



KANNUR UNIVERSITY

Course Structure & Syllabus for
Postgraduate Programme in

MICROBIOLOGY

under

Choice Based Credit Semester System
For affiliated colleges with effect from 2023
admission
Outcome Based Education (OBE)

Ad-hoc committee

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ABOUT THE POST GRADUATE MICROBIOLOGY PROGRAMME

Microorganisms have an important role in the bioprocess of all living things and maintain homeostasis of the universe. Without microbes, one cannot imagine such a biologically balanced and diverse universe; rather our earth would have placed as a barren planet. As the microbial activities are so diverse, the microbiology programme is a multidisciplinary program, which will have the roots of life science, environmental science, and engineering. Traditional microbiology is an important area of study in biology since it has enormous potential and vast scope in medical and public health care technologies, food fermentation, waste management and bioremediation and bioenergy-based technologies. The latest developments from human microbiome project, metagenomics and microbial genome projects have expanded its scope and potential in the next generation drug design, vaccine development, molecular pathogenesis, production of value-added products and biopharmaceuticals. Modern Microbiology has expanded its roots in genome technology, nanobiotechnology, green technology especially bioenergy and biofuel, computational biology and immunoinformatics. Considering recent innovations and rapid growth of microbiological approaches and applications in human and environmental sustainability, the M.Sc. Microbiology curricula is designed to enrich the students starting from the foundations of Microbiology to the recent and emerging trends and developments in the post-COVID era. The first semester of the curricula would cover foundations of Microbiology, Biochemistry, Cell biology, Genetics and Molecular biology. The second semester focuses interdisciplinary applied aspects such as Computational Biology and Bioinformatics, Immunology and Immunotechniques and Genetic Engineering. The third and fourth semester would cover the applications of Microbiology in Public health and medical, Industrial, Environmental and Sanitation Microbiology, Food, Dairy and Agricultural Microbiology sectors. During their curriculum, students also study skill development and entrepreneurship, Research methodology, Biosafety, bioethics and IPR as professional skill-based courses that enable them to cater the needs of the modern sciences, society and environment. A unique feature of the curricula includes both theory and practical components for each course, possibilities of internship and MOOCS within the curriculum, and research project work in their final year.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After completion of M.Sc. Microbiology programs, the post-graduate students will be able to:

PSO1: Apply their knowledge in microbial identification, classification, characterisation, diagnosis, control and treatment of various infectious diseases.

PSO2: Apply the microbiology process in interdisciplinary applied sciences such as genome technology, nanotechnology, solid waste management and sustainable development.

PSO3: Apply novel microbial processes and technologies in the field of food, industrial, agricultural and pharmaceutical biotechnology.

PSO4: Implement the recent developments of metagenomics and human microbial genome projects in the next generation vaccine design, biomarker discovery, molecular pathogenesis and production of value-added biomolecules.

PSO5: Formulate various algorithms and tools in computational biology and microbial omics for the discovery of novel molecular targets in the pathogens causing emerging, reemerging and neglected tropical diseases and infections.

PSO6: Develop various microbiological process for industrial scale up, product development and patent search with research and scientific temper, professionalism and ethics.

**CREDIT AND MARK DISTRIBUTION FOR MSc. MICROBIOLOGY (KUCBCSS PG
2023 ADMISSION) (OBE)**

SEMESTER I

Course Code	Title of the Course	Marks			Credit	Hours / Week
		Internal	External	Total		
MSMBG01C01	Foundations of Microbiology	10	40	50	4	4
MSMBG01C02	Fundamentals of Biochemistry	10	40	50	4	5
MSMBG01C03	Cell Biology and Genetics	10	40	50	4	4
MSMBG01C04	Molecular Biology	10	40	50	4	4
*MSMBG01C05	Practical I	-	-	-	-	4
*MSMBG01C06	Practical II	-	-	-	-	4
Total		40	160	200	16	25

*Practical examination is to be conducted along with II Semester Examinations.

SEMESTER II

Course Code	Title of the Course	Marks			Credit	Hours / Week
		Internal	External	Total		
MSMBG02C07	Bioinformatics and Computational biology	10	40	50	4	4
MSMBG02C08	Immunology and Immunotechniques	10	40	50	4	4
MSMBG02C09	Genetic Engineering	10	40	50	4	4
MSMBG02E01	Microbial Physiology and Metabolism	10	40	50	4	4
MSMBG02E02	Microbial Taxonomy and Systematics					
MSMBG02E03	Enzymology					
MSMBG01C05	Practical I	10	40	50	2	-
MSMBG01C06	Practical II	10	40	50	2	-
MSMBG02C10	Practical III	10	40	50	2	4
MSMBG02C11	Practical IV	10	40	50	2	4
MSMBG02C12	*Internship / MOOC	-	-	-	-	1
Total		80	320	400	24	25

*The internship evaluation will be conducted along with general Viva-Voce in IV SEM examination

SEMESTER III

Course Code	Title of the Course	Marks			Credit	Hours / Week
		Internal	External	Total		
MSMBG03C13	Medical Microbiology	10	40	50	3	4
MSMBG03C14	Industrial Microbiology and Bioinstrumentation	10	40	50	3	3
MSMBG03C15	Environmental and Sanitation Microbiology	10	40	50	3	3
MSMBG03C16	Biostatistics and Research Methodology	10	40	50	3	3
MSMBG03O01	Skill Development and Entrepreneurship	10	40	50	4	4
MSMBG03O02	Biodegradation and waste Management					
MSMBG03O03	Nanotechnology in Biological Science					
*MSMBG03C17	Practical V	-	-	-	-	4
*MSMBG03C18	Practical VI	-	-	-	-	4
Total		50	200	250	16	25

