and successful career.

Course Structure:

- For First year: Student has to select 4 different subjects among the subjects offered by the College /Institute.
- For Second year: Student has to select 3 different subjects among 4 subjects chosen in first year.
- For Third year: Student has to select only 1 subject among the 3 subjects opted in second year.
- CGPA will be calculated based on core 132 credits only.
- Each theory credit is equivalent to 15 clock hours of teaching (12 hrs classroom+3 hrs of tutorials-active learning method) and each practical credit is equivalent to 30 clock hours of teaching in a semester.
- For the purpose of computation of workload, the following mechanism may be adopted as per UGC guidelines:
- Each theory Lecture time for FY, SY, TY is of 1 lecture = 50 min
- Each practical session time for FY is of 3-hour 15 min = 195 min
- Each practical session time for SY & TY is of 4-hour 20 min = 260 min

Eligibility for Admission:

First Year B.Sc.:

a. Higher Secondary School Certificate (10+2) or its equivalent Examination with English and Biology; and two of the science subjects such as Physics, Chemistry, Mathematics, Geography, Geology, etc.

OR

b. Three Years Diploma in Pharmacy Course of Board of Technical Education conducted by Government of Maharashtra or its equivalent.

OR

c. Higher Secondary School Certificate (10+2) Examination with English and vocational subject of + 2 level (MCVC) - Medical Lab. Technician (Subject Code = P1/P2/P3)

Admissions will be given as per the selection procedure / policies adopted by the respective college keeping in accordance with conditions laid down by the University of Pune.

Reservation and relaxation will be as per the Government rules.
Medium of Instruction: English

Award of Credits:

- Each course having 4 credits shall be evaluated out of 100 marks and student should secure at least 40 marks to earn full credits of that course.

- Each course having 2 credits shall be evaluated out of 50 marks and student should secure at least 20 marks to earn full credits of that course.

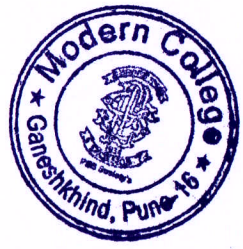
- GPA shall be calculated based on the marks obtained in the respective subject, provided that student should have obtained credits for that course.

Evaluation Pattern:

- Each course carrying 100 marks shall be evaluated with Continuous Assessment (CA) and University Evaluation (UE) mechanism.
- Continuous assessment shall be of 30 marks while University Evaluation shall be of 70 marks. To pass in a course, a student has to secure minimum 40 marks provided that he should secure minimum 28 marks in University Evaluation (UE).
- Each course carrying 50 marks shall be evaluated with Continuous Assessment (CA) and University Evaluation (UE) mechanism.
- Continuous assessment shall be of 15 marks while University Evaluation shall be of 35 marks.
- To pass in a course, a student has to secure minimum 20 marks provided that he/she should secure minimum14 marks in University Evaluation (UE).
- For Internal examination minimum two tests per paper of which one has to be a written test 10 marks
- Methods of assessment for Internal exams: Seminars, Viva-voce, Projects, Surveys, Field visits, Tutorials, Assignment, Group Discussion, etc (on approval of the head of the centre)

ATKT Rules:

- Minimum number of credits required to take admission to Second Year of B. Sc.: 22
- Minimum number of credits required to take admission to Third Year of B.Sc.: 44



Mandatory extra credits for award of B. Sc. degree

1. In addition to the compulsory credits of 132, the student has to earn additional 8 credits from following groups by taking/participating/conducting respective activities.
2. Courses in Group-I are compulsory.
3. The student can earn a maximum 04 credits from an individual group from Group 2 to Group-9. These extra credits will not be considered for GPA calculation; however, these are mandatory for the completion and award of B. Sc. Degree.

Group 1: Physical Education (at F. Y.B. Sc. Sem. I)-01 credit
Physical Education (at F. Y.B. Sc. Sem. II)-01credit (Note: Group I is compulsory for all the students as stated above.)

Group 2: Sport representation at Collegelevel-01 credit
Sport representation at University/Statelevel-02 credits

Group 3: National Social Service Scheme (participation in Camp): 01 credits
N.C.C. (with participation in annual camp)-01credit
N. C. C. (with B certificate/C certificate award)-02 credits
N.S.S. /N.C.C. Republic day parade participation-04 credits

Group 4: Avishkar participation; Extension activity participation, Cultural activity participation–01 credit, Avishkar selection at University level-02 credits. Avishkar winner at state level-04credits

Group 5: Research paper presentation at State/National level-01 credits. Research paper presentation at international level-02 credits

Group 6: Participation in Summer school/programme; Short term course (not less than 1-week duration) -03 credit.

