RIMT UNIVERSITY,
MANDI GOBINDGARH,
PUNJAB

Study Scheme & Syllabus

As per Choice Based Credit

System (CBCS)

For

M. Sc Microbiology
(First to Second Semester)

Program Code: MBIO401

(W.e.f. Session 2017-18)

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SECTION 1

Vision & Mission of the University

VISION

To become one of the most preferred learning places and a centre of excellence to promote and nurture future leaders who would facilitate the desired change in the society.

MISSION

- To impart teaching and learning through cutting-edge technologies supported by the world class infrastructure
- To empower and transform young minds into capable leaders and responsible citizens of India instilled with high ethical and moral values.

SECTION 2

Vision & Mission of the Department

VISION

The vision of life sciences encompasses a broad range of goals and aspirations related to the study and understanding of living organisms and their biological processes. Here are some key elements that contribute to the vision of life sciences:

1. Understanding life's complexity: Life sciences aim to unravel the intricate complexities of life, from the molecular and cellular level to the broader ecological and evolutionary scales. This involves investigating the structure, function, and interactions of living organisms to gain a comprehensive understanding of the principles that govern life.
2. Improving human health: Life sciences strive to enhance human health and well-being by advancing medical research, developing new therapies and treatments, and improving diagnostics. This includes studying the mechanisms of diseases, exploring novel drug targets, and developing personalized medicine approaches based on an individual's genetic makeup.
3. Exploring biodiversity and ecology: Life sciences seek to explore and preserve Earth's biodiversity, studying the diversity of species, their interactions, and the ecosystems they inhabit. Understanding ecosystems and their dynamics is crucial for conservation efforts, sustainable resource management, and addressing pressing environmental challenges, such as climate change.
4. Advancing agricultural and food sciences: Life sciences play a vital role in improving agricultural practices, crop yield, and food production. Research in this field focuses on developing sustainable and environmentally friendly farming methods, enhancing crop traits through genetic modification or breeding techniques, and ensuring food safety and security for an expanding global population.
5. Uncovering fundamental biological processes: Life sciences aim to uncover the fundamental principles that govern life, ranging from basic biological processes like metabolism, growth, and reproduction to more complex phenomena such as development and aging. Understanding these processes can provide insights into the origins of life, as well as potential applications in biotechnology and synthetic biology
6. Integrating interdisciplinary approaches: Life sciences embrace interdisciplinary collaboration, bringing together various scientific disciplines such as biology, genetics, biochemistry, neuroscience,

computational biology, and bioinformatics. By combining expertise from different fields, researchers can tackle complex problems and drive innovation in diverse areas, from drug discovery to bioengineering.

7. Promoting ethical considerations: Life sciences recognize the importance of ethical considerations in research and applications. This involves addressing ethical issues related to human subjects, animal welfare, genetic engineering, and the potential societal impact of scientific advancements. Ethical frameworks ensure responsible and sustainable practices within the life sciences community

Overall, the vision of life sciences encompasses a deep understanding of life's complexities, improving human health and well-being, preserving biodiversity, advancing agriculture, unraveling fundamental biological processes, promoting interdisciplinary collaboration, and upholding ethical standards. By pursuing these goals, life sciences contribute to our knowledge and pave the way for a healthier, more sustainable future.

School is committed to innovation and excellence in teaching and research and preparing the students to be successful in science-related careers that are essential for meeting global needs. School advances knowledge through multidisciplinary education and research in all streams of basic sciences viz; Microbiology, Botany and Zoology. The M.Sc. programmes are mainly focused on multi-disciplinary research based teaching with emphasis on dissertations. Each student is given perfect hands on training on current techniques in basic sciences.

MISSION

To transform education through academic excellence in sciences, providing analytical and application oriented teaching, innovative and world class pedagogy, nurture professionals who, with their commitment and integrity, can make a difference in their respective profession and in turn transform the society

Department of Life Sciences in School of Biosciences in RIMT University disseminating the knowledge in the field of Life Sciences through teaching & learning process. It offers various graduates, post graduate and doctorate courses in field of Microbiology. The Department is well equipped with teaching and research laboratories. For Life Science students, most of the opportunities are found in universities and research institutions.

There are a large number of research institutions under the Council of scientific and industrial research. Students can opt the option of CSIR NET exam; it will give a great career scope in research. Life sciences students can go for various Pharmaceuticals by opting Masters with one of the clinical subject.

The knowledge of plant sciences is essential for development and management of forests, parks, waste lands etc. Few of the industries which can work with are: Forest Services, Biotechnology Firms, Land Management Agencies, Food companies, Seed & Nursery companies, National Parks, Plant Resource Laboratories, Plant health inspection services, Arboretum, Chemical industries, Educational institutes, Biological supply houses. The field of Microbiology has immense scope, due to advancement of field of science and technology, and in many areas like medicine, pharmacy, dairy industry, clinical research, water industry, agriculture, chemical technology and nanotechnology. For higher studies also, students can go for various doctorate fellowships and Post doctorate fellowships for higher education in India and abroad as well.