*Practical examination is to be conducted along with IV Semester Examinations

SEMESTER IV

Course Code	Title of the Course	Marks			Credit	Hours / Week
		Internal	External	Total		
MSMBG04C19	Food and Dairy Microbiology	10	40	50	2	3
MSMBG04C20	Agricultural Microbiology	10	40	50	2	3
MSMBG04E04	Biosafety, Bioethics and IPR	10	40	50	4	4
MSMBG04E05	Pharmaceutical Microbiology					
MSMBG04E06	Marine Microbiology					
MSMBG03C17	Practical V	10	40	50	2	-
MSMBG03C18	Practical VI	10	40	50	2	-
MSMBG04C21	Practical VII	10	40	50	2	4
MSMBG04C22	Practical VIII	10	40	50	2	4
MSMBG04C23	Project and Institutional Visit	50	200	250	6	7
MSMBG02C12	Internship / MOOC	10	40	50	2	-
Total		130	520	650	24	25
Grand Total		300	1200	1500	80	-

About the Pattern of Questions:

A

Part	No. of Questions		Marks	%
A	No of Questions in the QP	6	10	25%
	No of Questions to be answered	5		
	Marks of each question	2		
B	No of Questions in the QP	5	12	30%
	No of Questions to be answered	3		
	Marks of each question	4		
C	No of Questions in the QP	5	18	45%
	No of Questions to be answered	3		
	Marks of each question	6		

B

Pattern and time for 40 marks			Marks	Approximate time to answer a question	Total time	Total
A Part	No of Questions in the QP	6	10	8 minutes	40 minutes	40+ 60 75 ----- 175 minutes
	No of Questions to be answered	5				
	Marks of each question	2				
B Part	No of Questions in the QP	5	12	20 minutes	60 minutes	
	No of Questions to be answered	3				
	Marks of each question	4				
C Part	No of Questions in the QP	5	18	25 minutes	75 minutes	
	No of Questions to be answered	3				
	Marks of each question	6				

C

Unit	Unit 1	Unit 2	Unit 3	Unit 4
Number of Questions	4	4	4	4

Criteria for Continuous evaluation Process

Continuous evaluation (Internal): End semester evaluation= 1 : 4

Theory Courses

Written test (best out of any 2 exams) 50 %

Seminars and assignment 50 % (Seminar 30 % and Assignment 20 %)

Lab Courses

Written lab exam 50 %

Lab involvement and record 50 % (Lab involvement 30 % and Record 20 %)

***Criteria for undertaking Internship / MOOC**

During the second semester or at during the vacation period the students must undergo an internship for not less than 6 days (30 hrs) at any of the various industry or institutions. After completing the internship, the student must submit a detailed report of the internship with the attendance statement from the corresponding institution. The evaluation process (10+40 Marks) will be conducted along with the IV Semester examinations.

Alternatively, students can undergo MOOC course available on the online platforms for not less than 30 hours duration (can be 2 courses of 15 hrs each). The students should submit the certificate of the course after completion of the course. The evaluation of the course (10+40 marks) will be conducted along with the IV semester examinations

Evaluation of Internship

Continuous evaluation

Periodic reporting including attendance 30 %, internal presentation 50 %, viva 20 %

End semester evaluation

Presentation 50 %, viva 20 %, report evaluation 30 %

Evaluation of MOOC

Continuous evaluation

Periodic reporting 30 %, presentation 30 %, viva 40 %

End semester evaluation

Presentation and Viva 50 %, certificate 50 %

Evaluation of Project

Continuous evaluation

Punctuality and regularity 20 %, Report 50 % Internal Viva 30 %

End semester evaluation

Presentation 20 %, Report 50 %, Viva 30 %

SEMESTER I

CORE COURSE I : FOUNDATIONS OF MICROBIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
1	MSMBG01C01	4	4	3

COURSE OUTCOME

CO1: Understand the history, scope and importance of Microbiology and to understand and apply various microscopic techniques

CO2: Familiarize the detailed structure of Microorganism and also to understand and apply the staining procedures in Microbiology

CO3: Understand and apply principles and various technique for controlling microorganisms

CO4: Understand and apply various methods of cultivation and preservation of Microorganisms

Unit I :

History of Microbiology: contributions of various scientists (Louis Pasteur, Robert Koch, Anton Van Leuwenhoek, Edward Jenner, Joseph Lister, Alexander Fleming, Beijerinck and Winogradsky) and their experiments. Scope & Importance of microbiology in different fields. Microscopy and specimen preparation: Light microscope- Bright field microscope, Dark field microscope, Phase contrast microscope, fluorescence microscope. Electron microscope- Transmission and Scanning electron microscope, cryoelectron Microscope and Confocal microscope.