Group 7: Scientific Survey, Societal survey, -02 credits.

Group 8: Field Visits; Study Tours; Industrial Visits; Participation in curricular/ co curricular competitions -01 Credit.

Group 9: Online certificate Courses /MOOC Courses/ Career Advancement Course up to 04 credits (Minimum10 Hrs. / credit)

Completion of Degree Course:

- A student who earns 140 credits, shall be considered to have completed the requirements of the B. Sc. degree program and CGPA will be calculated for such student.

Titles of Papers and Scheme of Study Evaluation

F. Y. B.Sc. Microbiology

Semester	Code	Paper	Paper title	Credits	Hours/ week	CIA	UE	Total
I	22-MB-111	I	Introduction to Microbial World	2	03	15	35	50
	22-MB-112	II	Basic Techniques in Microbiology	2	03	15	35	50
	22-MB-113	III	Practical Course based on theory papers 22-MB-111 and 22-MB-112	1.5	04	15	35	50
II	22-MB-121	I	Bacterial Cell and Biochemistry	2	03	15	35	50
	22-MB-122	II	Microbial Cultivation and Growth	2	03	15	35	50
	22-MB-123	III	Practical Course based on theory papers 22-MB-121 and 22-MB-122	1.5	04	15	35	50

S. Y. B. Sc. Microbiology

Semester	Code	Paper	Paper title	Credit	Hours/week	CIA	UE	Total
III	23-MB-231	I	Medical Microbiology and Immunology	2	3	15	35	50
	23-MB-232	II	Bacterial Physiology and Fermentation	2	3	15	35	50
	23-MB-233	III	Practical Course based on theory papers	2	4	15	35	50

			23-MB-231 and 23-MB-232					
IV	23-MB-241	I	Bacterial Genetics	2	3	15	35	50
	23-MB-242	II	Air, Water and Soil Microbiology	2	3	15	35	50
	23-MB-243	III	Practical Course based on theory papers	2	4	15	35	50
			23-MB-241 and 23-MB-242					

T. Y. B. Sc. Microbiology Proposed Structure
Semester V

Semester	Theory/ Practical / Skill Enhancement	Paper	Paper Title	Credit	Hours/week	CIA	UE	Total
Sem V	Discipline Specific Elective Course (DSEC)	24-MB-351	Medical Microbiology- I	2	3	15	35	50
	Theory	24-MB-352	Immunology- I	2	3	15	35	50
		24-MB-353	Enzymology	2	3	15	35	50
		24-MB-354	Genetics	2	3	15	35	50

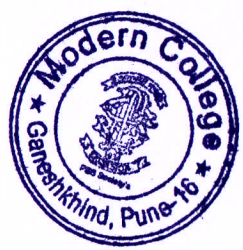
		24-MB-355	Fermentation Technology- I	2	3	15	35	50
		24-MB-356	Agricultural Microbiology	2	3	15	35	50
	Practical	24-MB-357	Practical Course I Based on: 24-MB-351 and 24-MB-352	2	4	15	35	50
		24-MB-358	Practical Course II Based on: 24-MB-353 and 24-MB-354	2	4	15	35	50
		24-MB-359	Practical Course III Based on: 24-MB-355 Fermentation Technology- I 24-MB-356 Agricultural Microbiology	2	4	15	35	50
	Skill Enhancement course	24-MB-3510	Marine Microbiology	2	3	15	35	50
		24-MB-3511	Dairy Microbiology	2	3	15	35	50
Sem VI	Discipline Specific Elective Course (DSEC) **Theory**	24-MB-361	Medical Microbiology- II	2	3	15	35	50
		24-MB-362	Immunology- II	2	3	15	35	50

		24-MB-363	Metabolism	2	3	15	35	50
		24-MB-364	Molecular Biology	2	3	15	35	50
		24-MB-365	Fermentation Technology II	2	3	15	35	50
		24-MB-366	Food Microbiology	2	3	15	35	50
	Discipline Specific Elective Course (DSEC)							
	Practical	24-MB-367	Practical Course I Based on: 24-MB-361 Medical Microbiology- II 24-MB-362 Immunology- II	2	4	15	35	50
		24-MB-368	Practical Course II Based on: 24-MB-363 Metabolism 24-MB-364 Molecular Biology	2	4	15	35	50
		24-MB-369	Practical Course III Based on: 24-MB-365 Fermentation Technology II 24-MB-366 Food Microbiology	2	4	15	35	50
	Skill Enhancement Courses	24-MB-3610	Waste Management	2	3	15	35	50