SECTION 3

About the Program

M.Sc. Microbiology Program is an Outcome Based Education model which is a 2 year, 4 Semester Full time Program of **44*** credit hours will be taken for first two semesters and credits with remaining semester will be decided in the coming meeting that will be based on Choice Based Credit System (CBCS) and Grading Evaluation System. This program comprises of foundational courses, core courses, specialization electives courses, enrichment courses and experimental learning. The suggestive curriculum takes the M.Sc. Microbiology program to the next level in terms of implementing Outcome Based Education and to develop professionals who are knowledgeable in their chosen domain, responsive to the living system-environment interface, ethical in all doings and with a global outlook and approach.

These objectives shall be achieved through a very rigorous academic processes, updated and relevant curriculum, extensive industry interaction and collaborations, sports and vibrant student activities.

SECTION 4

Program Educational Objectives (PEOs), Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PROGRAM EDUCATION OBJECTIVES

PEO1	To create knowledge about core areas related to the field of microbiology.
PEO2	Analyze, interpret and apply concepts of different aspect of microbiology.
PEO3	To exhibit and explore professional knowledge and entrepreneurial opportunities by working effectively and professionally in teams.
PE04	To analyze and evaluate ethical problems, gives broad exposure to various communities, ecological and commercial issues in the field microbiology

PROGRAM OUTCOMES

PO 1	***Domain Knowledge***: The program will provide students with the progressive research-based in-depth study of different microbiology aspects such as physiological and metabolic aspects, evolutionary trends, and biological functions in the ecosystem.
PO 2	***Specialization:*** Students can specializes in different categorical fields of microbiology such as medical microbiology, applied microbiology, industrial microbiology, marine microbiology, agriculture microbiology and so on after doing M.Sc. course in this discipline.
PO 3	***Skill development:*** This program will develop scientific knowledge and skills gained through courses such as immunology, virology, microbial ecology, soil microbiology, aquatic microbiology, environmental microbiology, clinical microbiology, microbial genetics and biotechnology.
PO 4	**Professionalism:** After doing this program, student will get enriched with skills needed for careers in different fields of microbiology and related scientific and professional fields.
PO 5	***Entrepreneurship***: Student can discover and harnesses the potential of microbes by developing microbial products that might aid in human and animal welfare, plant growth, environmental issues (e.g., degradation of plastics, chemical or biochemical), produce more food etc, after doing this course.
PO 6	**Employability:** This course will give employability to students in different employing areas such as food standards agency, water and waste management companies, public and private sector organization, Government agencies, Research institutions, Hospitals, Public health and private laboratories, Pharmaceutical, biochemical and biotechnology companies, Universities, Food and drink manufacturers

PO 7	***Environment and Sustainability:*** Microorganisms play a pivotal role in the environment biosphere sustainability through global environmental processes and recycling of elements and waste products. Microbiology has a direct link to achieving SDGs addressing food security, health and wellbeing, clean energy, environmental degradation and climate change.
PO 8	***Problem Solving***: Microbiologists are involved in finding/identify, formulate and provide urgent and innovative solution solutions to problems, such as new and emerging diseases, through to long-term issues, like antimicrobial drug resistance, food security and environmental sustainability using methodically applying modern quantitative and qualitative problem solving tools and techniques.
PO 9	**Disease management:** Microorganisms play major roles in the diseases of man, animals and plants. Microbiologists have been central to their diagnosis and in combating such diseases through the discovery of effective therapies.
PO 10	***Research & Innovation*** Ability to achieve collaborative cooperation for synergy in an organizational and across organizational boundaries and lead from the front to achieve organizational goals and optimize outcomes for all stakeholders. Aptitude to acquire newer knowledge and skills, assimilate and adapt them to be ready to confront uncharted environment scientifically and confidently.