(15 Hrs)

Unit II :

Ultra structure of Microorganisms: Bacteria: Morphology and arrangement of cells, The nucleoid, cytoplasmic structures, motility organelles. Gram-positive and Gram-negative cell wall, Cell membrane, Capsule, envelope, endospore and inclusion bodies. Bacterial staining- Simple, Negative, Differential (Gram Stain and AFB staining) and special staining for endospore, capsule flagella and Volutine granules. Morphology of animal, plant viruses and bacteriophages. structure and morphology of fungi and protozoans

(15 Hrs)

Unit III:

Control of Microorganisms: Physical control methods (heat, filtration and radiation) and chemical control methods (Alcohols, aldehydes, phenols, halogens, detergents, heavy metals and gases). Evaluation of effectiveness of antimicrobial agents. Antibiotics: classification, mechanism of action and methods of determination of antibiotic sensitivity. Anti-viral and anti-fungal agents.

(15 Hrs)

Unit IV:

Cultivation of Microorganisms: Nutritional requirements, media for cultivation of bacteria; Simple media, Complex media, special media, fungi, viruses and protozoans. Culture methods for bacteria: aerobic and anaerobic bacteria, Cultivation of viruses: animal, plant viruses and phages. Cultivation of fungi and protozoans. Enumeration of bacteria. Culture preservation methods.

(15 Hrs)

Books for Reference

1. Microbiology. Lansing M Prescott, John P Harley et al. McGraw Hill publication.
2. Microbiology. Jacquelyn G Black. WILEY publications.
3. Alcamo's fundamentals of microbiology. Jafrey C Pommerville. Jones and Bartlett Publishers.
4. Brock Biology of microorganisms. Michael. Madigan, Jack Parker et al. Prentice Hall publications.
5. An introduction to microbiology. Tortora, Funke et al. Pearson education Lt.
6. Introductory Microbiology. J Heritage, EGV Evans & RA Killington. Cambridge University Press.
7. General Microbiology. Hans G Schlegel. Cambridge University Press.

Model Question

FIRST SEMESTER MSc. DEGREE EXAMINATIONS 2023
Core Course in Microbiology
MSMBG01C01 – Foundations of Microbiology

Time : 3 Hrs

Maximum Marks: 40

Section A

Answer any five questions. Each question carries 2 marks

1. Recall the names, application and mode of action of any 3 disinfectant
2. Write on lyophilization technique
3. Write the general morphology of phages
4. Explain on the methods of identifying the potency of disinfectants.
5. Write on dark field microscope
6. Recall the morphology of protozoans

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Summarize various media used for cultivation of bacteria
8. Why staining is important in microbiology? Write on the principle and procedure of differential staining methods
9. Write on methods of enumeration of bacteria
10. Write on antibiotics and their classification with mode of action of each
11. Write on any two methods of viral cultivation

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Illustrate various methods of sterilization by using heat
13. Explain different methods of cultivation of bacteria
14. Comment on the contributions of various scientists in the field of Microbiology
15. Discuss the ultrastructure of bacteria
16. Explain the principle, types and applications of electron microscopy

(3X 6 = 18 Marks)

CORE COURSE II : FUNDAMENTALS OF BIOCHEMISTRY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	MSMBG01C02	5	4	3

COURSE OUTCOME

- CO1: Understand the basic structure and chemistry of biomolecules.**
- CO2: Understand the relationship between the structure and various functions of biomolecules in living systems.**
- CO3: Familiarize with the importance of engineered biomolecules and its applications**
- CO4: Investigate the significance of major biomolecules in public health**

Unit I :

Introduction to biomolecules. Carbohydrates; monosaccharides – structure of aldoses and ketoses, ring structure and conformation of sugars, mutarotation, epimers, anomers, enantiomers. Disaccharides – structure and functions of important reducing and non-reducing disaccharides. Polysaccharides – Structure and functions of homo- and hetero polysaccharides. Chemical synthesis of polysaccharides and its uses – glycal assembly method. Purification and characterization of polysaccharides. Conjugated forms of carbohydrates – Structure and functions of glycoproteins, proteoglycans and glycolipids. Sugar code - Carbohydrates as informational molecules.

(15 Hrs)

Unit II :

Proteins: Amino acids - Properties of amino acids. Structure and functions of essential and non – essential amino acids, Peptide bond – Structure and conformation of peptide bond- Ramachandran diagram and its importance. Peptides - Functions of biologically important peptides – peptide hormones and growth factors. Peptide synthesis– reactive ester method and modified Merrifield solid phase synthesis. Primary, secondary, Super secondary, tertiary and quaternary structure of proteins. Protein folding. Fibrous proteins – keratin, collagen, elastin, Globular proteins – albumin, globulin, myoglobin, haemoglobin. Membrane proteins – Integral membrane proteins (glycophorin, bacteriorhodopsin) and membrane associated proteins. Role of integral proteins in cell-cell interaction and adhesion; selectins, integrins, cadherins.

(15 Hrs)

Unit III:

Lipids : structure of building units of lipids- fatty acids, glycerol and ceramides. Fatty acids - saturated, unsaturated and poly unsaturated fatty acids. Classification of lipids – storage lipids – triacyl glycerol and waxes, Structural lipids – phospholipids, sphingolipids, sterols. Eicosanoids - prostaglandins, leukotrienes and thromboxane. Nucleic acids – Structure of nucleic acid – Nucleosides and nucleotides, Structure of DNA – Watson and crick model of DNA, A DNA and Z DNA, Structure of major species of RNA – Primary, Secondary, Tertiary. Biosynthesis and degradation of nucleotides.