		24-MB-3611	Nanobiotechnology	2	3	15	35	50

Equivalence of Previous Syllabus: F. Y. B. Sc. Microbiology

Semester	F. Y. B. Sc. (2019 Pattern) SPPU		F. Y. B. Sc (2022 pattern)	
	Course Number	**Course title**	**Course Number**	**Course title**
I	MB 111	Introduction to Microbial World	22-MB-111	Introduction to Microbial World
	MB 112	Basic Techniques in Microbiology	22-MB-112	Basic Techniques in Microbiology
	MB 113	Practical Course based on theory paper I (MB 111) and Paper II (MB 112)	22-MB-113	Practical Course based on theory papers 22-MB-111 and 22-MB-112
II	MB 121	Bacterial Cell and Biochemistry	22-MB-121	Bacterial Cell and Biochemistry
	MB 122	Microbial cultivation and growth	22-MB-122	Microbial Cultivation and Growth
	MB 123	Practical Course based on theory paper I (MB 121) and Paper II (MB 122)	22-MB-123	Practical Course based on theory papers 22-MB-121 and 22-MB-122



External Students
There shall be no external students.

University Terms
Dates for commencement and conclusion for the first and second terms will be declared by the University authorities. Terms can be kept by only duly admitted students. The term shall be granted only on minimum 80 percent attendance at theory and practical course and satisfactory performance during the term.

Current curriculum orientation
To accommodate more advanced topics in the syllabi, it is necessary to understand the basic science knowledge level of the students that have chosen the Microbiology discipline. Curricula of courses of state and central boards of higher secondary level were reviewed to avoid reiterations of previous syllabi.

At **first year of under-graduation**, students will be provided the basic information that includes – characteristics of microbial world. The microorganisms will be studied for morphological, structural characterization, isolations techniques from natural and extreme environments and their prominent features. The methodology to develop keen observation i.e., different microscopy techniques, staining techniques and nutritional requirements will be taught in detail, including these aspects at laboratory level as well. Introduction to biochemical characterization of components of micro-organism e.g., proteins, lipids, nucleic acids and carbohydrates and instrumental techniques to estimate these components qualitatively and quantitatively from micro-organisms or other natural sources will be the focus for second theory paper. Relevant experimentation on these topics will be included in practical course. In practical course, students will be trained in preparing laboratory manuals, standard operating practices and logbooks.

At **second year under-graduation** includes paper on principles of taxonomy and classification of major groups of microorganisms. The said paper will also include the physiological studies on these groups of micro-organisms. Second paper will deal with Air and Water Microbiology; role of micro-organisms in environment in regard to pollution and biodegradation; water and sewage treatment. Practical for the second-year students will be designed to be flexible incorporating project themes on environment, agriculture and pollution aspects to acquire laboratory skills. Practical at this level will also include application of biostatistics principles, computers for data analysis, interpretation, introduction to scientific writing and report preparation. These aspects can be better while carrying out the mini projects.

At **third year under-graduation**, the six theory papers will deal with broad areas of microbiology. Five such areas are – Medical microbiology, Microbial physiology, Microbial (prokaryotic and eukaryotic) Genetics, Immunology and Fermentation technology. The sixth course will be Applied Microbiology that will include – Dairy Microbiology, Food Microbiology, Fermentation Technology, Agriculture Biotechnology, Fungal Biotechnology, etc. The practicals at third year will be planed more intensively, with exposure to applied fields and hands-on training.

Qualification of Teachers:
He/she should hold a minimum undergraduate and postgraduate degree in Microbiology (B. Sc. and M. Sc. Microbiology) and qualified as per UGC regulations.

Semester I
22-MB-111: Introduction to Microbial World

Course outcomes

Students will be able to

CO1: Describe history of microbiology, contribution of different scientists in microbiology and nobel laureates in the field of immunology, molecular biology and biotechnology.
CO2: Explain concepts of Vaccination and Chemotherapy and their applications.
CO3: Differentiate between different microbial groups like Bacteria, Fungi, Algae, Viruses and algae.
CO4: Explain the basis of classification of bacteria and viruses.
CO5: Explain beneficial and harmful effects of microorganisms in different areas of Microbiology.