PROGRAM SPECIFIC OUTCOMES

PSO 1	Students enrolled in M.Sc. degree program in microbiology will impart in-depth understanding of aspects of microbiological science pertaining to basic and advanced microbiology including such as **food, soil, water,** industrial microbiology & fermentation technology, genetic engineering, microbial genetics, bio-analytical techniques, microbial physiology, agriculture & environmental microbiology, animal biotechnology, immunology and vaccinology. industrial applications. The student will be able to assess acquire complete knowledge of disciplinary as well as allied biological sciences.
PSO 2	Students will be able to define and explain major concepts in the biological sciences. They are able to correctly use biological instrumentation and proper laboratory techniques. The program provides students with skills in microbial genetics and evolutionary trends in genetics. Students will explain the role of microorganisms in food production and preservation, their ability to cause food-borne infections and demonstrate practical skills in fundamental microbiological techniques. Students will demonstrate engagement in the Microbiology discipline through involvement in their post-graduation period, research or internship activities, and outreach their goals specific to microbiology.
PSOs3	Student will able to get knowledge about will make the students ready to contribute to molecular, biochemical, industrial, medical and other basic and applied applications of better understanding of the key principles of microbial functioning at an advanced level including the appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance.
PSOs4	The program will also provide a platform for classical genetics in order to understand distribution or inheritance of different traits and diseases among populations, their ethnicity and correlate with contemporary and modern techniques like genomics, metagenomics, genome editing and molecular diagnostic tools. Acquired practical skills in biotechnology, biostatistics, bioinformatics and molecular biology can be used to pursue career as a scientist

SECTION 5

Curriculum/Scheme with Examination Grading Scheme

SEMESTER WISE SUMMARY OF THE PROGRAMME: M.Sc. (MICROBIOLOGY)

S. No.	Semester	No. of Contact Hours	Marks	Credits
1.	I	28	600	22
2.	II	28	600	22
	Total	**56**	**1200**	**44**

EXAMINATION GRADING SCHEME

Marks Percentage Range	Grade	Grade Point	Qualitative Meaning
80-100	O	10	Outstanding
70-79	A+	9	Excellent
60-69	A	8	Very Good
55-59	B	7	Good
50-54	B	6	Above Average
45-49	C	5	Average
40-44	P	4	Fail
0-39	F	0	Fail
ABSENT	AB	0	Fail

Percentage Calculation: CGPA *10

Examination Grading Scheme is different for different programs. It has to be changed by the department The text highlighted yellow is for instruction and will not be included in the final format.

SECTION 6

Detailed Syllabus with Course Outcomes

FIRST SEMESTER

Subject		Contact Hours/Week			Credit	Contact Hrs.	Evaluation Scheme (% of Total Marks)			Exam Duration (Hours)
Code	Title	L	T	P			Internal	External	Total	
Core Courses										
MMB-1101	General microbiology	4	0	0	4	4	40	60	100	3Hrs
MMB-1102	Microbial physiology and biochemistry	4	0	0	4	4	40	60	100	3Hrs
MMB-1103	Bacteriology and virology	4	0	0	4	4	40	60	100	3Hrs
MMB-1104	Mycology, phycology and parasitology	4			4	4	40	60	100	3Hrs
MMB-1105	Practical-1 pertaining to (MMB-1101General microbiology; MMB-1102 Microbial physiology & biochemistry)	0	0	6	3	6	---	100	100	3Hrs
MMB-1106	Practical -2 pertaining to (MMB-1103Bacteriology and virology ; MMB-1104Mycology, phycology and parasitology)	0	0	6	3	6	---	100	100	3Hrs
Total		**16**		**12**	**22**	**28**	**160**	**440**	**600**	**18**

L--Lecture T--Tutorial P---Practical

The breakup for internal evaluation (40marks) is as follows:

1. Mid Semester Exams :20
2. Assignment: 10
3. Attendance: 10

Note: For Evaluation scheme see ordinance number8 "Regulation for Academic Evaluation" RIMT University.

SECOND SEMESTER

Subject L--Lecture T--Tutorial		Contact Hours/Week			Credit	Contact Hrs.	Evaluation Scheme (% of Total Marks) P---Practical			Exam Duration (Hours)
Code	**Title**	**L**	**T**	**P**			**Internal**	**External**	**Total**	
Core Courses										
MMB-1201	Fundamentals of immunology	4	0	0	4	4	40	60	100	3Hrs
MMB-1202	Research methodology and instrumentation	4	0	0	4	4	40	60	100	3Hrs
MMB-1203	Molecular biology and genetic engineering	4	0	0	4	4	40	60	100	3Hrs
MMB-1204	Soil and Environmental microbiology	4	0	0	4	4	40	60	100	3Hrs
MMB-1205	Practical 1 pertaining to MMB-1201Fundamentals of immunology and MMB-1202 Research methodology and instrumentation	0	0	6	3	6	---	100	100	3Hrs
MMB-1206	Practical-2 pertaining to MMB-1203Molecular biology and genetic engineering & MMB-1204 Soil and Environmental microbiology	0	0	6	3	6	---	100	100	3Hrs
	Total	**16**		**12**	**22**	**28**	**160**	**440**	**600**	**18**

The breakup for internal evaluation (40marks) is as follows:

6. Mid Semester Exams :20
7. Assignment: 10
8. Attendance: 10

Note: For Evaluation scheme see ordinance number8 "Regulation for Academic Evaluation" RIMT University.