(15 Hrs)

Unit IV:

Clinical biochemistry: Vitamins and vitamin disorders. Clinical significance of sugars, proteins, ketone bodies, bilirubin and porphyrins. Disorders of carbohydrate metabolism - blood sugar levels, hyper- and hypoglycemia, regulation of blood glucose, renal threshold, diabetes mellitus, insulin receptors and insulin C-peptide assay. Glycogen storage diseases, galactosemia, fructose intolerance and fructosuria. Disorders of lipid metabolism - lipidosis, xanthomatosis, hypo- and hypercholesteremia, fatty liver, atherosclerosis. Disorders of protein metabolism – non-nitrogenous constituents of blood –urea, uric acid and creatinine, agammaglobunemia and proteinuria. Principle and assay of important serum enzyme activities in disease – serum glutamic-oxaloacetic transaminase (SGOT), Serum glutamic pyruvic transaminase (SGPT), alkaline phosphatase, acid phosphatase, streptokinase and asparaginase. Immunodeficiency disorders of purine nucleotide metabolism - gout, orotic aciduria, xanthinuria.

(15 Hrs)

Books for Reference

1. Biochemistry. Voet, J. G., Voet, D. (2021). John Wiley & Sons, Inc. (2010) ISBN: 9781119770640
2. Lehninger principles of biochemistry. Nelson et al., (2008). W. H. Freeman. ISBN: 9780716771081.
3. Harper's Illustrated Biochemistry 31st Edition. Rodwell et al., (2018). McGraw-Hill Education. ISBN: 9781259837937.
4. Biochemistry. Stryer, L. et al., (2019). WH Freeman. ISBN: 978-1319114657
5. Fundamentals of Biochemistry. Jain et al., (2022). S Chand & Company Limited. ISBN: 9789352838301.
6. The Sugar Code: Fundamentals of Glycosciences. Gabius, H. J. (2013). Wiley Publishers, Germany. ISBN: 9783527644964
7. Recent Trends in Carbohydrate Chemistry: Synthesis, Structure and Function of Carbohydrates. Rauter et al. (2020). Elsevier Science. ISBN: 9780128174685
8. Next Generation Sequencing - Advances, Applications and Challenges. Jerzy K Kulski (2016), Intech Open. ISBN: 978-953-51-2240-1
9. The vitamins, Fundamental aspects in Nutrition and Health. G.F. Coombs Jr. (2008), Elsevier's Publications. ISBN: 9780128029657
10. Applied nutrition. Rajalekshmi R. and Sakhariah K. K. (2013). ISBN: 9788120417663

11. Principles of Nutritional Assessment. Rosalind Gibson (2005), Oxford University Press.
12. Textbook of Biochemistry with Clinical Correlations. Devlin, T.M. (2011), Wiley & Sons, Inc. (New York). ISBN: 9780470281734.
13. Clinical Chemistry. Marshall et al., (2016), Elsevier Health Sciences. ISBN:9780723434559.
14. Experimental Biochemistry: A Student Companion. Rao, B.S. and Deshpande, V (2005). Anshan Ltd. ISBN: 9788188237418.
15. Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests - Vol. 1. Mukherjee K.L. and Chakravarthy A. (2017). McGraw Hill Education. ISBN: 9789352606801
16. Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests - Vol. 2. Mukherjee K.L. (2022). CBS Publishers. ISBN: 978-9354661730.

Model Question Paper

FIRST SEMESTER MSc. DEGREE EXAMINATIONS 2023

Core Course in Microbiology

MSMBG01C02 – Fundamentals of Biochemistry

Time :3 Hrs.

Maximum marks: 40

A Part

Answer any five questions. Each question carries two marks

1. Differentiate between epimers and anomers.
2. Explain the structure and confirmation of peptide bond.
3. Write a note on PUFA.
4. Write a short note on glycan assembly method.
5. What is SGOT? Explain its clinical importance.
6. Write a short note on bacteriorhodopsin.

(5X2 = 10 Marks)

B Part

Answer any three questions. Each question carries four marks

7. Give an account on biosynthesis of prostaglandins.
8. Explain the structure of major species of RNA.
9. Explain different types of conjugated forms of carbohydrates.
10. Briefly explain different types purine metabolism disorders.
11. Give an account of biologically important fibrous proteins and their functions.

(3X4 =12 Marks)

C Part

Answer any three questions. Each question carries six marks

12. What are heteropolysaccharides? Explain their structure and biological functions.
13. Explain biological functions and significance of various peptide hormones.
14. Give an account of classification of lipids.
15. Explain different types of disorders of carbohydrate metabolism.
16. What are sphingolipids? Explain their structure and functions.

(3X6 =18 Marks)

CORE COURSE III : CELL BIOLOGY & GENETICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	MSMBG01C03	4	4	3

COURSE OUTCOMES

- CO1:** Understand the molecular nature, functioning of the cell components and dynamics.
- CO2:** Understand the concepts of cell division, apoptosis and etiology of cancer.
- CO3:** Familiarise the basic principles of genetics, heredity, Mendelian laws of inheritance and deviations
- CO4:** Understand linkage, mapping and familiarize with prokaryotic gene transfer methods

UNIT I:

Comparative account on prokaryotic and eukaryotic cells. Cell junctions: tight junctions, desmosomes and gap junctions, cell coat. Cell- cell Adhesion. Cytoskeleton: microtubules, microfilaments and intermediate filaments. Cell communication: general principles, Quorum sensing and quenching. signalling pathways. Cellular Organelles and Membrane Trafficking. Mitochondria, Plastids, Endoplasmic reticulum, Golgi complex, processing and trafficking of biomolecules.