Unit	Topic	No. of Lectures (36)
I	**Fascinating discoveries in Microbiology** **a. Development of microbiology as a discipline -** 1. Discovery of microscope and Microorganisms (Anton van Leeuwenhoek and Robert Hooke), 2. Abiogenesis v/s biogenesis (Aristotle's notion about spontaneous generation, Francesco Redi's experiment, Louis Pasteur's & Tyndall's experiments) **b. Golden Era of Microbiology** 1. Contributions of - Louis Pasteur (Fermentation, Rabies, Pasteurization and Cholera vaccine-fowl cholera experiment) Robert Koch (Koch's Postulates, Germ theory of disease, Tuberculosis and Cholera-isolation and staining techniques of causative agent) Ferdinand Cohn (Endospore discovery). Isolation techniques of bacteria. (Robert Koch) 2. Discovery of viruses (TMV and Bacteriophages), River's Postulates,Contribution of Joseph Lister (antiseptic surgery), Paul Ehrlich (Chemotherapy), Elie Metchnikoff (Phagocytosis), Edward Jenner (Vaccination) and Discovery of antibiotics. 3. Contribution of Martinus W. Beijerinck (Enrichment culture	4 4 4

	technique, Rhizobium), Sergei N. Winogradsky (Nitrogen fixation and Chemo-lithotrophy) in the development of the field of soil microbiology	2
	c. Classification of Microorganisms 1. Five Kingdom System 2. Carl Woese classification based on 16S rRNA 3. Three domain system of classification 4. Classification of viruses – ICTV nomenclature	4
	d. Nobel laureates in Life Sciences of 21st Century (*Project Based Learning: Assignments should be given to student*)	
II	**World of Microorganism** **a.** Prokaryotes, Eukaryotes, **b.** Bacteria :Archaebacteria and Eubacteria (including Actinomycetes) **c.** Protozoa **d.** Fungi **e.** Algae **f.** Viruses, Viroids and Prions	2 2 1 1 1 2
	Scope of Microbiology **a.** Medical Microbiology (Normal flora, Diseases caused by various microorganisms) **b.** Environmental Microbiology (Eutrophication, Sewage treatment, bioremediation) **c.** Food and Dairy Microbiology (Food spoilage, food borne diseases, Human microbiome and Probiotics, fermented food) **d.** Agriculture Microbiology (Plant diseases, Biofertilizers and Bio-control agents) **e.** Industrial Microbiology (Production of antibiotics, enzymes, solvents) **f.** Immunology (Three lines of defense, vaccines, Passive immunization, active immunization) **g.** Genetic Engineering (Concept of Recombinant DNA Technology and its Applications)	1 1 1 1 2 2 1

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17. Talaros, Foundations in Microbiology, MacGrew Hill Publication

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Semester I
22-MB-112: Basic Techniques in Microbiology

COURSE OUTCOMES:

Students will be able to

CO1: Explain the concepts- magnification, resolving power, numerical aperture, aberrations in lenses in bright field microscopy.

CO2: Explain principle and working of compound light microscope, phase contrast microscope, electron microscopes and fluorescent microscope.

CO3: Describe properties and role of fixatives, mordant, decolorizes, accentuators and stains.

CO4: Explain Principles and methodology of monochrome, negative, Gram Staining, acid fast staining and special staining techniques for different components of bacterial cell.

CO5: Describe sterilization and disinfection by physical and chemical agents, their mode of action.

Unit	Topic	No. of Lectures (36)
I	**Visualization of Microorganisms**	
	a. Microscopy	4
	1. Bright field microscopy:	
	i. Electromagnetic spectrum of light	
	ii Structure, working of and ray diagram of a compound light microscope; concepts of magnification, numerical aperture and resolving power.	
	iii. Types, ray diagram and functions of – condensers (Abbe and cardioid) eyepieces and objectives	
	iv. Concept of aberrations in lenses - spherical, chromatic, comma and astigmatism	
	2.Principle, working and ray diagram of	
	i. Phase contrast Microscope	2
	ii. Fluorescence Microscopy	1

	iii. Electron Microscopy – TEM, SEM **b. Staining Techniques** i. Definition of Stain; Types of stains (Basic and Acidic), Properties and role of Fixatives, Mordants, Decolourisers and Accentuators ii. Monochrome staining and Negative (Relief) staining iii. Differential staining - Gram staining and Acid-fast staining iv. Special staining- Capsule, Cell wall, Spore, Flagella, Lipid granules, metachromatic granules	2 9
II	**Sterilization and Disinfection** **a. Sterilization** i. Physical Agents - Heat, Radiation, Filtration ii. Checking of efficiency of sterilization (Dry and Moist) – Biological and Chemical Indicators **b. Disinfection:** i. Chemical agents and their mode of action - Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and phenolic compounds, ii. Heavy metals, Alcohol, Dyes, Detergents and Ethylene oxide. iii. Characteristics of an ideal disinfectant iv. Checking of efficiency of disinfectant - Phenol Coefficient (Rideal–Walker method)	7 11

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10. Talaros, Foundations in Microbiology, MacGrew Hill Publication

22-MB-113 Practical course based on theory papers 22-MB-111 and 22-MB-112

COURSE OUTCOMES

Students will be able to:

CO1: Describe construction and Working of common instruments used in Microbiology laboratory.