SUBJECT TITLE: GENERAL MICROBIOLOGY
SUBJECT CODE: MMB-1101
SEMESTER: I
CONTACT HOURS/WEEK: 4

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	0	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective and outcome of course: This course will orient the students with the basics of Microbiology and its associated subjects. On successful completion of the course, the students will be able to understand the diversity of microbes and their applications. This course will enable the students to apply the acquired knowledge in the fields of other biological science.

Contents of Syllabus:

Sr. No	Contents	Contact Hours
UNIT-I	Introduction, history and scope of Microbiology. General characteristics and composition of Prokaryotes and Eukaryotes. Classification of Microorganisms: Haekel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese , classification and salient features of bacteria according to Berger's Manual of Determinative Bacteriology. Nomenclature and modern methods of Bacterial taxonomy.	**15 hrs**
UNIT-II	Morphology and ultra structure of bacteria: size, shape, and arrangement of bacteria, ultra structure of bacterial cell wall of eubacteria and archeabacteria. Protoplast and spheroplast formation and L-form. Components external to cell wall: Structure and function of flagella, fimbriae and pilli, capsule- types, composition and function, slime layers, S-layers. Prokaryotic cell membrane and cytoplasmic matrix – cell membrane structure and function of bacteria and archeabacteria, mesosomes, ribosomes, cytoplasmic inclusion bodies (polyhydroxy butyrate, polyphosphate granules, oil droplets, cyanophycin granules) and nucleoid. Bacterial response to external stimulus and bacterial endospores: Chemotaxis and phototaxis structure, formation and germination of bacterial endospore.	**15 hrs**
UNIT-III	Bacterial nutrition: Basic nutritional requirements, growth factors, nutritional categories, physical requirements of bacterial growth. Bacteriological media: types (complex, synthetic, differential, enrichment and selective media) and their uses, culture characteristics of bacteria on different media. Cultivation of bacteria: aerobic and anaerobic culture, pure culture techniques, shaker and still culture, maintenance and preservation of microbial culture. Bacterial growth: growth kinetics, growth curve. Batch, continuous and synchronous culture. Measurement of growth and influence of environmental factors affecting growth.	**15 hrs**
UNIT-IV	Asexual methods of reproduction, logarithmic growth of bacterial populations, phases of growth, calculation of generation time and specific growth rate. Diauxic growth. Maintenance of population in exponential	**15 hrs**

	phase, synchronous growth, continuous culture, fed batch culture and measurement of growth. Catabolism vs. anabolism. Energy currency and reducing power of a living cell. Fermentation vs. aerobic and anaerobic respiration. Bacterial cell division and genes involved in the process.	

Recommended books:

1. Atlas RM. (2015). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
2. Pelczar MJ, Chan ECS and Krieg NR. (2004). Microbiology. 5th edition. McGraw Hill Book ompany.
3. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan
4.Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw

Instruction of Question Paper setter: The question paper will consist of three sections: A, B & C. Sections A will consist of twelve multiple choice questions carrying one mark each from the whole syllabus of concerned paper. Section B will have six questions of four marks each and section C will have three questions of eight marks each from the respective sections of the syllabus**.**

SUBJECT TITLE: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY
SUBJECT CODE: MMB-1102
SEMESTER: I
CONTACT HOURS/WEEK: 4

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	0	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective and outcome of course: This course will help students to know how nutrients needed by microorganisms, isolate microorganisms and also identify these microorganisms based on their physiological requirements.

Contents of Syllabus:

Sr. No	Contents	Contact Hours
UNIT-I	**Microbial Growth and Effect of Environment on Microbial Growth** Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe),barophilic. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.	**15 hrs**
UNIT-II	**Nutrient uptake and Transport** Passive and facilitated diffusion , Primary and secondary active transport, concept of uniport, symport and antiport Group translocation and Iron uptake **Chemoheterotrophic Metabolism – Aerobic Respiration** Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway ,TCA cycle , Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors	**20hrs**
UNIT-III	**Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation** Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways	**10 hrs**

UNIT-IV	**Chemolithotrophic and Phototrophic Metabolism** Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria **Nitrogen Metabolism - an overview** Introduction to biological nitrogen fixation , Ammonia assimilation , Assimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification	**15 hrs**

SUGGESTED READINGS

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons 3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2016). Prescott's Microbiology. 10th edition. McGraw Hill Higher Education.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B & C. Sections A will consist of twelve multiple choice questions carrying one mark each from the whole syllabus of concerned paper. Section B will have six questions of four marks each and section C will have three questions of eight marks each from the respective sections of the syllabus.