(15Hrs)

UNIT II:

Cell cycle- different phases & regulation of cell cycle. Types of cells, stem cells, quiescent cells, cellular differentiation, types of tissues- epithelium, microvilli, basement membrane, structural features and characteristics. Kinases, cyclins and related proteins and their role in cell cycle regulation. Cell death and cancer: Apoptosis and necrosis, apoptotic pathways, theories on apoptosis, types of tumours, oncogenes, protooncogenes and tumour suppressors, Molecular pathways- PIP3 Akt, MAP kinase.

(15Hrs)

UNIT III:

Definition and scope of genetics; Mendelism- dominant and recessive traits, alleles, law of segregation, law of independent assortment, back cross, test cross, incomplete dominance; codominance, multiple alleles, multiple gene inheritance, lethal genes, complementary genes, pleiotropism, epistasis, Sex linked inheritance. Chromosome-morphology and structure of chromosome, functions of chromosomes; karyotype; cell division-mitosis and meiosis.

(15Hrs)

UNIT IV:

Genetic linkage, crossing over, recombination, mutations; tetrad analysis; DNA markers; genome maps-linkage maps, physical maps, cytogenetic maps. Genetic basis of cell differentiation, gametogenesis and fertilization, Population genetics, Hardy Weinberg equilibrium. Gene transfer mechanism in prokaryotes -conjugation, transformation, and transduction. Mapping of genes in bacteria and bacteriophages.

(15Hrs)

Books for reference

1. Cell Biology, Smith and Wood
2. Cell and Molecular Biology by Gerald Karp, Academic Press
3. Cell and Molecular Biology by Cooper
4. Biology of Cancer by Robert Weinberg
5. Molecular Cell Biology Gerald Karp 9th Edition Wiley 2020
6. Molecular Biology of The Cell Alberts 6th Edition 2014 Garland Science
7. Molecular Cell Biology Lodish 8th Edition. W.H. Freeman 2016
8. Genes XI Benjamin Lewin Jones and Bartlett Learning 2014
9. Pierce BA (2017). Genetics: A Conceptual Approach. W. H. Freeman Company, UK.
10. Snustad DP, Simmons MJ (2015). Principles of genetics. Wiley, USA
11. Hartl DL (2011). Essential of Genetics. Jones and Bartlett Publishers, Massachusetts,

Model Question Paper

FIRST SEMESTER MSc. DEGREE EXAMINATIONS 2023

Core Course in Microbiology

MSMBG01C03 – Cell Biology & Genetics

Time :3 Hrs

Maximum marks: 40

A Part

Answer any **five** questions. Each question carries **two** marks

1. Differentiate between quorum sensing and quenching.
2. Explain extrinsic pathway in apoptosis.
3. Write a note Tight junction.
4. Write a short note bacteriophage mapping.
5. What is Mitotic recombination.
6. Write a short note on Hardy Weinberg equilibrium.

(5X 2 = 10 Marks)

B Part

Answer any **three** questions. Each question carries **four** marks

7. Give a comparative account on epistasis and dominance
8. Explain Tumour suppressor genes
9. Explain genetic basis of cell differentiation.
10. Explain theories of apoptosis. Differentiate necrosis with apoptosis
11. Give an account tetrad analysis.

(3X4 =12 Marks)

C Part

Answer any **three** questions. Each question carries **six** marks

12. What are cell cycle check points? Describe the molecular events during mitosis.
13. Describe Mendel's laws and exceptions to it.
14. Give an account on Gene transfer mechanism in prokaryotes.
15. Explain the molecular mechanisms of crossing over.
16. Illustrate on various Cellular Organelles and Membrane Trafficking.

(3X6 =18 Marks)

CORE COURSE IV : MOLECULAR BIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	MSMBG01C04	4	4	3

COURSE OUTCOMES

- CO1: Understand the nature and character of the genetic material controlling the life processes**
- CO2: Make aware the students about the mechanism of functioning of a cell and expression of structural and functional characters.**
- CO3: Understand the mechanism of hereditary transfer of characters from generations to generation.**
- CO4: Understand the mechanisms of development of variations among the generations**

UNIT I:

Structure and functions of genetic material: DNA as genetic material- Historical perspectives, experimental proof; Nucleosides and Nucleotides, Chargaff's rule, Nitrogen base pairing, Hoogsteen base pairing; Abnormal forms of DNA, Watson-Crick model, characteristics of DNA & RNA; Types Of RNA; Coiling and Supercoiling of DNA; Protein DNA interactions; Chromatin organization- nucleosomes' Solenoid and Plectonemic model; Euchromatin and Heterochromatin.

(15Hrs)

UNIT II:

DNA Replication and Transcription - DNA replication: Central dogma of molecular biology; Theories of DNA replication, semiconservative replication-experimental proof; Proteins and enzymes involved in replication, DNA polymerases- structure, types and characteristics; Eukaryotic and Prokaryotic DNA replication- mechanisms of initiation, elongation and termination. DNA damage and repair mechanisms; Genetic recombination- homologous and non-homologous recombination mechanisms.