CO2: Explain use of various glassware used in microbiology experiments.

CO3: Handle and use compound microscope to observe microorganisms.

CO4: Prepare and stain the smear and focus the slide to observe bacterial/ fungal specimens or their specific cellular components.

CO5: Observe bacterial motility.

CO6: Evaluate disinfectant efficiency by determining its Phenol Coefficient.

Expt. No.	Topics	No. of Practicals
1	a. Safety measures and Good Laboratory Practices in Microbiology laboratory. b. Introduction, operation, precautions and use of common microbiology laboratory instruments: Incubator, Hot air oven, Autoclave, Colorimeter, Laminar air flow hood, Clinical Centrifuge.	2

2	a. Construction (mechanical and optical), working and care of bright field microscope. b. Permanent slide observation: Algae, Fungi and Protozoa c. Wet mount slide preparation and its observation for: Bacteria, Algae, Fungi and Protozoa.	3
3	a. Introduction and use of common laboratory glass wares: Test tubes, culture tubes, suspension tubes, screw capped tubes, Petri plates, pipettes (Mohr and serological) micropipettes, Pasteur pipettes, Erlenmeyer flask, volumetric flask, glass spreader, Durham's tube, Cragie's tube and inoculating needles (wire loop, stab needles). b. Learning basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing of glassware, biological waste disposal.	2
4	Basic staining techniques: a. Monochrome staining b. Negative staining c. Gram staining of bacteria	3
5	Observation of motility in bacteria using: Hanging drop method and swarming growth method.	2
6.	Checking of efficacy of chemical disinfectant: Demonstration of Phenol Coefficient by Rideal–Walker method.	2
	TOTAL	**14**

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Semester II
22-MB-121: Bacterial Cell and Biochemistry

COURSE OUTCOMES:

Students will be able to

CO1 : Describe types of bonds present in biomolecules, structures and roles of biomolecules like Carbohydrates, Proteins, Lipids, Nucleic acids etc.

CO2: Describe basics of bacterial cytology, composition and functions of different bacterial cell components

CO3: Describe bacterial classification based on 16s RNA sequencing.

CO4: Explain significance and applications of Human Microbiome, basics of Nano Biotechnology and Space Microbiology.

Unit	Topic	No. of Lectures (36)
I	**1. Bacterial Cytology** **a.** Unit of Measurement-Introduction to SI Units	2
	2. Structure, chemical composition and functions of the following components in bacterial cell	
	a. Cell wall (Gram positive, Gram negative)	2
	b. Concept of Mycoplasma, Spheroplast, protoplast, L-form	1
	c. Cell membrane	1
	d. Endospore (spore formation and stages of sporulation)	1
	e. Capsule	1
	f. Flagella	2
	g. Fimbriae and Pili	1
	h. Ribosomes	1
	i. Chromosomal & extra-chromosomal material	2
	j. Cell inclusions (Gas vesicles, carboxysomes, PHB granules, metachromatic granules, glycogen bodies, starch granules, magnetosomes, sulfur granules, chlorosomes)	4

II	**1. Chemical Basis of Biomolecules** **a.** Atom, Biomolecules, types of bonds (covalent, co-ordinate bond, non-covalent)	3
	2. Chemistry of Biomolecules **a. Carbohydrates: Definition, classification and function**	4
	i. Monosaccharides: Classification based on aldehyde and ketone groups; structure of Ribose, Deoxyribose, Glucose, Galactose and Fructose. ii. Disaccharides: Glycosidic bond, structure of lactose and sucrose. iii. Polysaccharides: Structure and types Examples-Starch, glycogen, Peptidoglycan, chitin	3
	b. Lipids: Definition, classification and function i. Simple lipids – Triglycerides, Fats and oils, waxes. ii. Compound lipids – Phospholipid, Glycolipids iii. Derived lipids – Steroids, Cholesterol	5
	c. Proteins: Definition, classification and function i. General structure of amino acids, peptide bond. ii. Types of amino acids based on R group iii. Structural levels of proteins: primary, secondary, tertiary and quaternary iv. Study of Hemoglobin, flagellin and cytoskeletal proteins	3
	d. Nucleic acids: Definition, classification and function i. DNA – structure and composition ii. RNA – Types (m-RNA, t-RNA, r-RNA), structure and functions.	