SUBJECT TITLE: BACTERIOLOGY AND VIROLOGY
SUBJECT CODE: MMB-1103
SEMESTER: I
CONTACT HOURS/WEEK: 4

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	0	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective and outcome of course: This course will orient the students with structures and basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles. This course will enable the students to apply the acquired knowledge in the field of biological sciences. Successful completion of the course will give a solid understanding of basic concepts in the field of virology and enable the students to apply these concepts to problems in the field of virology. At the end of the course the student will be able to describe the basics steps in virus replication and disease.

Contents of syllabus:

Sr. No	Contents	Contact Hours
UNIT-I	General characteristics of bacteria. Bacterial growth, cell division, reproduction and nutrition. Domain bacteria; Aquifical and Thermotogae, Deinococcus-Thermus, photosynthetic bacteria: Chloroflexi, Chlorobicyanobacteria. The low G+C Gram positive bacteria: Clostridia, Mollicutes, Bacilli. The high G+C Gram positive bacteria; Actinobacteria, Planctomycetes, Spirochetes, Fibrobacters, Bacteriodes, Fusobacteria.	**20 hrs**
UNIT-II	The Archaea and deeply branching phototrophic bacteria, Domain Archaea: Methanogens, Thermoplasmas, extremely thermophilic sulphur metabolizers. The Proteobacteria: α-proteobacteria, β-proteobacteria, γ-proteobacteria, δ-proteobacteria and ε- proteobacteria.	**15 hrs**
UNIT-III	Historical account and development of virology. General characteristics, morphological variations, envelope, capsid, nucleic acid & classifications of plant viruses, animal & human viruses, bacterial viruses. Assay of viruses, biophysical properties of viruses, and point, thermal inactivation, dilution end point, longevity *in-vitro,* virus culture. Chloroplast agglutination, haemagglutination, serological & molecular based detection of viruses, use of electron microscopy & Natural & Mechanical in virology.	**15 hrs**
UNIT-IV	Transmission of viruses isolation & purification of viruses, criteria of purity of viruses, general properties of bacteriophage, one step growth, type of phages, life cycle of M13 phage. Viral diseases of plants, (papaya, banana, tomato) symptoms, infections & multiplication (TMV). Transmission by vectors, other means & control of viral diseases of animals including (Ranikhet disease of poultry farm, foot & mouth disease of cattle, bird flu & SARS). Role of viruses in genetic engineering. Brief concept of viroids and prions.	**20 hrs**

Recommended books:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
3.Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw
Hill International.
4. Atlas RM. Principles of Microbiology.Latest edition. WM.T.Brown Publishers.
5. Pelczar MJ, Chan ECS and Krieg NR.. Microbiology (2005) 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B & C. Sections A will consist of twelve multiple choice questions carrying one mark each from the whole syllabus of concerned paper. Section B will have six questions of four marks each and section C will have three questions of eight marks each from the respective sections of the syllabus.

SUBJECT TITLE: MYCOLOGY, PHYCOLOGY AND PARASITOLOGY
SUBJECT CODE: MMB-1104
SEMESTER: I
CONTACT HOURS/WEEK: 4

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	0	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective and outcome of course: This course will help students to understand lifecycle of medically important parasites, define the organs commonly involved in the infection, recall the relationship of infection to symptoms, relapse and the accompanying pathology. This course will help students to work safely in the medical mycology laboratory, dealing with specimens and identify the causative fungi using a variety of traditional and molecular techniques. This course will help students understand the basic concepts about the structure and nutrition of algae, its economic importance and ecological aspects of algae.

Contents of syllabus:

Sr. No	Contents	Contact Hours
UNIT-I	Introduction to mycology, general features of fungi, classification of fungi, life cycle of selected fungi (*Aspergillus*, *Penicillium*, Yeasts). Heterothallism, sex hormones in fungi, Lichens, Mycorrhiza – ectomycorrhiza, endomycorrhiza, vesicular arbuscular mycorrhiza. Fungi as insect symbiont, fungal diseases – mycoses systemic and subcutaneous, candidiasis, Pneumocystis, blastomyxoses, dermotophytosis.	**20 hrs**
UNIT-II	Fungi and ecosystem: effect of environment on growth, prevention of fungal growth. Substrate groups and nutritional strategies substrate successions, fungi and bioremediation.	**10 hrs**
UNIT-III	Structure of algae, classification of algae, algal nutrition, algal thallus, algal reproduction, green algae, diatoms, euglenoids, brown Rhodophyta, pyrrophyta, economic importance of algae.	**10 hrs**
UNIT-IV	General Characteristics and classification of microbial parasites, diseases caused by parasites, diagnosis and treatment of parasitic diseases. Life cycles of *Plasmodium, Leishmania, Entamoeba, Giardia*.	**20 hrs**

Recommended books:

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2.Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Atlas RM. (2005). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
4. Pelczar MJ, Chan ECS and Krieg NR. (2005). Microbiology. 5th edition. McGraw Hill Book Company.
5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B & C. Sections A will consist of twelve multiple

choice questions carrying one mark each from the whole syllabus of concerned paper. Section B will have six questions of four marks each and section C will have three questions of eight marks each from the respective sections of the syllabus.