Transcription: Enzymes and proteins involved, RNA polymerases- structure, types and characteristics, Eukaryotic and Prokaryotic transcription- initiation, elongation and termination processes; Monocistronic and Polycistronic mRNA; RNA processing- capping, splicing, polyadenylation; snRNA, miRNA, RNA editing, exon shuffling. Transcription inhibitors, Reverse transcription.

(15Hrs)

UNIT III:

Protein synthesis: Translation; Genetic code, aminoacyl tRNA, aminoacyl tRNA synthetase, tRNA identity; Prokaryotic and Eukaryotic translation mechanisms: initiation complex; factors and their regulation; elongation and elongation factors; termination mechanisms; Properties of prokaryotic and eukaryotic ribosomes; translational proof reading; suppressors, inhibitors and modifiers of translation; Post translational modifications.

(15Hrs)

UNIT IV:

Regulation of gene expression: translational regulation- inducible and repressible systems, positive and negative regulation; Operon concept- Lac, Trp, Ara operons; Promoters, Operators, Regulons, Master switches; Feedback inhibition, mRNA half-life, ribozymes, RNA interference. Gene expression regulation in eukaryotes- gene alteration, gene loss, gene rearrangement (Immunoglobulin genes); regulation by transcription factors, enhancer activity, chromatin changes in gene regulation.

(15 Hrs)

Books for reference

1. Molecular biology of the Gene by Watson James D., Baker Tania A., Bell Stephen P., Gann Alexander, Levine Michael, Losick Richard
2. The world of the Cells by Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin, Gregory Paul Bertoni, 7th edition
3. Karp's Cell and Molecular Biology: Concepts and Experiments by Gerald Karp, Janet Iwasa, Wallace Marshall 8th edition, Wiley
4. Lewin's Essential Genes by Jocelyn E. Krebs, 3rd edition
5. Molecular Biology of the Cell by Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter 6th edition
6. Cell and Molecular biology by EDP DeRobertis
7. Molecular biology by David Freifelder
8. Fundamental Molecular biology by Lizabeth A Allison; Blackwell
9. iGenetics by Peter J Russell, Pearson

Model Question Paper

FIRST SEMESTER MSc. DEGREE EXAMINATIONS 2023

Core Course in Microbiology

MSMBG01C04 – Molecular Biology

Time : 3 Hrs

Max. Marks : 40

Draw diagrams wherever necessary

Section A

Answer any five questions. Each question carries 2 marks

1. What are nucleotides?
2. What is Klenow fragment?
3. Compare the properties of prokaryotic and eukaryotic ribosomes
4. What are ribozymes?
5. Differentiate euchromatin and heterochromatin.
6. Write on Hoogsteen base pairing

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Describe Watson-Crick model of DNA
8. Discuss about the proteins and enzymes involved in transcription
9. Write on the post translational modifications of proteins
10. Write a note on the immunoglobulin gene rearrangements
11. Write a note on RNA interference.

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Discuss about the interaction between DNA and proteins. Write on the structural organization of chromatin fibres.
13. Write a note on DNA damage and repair mechanisms. Describe the mechanisms of genetic recombinations.
14. What are the characteristics of genetic code? Discuss about the structure of tRNA and the mechanism of incorporation of codon specific amino acids in polypeptides during translation.
15. What are operons? Describe the regulation of Trp operon.
16. Explain the translation process in eukaryotes.

(3X 6 = 18 Marks)

CORE COURSE V PRACTICAL : I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	MSMBG01C05	4	-	3

PART I. FOUNDATIONS OF MICROBIOLOGY

1. Cleaning and sterilization of glass wares.
2. Preparation of solid and liquid media and their sterilization.
3. Uses and study of microscopes.
4. Measurement of microorganisms – micrometry.
5. Bacterial cell counting by hemocytometer.
6. Staining of bacteria
 - i) Gram staining.
 - ii) Negative staining.
 - iii) Capsule staining
 - iv) Endospore staining.
 - v) Acid – fast staining.
 - vi) Volutin granule staining
7. Microscopic test for bacterial motility by hanging drop method.
8. Efficiency testing of autoclave
9. Evaluation of potency of disinfectant by phenol coefficient method.
10. Cultivation of bacteria
 - i) Pour plate method.
 - ii) Spread plate method.
 - iii) Streak plate method.
 - iv) Anaerobic culture method by liquid paraffin overlay
12. Microbial culture preservation by glycerol stock
13. Isolation of fungi using suitable media.
14. Identification of fungi by lactophenol cotton blue mounting and study of the cultural characteristics of various fungi.