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1. Klein D. A., Harley J. P. And Prescott L. (2001). Microbiology. United Kingdom: McGraw-Hill Higher Education.
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Semester II
22-MB-122: Microbial cultivation and growth

CO1: Explain nutritional requirements, nutritional classification and cultivation of bacteria and different types of microorganisms

CO2: Explain concept of enrichment, pure culture, isolation and maintenance of microbial cultures and role of culture collection centers

CO3: Describe kinetics, different methods of measurement and factors affecting bacterial growth.

Unit	Topic	No. of Lectures (36)

I	**1. Cultivation of Microorganisms** **a.** Nutritional requirements and nutritional classification. **b.** Design and preparation of media: Common ingredients of media and types of media. **c.** Methods for cultivating photosynthetic, extremophilic and chemo-lithotrophic bacteria, anaerobic bacteria, algae, fungi, actinomycetes and viruses. **d.** Concept of Enrichment, Pure Culture, Isolation of culture by streak plate, pour plate, spread plate. **e.** Maintenance of bacterial and fungal cultures using different techniques. **f.** Culture collection centres and their role. **g.** Requirements and guidelines of National Biodiversity Authority for culture collection centres.	**3** **3** **4** **3** **3** **1** **1**
II	**1. Bacterial growth** **a.** Kinetics of bacterial growth (Exponential growth model) **b.** Growth curve and Generation time **c.** Diauxic growth **d.** Measurement of bacterial growth- i) Methods of enumeration: 1. Microscopic methods (Direct microscopic count, counting cells using improved Neubauer, Petroff-Hausser's chamber) 2. Plate counts (Total viable count)	**3** **2** **1** **4** **1**
	ii) Turbidimetric methods (including Nephelometry) iii) Estimation of biomass (Dry mass, Packed Cell Volume) iv) Chemical methods (Cell carbon and nitrogen estimation) **e.** Factors affecting bacterial growth [pH, Temperature, Solute Concentration (Salt and Sugar) and Heavy metals.]	**1** **1** **1** **4**

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1. Atlas R. M. (2005). Handbook of Media for Environmental Microbiology. United States: Taylor and Francis.
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3. Klein D. A., Harley J. P. And Prescott L. (2001). Microbiology. United Kingdom: McGraw-Hill Higher Education
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7. Talaros, Foundations in Microbiology, MacGrew Hill Publication

22-MB-123 Practical course based on theory papers 22-MB-121 and 22-MB-122

Students will be able to-

CO1: Prepare growth medium for cultivation of bacteria.

CO2: Prepare and stain the smear and focus the slide specific cellular components of bacteria.

CO2: Isolate bacteria from given samples.

CO3: Observe and record colony characteristics of bacterial isolates.

CO4: Study effect of physical & chemical agents like pH, temperature, Salt concentrations, heavy metals etc. on growth of bacteria.

CO5: Learn various methods of culture preservation.

Expt. No.	Topics	No. of Practicals
1	i. Preparation of simple laboratory nutrient media (Nutrient agar/broth, MacConkey's agar). ii. Checking sterilization efficiency of autoclave using a biological indicator (*B. stearothermophilus*) iii. Preparation of Winogradsky's column and observation of different types of microorganisms using a bright field microscope.	1 1 1
2	**Special staining techniques:** i. Endospore staining ii. Capsule staining	2
3	**Isolation of bacteria:** Streak plate technique (Colony and cultural characteristics)	1

4	**Enumeration of bacteria from fermented food / soil / water by:** **i.** Spread plate method **ii.** Pour plate method	2
5	**Study of normal flora of skin:** **i.** Cultivating and observing different morpho-forms of bacteria from skin. **ii.** Study of the effect of washing on skin with soap and disinfectant on it's microflora.	2
6	**To study the effect of different parameters on growth of *E. coli*:** **i.** pH, temperature, sodium chloride concentration **ii.** Study of oligodynamic action of heavy metal	3
7	**Preservation of cultures on:** Slants, soil and on grain surfaces; revival of these cultures and lyophilized cultures.	1
	TOTAL	**14**

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