SUBJECT TITLE: PRACTICALS PERTAINING TO GENERAL MICROBIOLOGY/ MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY
SUBJECT CODE: MMB-1105
SEMESTER: I
CONTACT HOURS/WEEK: 6

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	6	3

Duration of Exam; 3 Hrs

GENERAL MICROBIOLOGY

1. The general microbiological instruments used in laboratory.
2. Microscopy (Visit to sophisticated instrumental lab)
3. Staining Techniques (Simple, Negative, Gram's, Spore and Acid fast).
4. Media preparation, sterilization and isolation of pure cultures of bacteria.
5. Microbiological Quality of Water.
6. Isolation and enumeration of bacteria from soil by serial dilution agar plating method

MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

7. Morphological and cultural characterization of bacteria.
8. Growth curve of bacteria
9. To perform various physiological tests of bacteria: acid and gas production from sugars, starch hydrolysis, indole production, H_2S production, methyl red test, Voges Proskauer test, citrate utilization, catalase activity, urea activity, oxidase activity.
10. Qualitative tests for the presence of carbohydrates, proteins and fats.
11. Quantitative tests of carbohydrates, proteins, fats and vitamins.

SUBJECT TITLE: PRACTICALS PERTAINING TO BACTERIOLOGY AND VIROLOGY/ MYCOLOGY, PHYCOLOGY AND PARASITOLOGY
SUBJECT CODE: MMB-1106
SEMESTER: I
CONTACT HOURS/WEEK: 6

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	6	3

Duration of Exam; 3 Hrs

BACTERIOLOGY AND VIROLOGY

1. Identification of common plant and animal viruses by using their photographs.
2. Symptoms of virus infected plants.
3. Phage isolation from sewage water.
4. Indication of plant virus infection.
5. Preparation of different media: synthetic media, Complex media-nutrient agar, McConkey agar, EMB agar,
6. Isolation of pure cultures of bacteria by streaking method.
7. Motility by hanging drop method.
8. Preservation of bacterial cultures by various techniques.

MYCOLOGY, PHYCOLOGY AND PARASITOLOGY

9. To isolate fungi from various sources and study their morphology.
10.Measurement of fungal growth by weight determination.
11.Staining of fungi by using Lactophenol cotton blue stain.
12. To study the pathology of various fungal plant diseases and specimens of fungi.
13. Study of *Volvox* and *Oedogonium* by using permanent slides or photographs.
14. Identification of protozoan parasites: *Trypanosoma, Leishmania, Giardia* and *Entamoeba.*

SUBJECT TITLE: FUNDAMENTALS OF IMMUNOLOGY
SUBJECT CODE: MMB-1201
SEMESTER: II

CONTACT HOURS/WEEK: 4

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	0	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective and outcome of course: This course will help students to understand the ability of our immune system to defend against invading pathogens in a logical fashion. This course will enable the students to apply the acquired knowledge in the field of immunology.

Contents of Syllabus:

Sr. No	Contents	Contact Hours
UNIT-I	History of immunology. Three fundamental concepts in immunology: Specificity, discrimination of self from non-self and memory Structure, Functions and origin of Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell and Immune Organs like Bone marrow, Thymus, Lymph Node, Spleen. Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes, Adjuvants, Structure, Types and Functions of antibodies. Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA.	**20 hrs**
UNIT-II	Immune cell receptors: Detailed structure and development of B cell (Ig) and T cell (TcR) receptors. Structure of CD4, CD8, MHC-I, MHC-II molecules, cellular adhesion molecules (ICAM, VCAM, MadCAM, selectins, integrins); Pattern Recognition Receptors (PRRs) and Toll-like receptors (TLR). Markers of suppressor / regulatory T cells - CD4+ CD25+	**10 hrs**
UNIT-III	Genetic organization: Organization of the genes for B and T cell receptors. Genetic organization of MHC-I and MHC-II complex, Peptide loading and expression of MHC-I and MHC-II molecules. Molecular mechanisms responsible for generating diversity of antibodies and T cell receptors. Hybridoma technology and monoclonal antibodies. Complement system. Classical, lectin and alternative pathway for complement activation.	**15 hrs**
UNIT-IV	Major cytokines and their role in immune system: TNF, IFN, IL-1, IL-2, IL-4, 1L-6, IL-10, IL-12, IL-17, TGFβ. Tolerance and autoimmunity and their mechanism; Mechanisms of autoimmunity; Autoimmune components of diabetes mellitus (DM), multiple sclerosis (MS), experimental autoimmune encephalitis (EAE); Infections leading to autoimmune diseases. Hypersensitivity and allergy. Comparative study of Type I-V hypersensitivities with examples.	**15 hrs**

Recommended books:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition.