Books for Reference

1. Dubey RC & Maheshwari DK (2002) Practical Microbiology (S. Chand & Company Limited
2. Aneja KR (2003) Experiments In Microbiology, Plant Pathology And Biotechnology. New Age International.
3. Kannan N (2002) Manual in General Microbiology. 2nd Edition, Panima Publishing Co., New Delhi
4. Cappucino, J.G & Sherman, S (2010) Microbiology. A Laboratory Manual 9th edition Benjamin-Cummings Publishing Company

PART II. CELL BIOLOGY AND GENETICS

1. Cell Fractionation: mitochondria: differential centrifugation.
2. Estimation of nucleic acid by spectrophotometric method/Diphenylamine method
3. Polytene Chromosome (Drosophila).
4. Karyotyping.
5. Apoptosis- DNA Ladder Pattern, Annexin V staining
6. Study of Barr Body (Buccal smear).
7. Bacterial transformation
8. Mitosis and meiosis experiment
9. Transduction
10. Bacterial conjugation
11. Cell viability test- Trypan blue. MTT assay
12. Genetic Problems

Books for Reference

1. Cell Biology A Laboratory Handbook 3rd Edition Elsevier Inc 2006
2. Cell and Molecular Biology Lab Manual David A Thompson 2009
3. Molecular Cloning- A Laboratory Manual Sambrook, J., Fritsch, E. F. and Maniatis, T. 1989. Second Edition. Cold Spring Harbor Laboratory Press.
4. Zinsser Microbiology Prentice- Hall International Inc. Manual of Methods for General Bacteriology. Gerhardt P et al (eds.) American Society for Microbiology.
5. Hayes, W., 1994. Genetics of Bacteria and their viruses. 2nd Edn, CBS Publishers and Distributors, New Delhi
6. Methods in Molecular Biology Vol. 28. Protocols for Nucleic acid analysis by non - radioactive probes. Edited by Issac P. G. Human Press,

CORE COURSE VI PRACTICAL: II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	MSMBG01C06	4	-	3

PART I. FUNDAMENTALS OF BIOCHEMISTRY

1. Preparation of solutions – percentage, normal and molar solutions
2. Preparation of buffers
3. Qualitative tests for carbohydrates, proteins and lipids.
4. Estimation of glucose by anthrone method.
5. Estimation of reducing sugars by DNS method
6. Estimation of amino acid by ninhydrin method
7. Estimation of protein by Lowry's method
8. Estimation of cholesterol by Zak's method.
9. Paper and Thin Layer chromatography.
10. Estimation of serum urea by DAMO or nitroprusside method
11. Quantitative determination of serum creatinine by Jaffe's method.
12. Estimation of Vitamin C from fruit juice by DPPH method
13. Determination of iodine number from vegetable oil.
14. Isolation of cholesterol from egg yolk and its estimation
15. Estimation of triglycerides.
16. Assay of serum transaminases – SGOT and SGPT
17. Bioassay for vitamin B₁₂

Books for Reference

1. Experimental Biochemistry: A Student Companion. Rao, B.S. and Deshpande, V (2005). Anshan Ltd. ISBN : 9788188237418.
2. Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests - Vol. 1. Mukherjee K.L. and Chakravarthy A. (2017). McGraw Hill Education. ISBN: 9789352606801
3. Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests – Vol.2 Mukherjee K.L.(2022). CBS Publishers. ISBN: 978-9354661730.
4. Practical Manual of Biochemistry. Sattanathan, Padmapriya and Balamuralikrishnan. (2020). Skyfox Publishing Group. ISBN : 9788193953655.
5. Fundamentals of Practical Clinical Biochemistry. Mohanty, B and Basu, S (2006). B.I. Publications Pvt. Limited. ISBN:9788172252267
6. A Textbook of Practical Biochemistry. Rashmi, J. A. (2021). IB. Jain Publishers (P) Limited. ISBN:9788180560378

PART II. MOLECULAR BIOLOGY

1. Isolation of DNA/RNA from bacteria
2. Determination of melting temperature of DNA.
3. DNA staining
4. Plasmid isolation
5. Agarose gel electrophoresis of nucleic acids

Books for Reference

1. Cell and Molecular Biology Lab Manual David A Thompson 2009
2. Molecular Cloning- A Laboratory Manual Sambrook, J., Fritsch, E. F. and Maniatis, T. 1989. Second Edition. Cold Spring Harbor Laboratory Press
3. Methods in Molecular Biology Vol. 28. Protocols for Nucleic acid analysis by non - radioactive probes. Edited by Issac P. G. Human Press

SEMESTER II

**CORE COURSE VII : BIOINFORMATICS & COMPUTATIONAL
BIOLOGY**

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	MSMBG02C07	4	4	3

COURSE OUTCOMES

- CO1: Understand various biological databases and apply relevant bioinformatics tools for similarity searching and sequence alignments of various molecular sequences.**
- CO2: Apply the concept of molecular phylogenetics and study the evolutionary relationship among the sequences and predict the composition and structure of genes and proteins by relevant bioinformatics tools.**
- CO3: Predict the three-dimensional structures of molecular targets and design potential therapeutic lead candidates by computer aided virtual screening.**
- CO4: Formulate predictive models for studying the receptor-ligand interactions in drug discovery and development process and their validation by various bioinformatics tools.**

UNIT-I:

Bioinformatics and Computational Biology: Introduction, Need and scope, biological databases-Classification of databases: Primary, secondary, and composite databases. Specialized databases. Sequence and structural databases, File formats of databases-GBFF, PDB and PIR. Similarity searching tools and their variants-BLAST, FASTA, Sequence alignment methods-Pair-wise and multiple sequence alignment- global, local and progressive alignments. Gap penalties, Substitution scores and matrices, Pattern determination by MSA
(15 Hrs)

UNIT-II:

Molecular phylogenetics: Structural component of phylogenetic tree, Types of phylogenetic trees, molecular clock hypothesis. Phylogenetic data analysis-Multiple sequence alignment, substitution models, tree building- Distance based and character based, and tree evaluation- boot strapping, resampling and jack knifing, Major bioinformatics tools and software for phylogenetic data analysis. Computational gene prediction-Introduction, steps,

Bioinformatics tools for gene prediction. Prediction of RNA folding. Computational structure prediction-Prediction of secondary structures, major approaches, and tools

(15 Hrs)

UNIT-III

Tertiary structure prediction- *Ab initio/de novo* prediction, Comparative modelling. Fold recognition (threading), Comparative modelling- steps, molecular superposition, and structural alignment (RMSD calculation), energy minimization and their methods, Major bioinformatics tools, Structure visualization, Major molecular visualization soft wares. Molecular dynamic simulation-Introduction, principles, steps, bioinformatics tools.