McMillan

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B & C. Sections A will consist of twelve multiple choice questions carrying one mark each from the whole syllabus of concerned paper. Section B will have six questions of four marks each and section C will have three questions of eight marks each from the respective sections of the syllabus.

SUBJECT TITLE: MICROBIAL GENETICS
SUBJECT CODE: MMB-1202
SEMESTER: II

CONTACT HOURS/WEEK: 4

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	0	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective and outcome of course: The aim of this course is to introduce students to mechanisms behind stability and change in microbial genomes, genetic aspects of extra chromosomal elements such as bacteriophages and plasmids. Genetic methods to construct, map and move mutations, and to measure gene expression. This course will enable the students to apply the acquired knowledge in the field of microbial genetics.

Contents of syllabus:

Sr. No	Contents	Contact Hours
UNIT-I	History of DNA structure, from Miescher to Watson and Crick, Building blocks of nucleic acids. Salient features of DNA double helix. Types of DNA. Types of genetic material. Nucleous, nucleoid and plasmid. Denaturation and renaturation. Bidirectional and unidirectional replication. Conservative, Dispersive and semi- conservative and semi-discontinuous replication. Mechanism of DNA replication: Enzymes and proteins involved in DNA replication. DNA polymerases, DNA ligase, primase. Various models of DNA replication including rolling circle and Θ (theta) mode of replication.	**20 hrs**
UNIT-II	DNA repair (Mismatch repair, excision repair, recombination, SOS repair.) Genotype and phenotype. Understanding of events involved in gene expression (transcription, translation, posttranslational events) Mutation, variation and evolution. Types of mutation. Mechanism of mutation (spontaneous mutation, chemical mutagen, UV irradiation) Isolation and identification of mutants (mutation and selection, replica plating, penicillin enrichment, molecular methods) Phenotype restoration (reversion, suppression, complementation)	**15 hrs**
UNIT-III	Gene organization. Transcriptional control (terminators, attenuators, anti-terminators, Induction and repression). Translational control. Codon usage. Plasmids, Plasmid replication and stability. Gene transfer: Transformation, Conjugation (F plasmid), Transduction (general and specialized) Insertion sequence	**15 hrs**
UNIT-IV	Transposons, Mechanism of transposition,train development, Generation of variation, Overproduction of primary metabolite, Overproduction of secondary metabolite. Genetic methods for investigating bacteria (complementation, cross feeding, reporter genes)	**10 hrs**

Recommended books:

1. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
3. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
4. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B & C. Sections A will consist of twelve multiple choice questions carrying one mark each from the whole syllabus of concerned paper. Section B will have six questions of four marks each and section C will have three questions of eight marks each from the respective sections of the syllabus.

SUBJECT TITLE: MOLECULAR BIOLOGY AND GENETIC ENGINEERING
SUBJECT CODE: MMB-1203
SEMESTER-II
CONTACT HOURS/WEEK: 4

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	0	0	4

Internal Assessment: 40
End Term Exam: 60
Duration of Exam; 3 Hrs

Objective and outcome of course: The aim of this course is to introduce students to mechanisms behind stability and change in microbial genomes, genetic aspects of extra chromosomal elements such as bacteriophages and plasmids. Genetic methods to construct, map and move mutations, and to measure gene expression. This course will enable the students to apply the acquired knowledge in the field of microbial genetics.

Contents of Syllabus:

Sr. No	Contents	Contact Hours
UNIT-I	Nucleic acids: structure of DNA, functions, replication, DNA damage and repair – types of damage (deamination, oxidative damage, alkylation, pyrimidine dimmers); repair pathways – methylation–directed mismatch repair, nucleotide excision repair, base excision repair, recombination repair, SOS repair., isolation and sequencing.	**15 hrs**
UNIT-II	Transcription; types of RNA and their role in gene expression, Translation; components involved, t-RNA as adapter, genetic code and its salient features, gene expression; inducible and repressible operon (account of *lac* operon and *trp* operon regulation).	**10 hrs**
UNIT-III	Molecular cloning; techniques and their importance, Cloning vectors – Plasmids, phages and cosmids, phagemids, Ti plasmids, other viral vectors (M13 and retroviruses); Cloning strategies, cloning and selection of individual genes; Gene libraries: cDNA and genomic libraries. Expression vectors, promoter probe vectors, vectors used for construction of library –artificial chromosomes; BAC vectors, YAC vectors. Cloning of genomic DNA, cDNA cloning, selection and characterization of clones, gene probes, labeling.	**20 hrs**
UNIT-IV	Working principle of PCR, requirements, types of PCR, application of PCR, Sequencing of DNA and protein in brief. Recombinant products – human growth hormone (insulin somatotropin), vaccines (hepatitis B virus vaccine, FMD vaccine), interferons, tPA. Overview of Southern, Northern, Western blotting, SDS PAGE.	**15 hrs**

Recommended books:

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication.
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.

4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B & C. Sections A will consist of twelve multiple choice questions carrying one mark each from the whole syllabus of concerned paper. Section B will have six questions of four marks each and section C will have three questions of eight marks each from the respective sections of the syllabus.

SUBJECT TITLE: SOIL AND ENVIRONMENTAL MICROBIOLOGY
SUBJECT CODE: MMB-1204
SEMESTER-II
CONTACT HOURS/WEEK: 4

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	0	0	4

Objective and outcome of course: The aim of this course is to introduce students to the basic understanding of environmental microbiology including the functional diversity of microorganisms in the environment in a relation to human welfare and ecosystem health, microbial interactions with pollutants in the environment and fate of microbial pathogens in environment

Content of Syllabus:

Sr. No	Contents	Contact Hours
UNIT-I	**Soil Habitat**: Soil biota, Soil microbial ecology, Types of organisms in different soils, Soil microbial biomass, Microbiology and biochemistry of root-soil interface; phyllosphere, Biofertilizers, soil enzyme activities and their importance. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.	15 hrs
UNIT-II	**Biogeochemical Cycling**: Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction Phosphorus cycle: Phosphate immobilization and solubilisation Sulphur cycle: Microbes involved in sulphur cycle Other elemental cycles: Iron and manganese .	10 hrs
UNIT-III	**Microbial Bioremediation**: Biochemical composition and biodegradation of soil organic matter and crop residues. Biodegradation of pesticides, Organic wastes and their use for production of biogas and manures: Biotic factors in soil development. Genetic engineering of microbes for enhanced pesticide degradation Mechanisms of pesticide degradation by microbes. organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants **Microbial Interactions**: Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation, Microbe-Plant interaction: Symbiotic and non-symbiotic interactions, Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria	20 hrs
UNIT-IV	**Waste Management Solid Waste management**: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment, Gaseous treatment	15 hrs

Recommended books:

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings

3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
5. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
6. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B & C. Sections A will consist of twelve multiple choice questions carrying one mark each from the whole syllabus of concerned paper. Section B will have six questions of four marks each and section C will have three questions of eight marks each from the respective sections of the syllabus.

SUBJECT TITLE: PRACTICALS PERTAINING TO FUNDAMENTALS OF IMMUNOLOGY/ MICROBIAL GENETICS
SUBJECT CODE: MMB-1205
SEMESTER-II
CONTACT HOURS/WEEK: 6

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	6	3

Duration of Exam; 3 Hrs

FUNDAMENTALS OF IMMUNOLOGY

1. Separate serum from the blood sample (demonstration).
2. Identification of human blood groups.
3. Demonstration of alpha, beta and gamma haemolysis in *Streptococcus, Staphylococcus.*
4. Demonstration of some serological reactions, Vidal tests, VDRL test.
5. Estimation of Total and differential lymphocyte count using haemocytometer
6. Perform ELISA.
7. Perform immuno-electrophoresis.

MICROBIAL GENETICS

8. Preparation of Master and Replica Plates.
9. Study the effect of chemical (HNO2) and physical (UV) mutagens on bacterial cells.
10. Study of survival curve of bacteria after exposure to ultraviolet (UV) light.
11. Isolation of Plasmid DNA from E. coli.
12. Study of different conformations of plasmid DNA through Agaraose gel electrophoresis.
13. Demonstration of Bacterial Conjugation.
14. Demonstration of bacterial transformation and transduction.
15. Demonstration of AMES test.

SUBJECT TITLE: PRACTICALS PERTAINING TO MOLECULAR BIOLOGY AND GENETIC ENGINEERING/ SOIL & ENVIRONMENTAL MICROBIOLOGY
SUBJECT CODE: MMB-1206
SEMESTER-II

CONTACT HOURS/WEEK: 3

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	6	3

Duration of Exam; 3 Hrs

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

1. Study of different types of DNA and RNA using micrographs and model / schematic representations.
2. Study of semi-conservative replication of DNA through micrographs / schematic representations.
3. Isolation of genomic DNA from E. coli.
4. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
5. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).
6. Amplification of genomic DNA by using end-point PCR.

SOIL AND ENVIRONMENTAL MICROBIOLOGY

7. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
8. Isolation of microbes (bacteria & fungi) from soil (28ºC & 45ºC).
9. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
10. Assessment of microbiological quality of water.
11. Determination of BOD of waste water sample.
12. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
13. Isolation of *Rhizobium* from root nodules.