(15 Hrs)

UNIT-IV

Introduction to computer aided drug discovery, Outline of drug discovery and development process, Need for bioinformatics tools , Receptor and small molecules databases, Prediction of drug likeliness and ADMET of lead molecules, Pharmacophoric patterns and bioactive conformation, Quantitative structure-activity relationship (QSAR), Prediction of binding pockets by computational biology tools, Molecular docking: Types of docking, Approaches for molecular docking, Calculation of energy and molecular properties during docking studies, Major molecular docking algorithms/software/web based tools.

(15 Hrs)

Books for Reference

1. Xinog J, Essentials of Bioinformatics, Texas A & M University, Cambridge University press. 2006. ISBN: 9780521600828
2. Baxevanis AD, Ouellette BFF. Bioinformatics. A practical guide to the analysis of genes and Proteins. Third edition. John Wiley & Sons. 2006. ISBN: 978-0-471-47878-2.
3. Tramontano A. Introduction to Bioinformatics. Chapman and Hall/CRC Press, 2006. ISBN 13: 9781584885696.
4. Cohen NC. Guidebook on Molecular Modeling in Drug Design. Academic Press, Elsevier. 1996. ISBN: 9780121782450
5. Pevsner J. Bioinformatics and Functional Genomics, 3rd Edition. Wiley-Blackwell. 2015. ISBN: 978-1-118-58178-0
6. Campbell AM. Discovering Genomics, Proteomics, and Bioinformatics. CSHL Press, 2007. ISBN-13: 978-0805382198.

Model Question Paper

SECOND SEMESTER MSc. DEGREE EXAMINATIONS 2023

Core Course in Microbiology

MSMBG02C07 – Bioinformatics and Computational Biology

Time : 3 Hrs.

Max. Marks : 40

Section A

Answer any five questions. Each question carries 2 marks

1. Define substitution matrix
2. What do you mean by composite databases?
3. Inspect the variants of BLAST
4. Define progressive alignment.
5. Define molecular clock hypothesis.
6. Differentiate between rigid body and flexible body docking.

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Outline the salient features and types of dynamic programming algorithms.
8. Inspect the concept of identity, similarity, gap penalty and alignment scores in context of pairwise alignment.
9. Examine various approaches and computational biology tools used for the secondary structure of proteins.
10. Summarise the principle involved in energy minimisation and extend a note on various approaches used for the energy minimisation of hypothetical models.
11. Illustrate the principle and applications of pharmacophore modelling

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Investigate the steps and approaches involved in the phylogenetic data analysis with relevant bioinformatics tools.
13. Outline the major approaches and steps involved in the computational prediction of functional sites of genes and genomes.
14. What you mean by computer aided virtual screening? Inspect the basic principles and computational biology tools for the prediction of drug likeness and ADMET properties of small molecules.
15. Formulate the principle involved in molecular dynamic simulation and add a relevant note on various bioinformatics tools used for force field analysis during MD simulation.
16. Elaborate various methods and computational biology tools used for the prediction of tertiary structure prediction of protein.

(3X6 = 18 Marks)

CORE COURSE VIII : IMMUNOLOGY AND IMMUNOTECHNIQUES

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	MSMBG02C08	4	4	3

COURSE OUTCOMES

- CO1: Understand the basics of immune system, divisions and general mechanisms**
- CO2: Understand organs, cells, and molecules involved in immunity and their interactions involved in immune responses**
- CO3: Explain the importance of Immunotechniques along with its applications in the diagnosis of various diseases.**
- CO4: Understand the immunologic basis of allergic reactions, autoimmunity, immune deficiency disorders graft transplantation and cancer immunology**

UNIT I:

Historical landmarks, branches, types of immunity. General concepts of the immune response; Innate and adaptive immunity types and properties; Mechanisms of innate immunity- barriers, inflammation, phagocytosis- mechanisms, Pattern recognition receptors- soluble (Antimicrobial peptides, CRP, MBL) and membrane associated (TLR, Scavenger, NOD). Hematopoiesis, apoptosis; Structure, properties, classification and functions of all the immune cells; CD markers, B and T cell receptors; Structure, properties and functions of primary and secondary lymphoid organs.

(15 Hrs)

UNIT II:

Antigen: Types and properties; antigens, immunogens, haptens, carriers, epitopes and paratopes. T-dependent and T-independent antigens. Antibodies: Structure, function; Theories of antibody production, Different classes and biological activities of antibodies; isotypes, allotypes, idiotypes; Genesis of antibody diversity; Hybridoma technology and monoclonal antibodies. Complement system: components, types and application. MHC structure, classification and restriction, Antigen processing and presentation pathways. Humoral immune response; primary and secondary immune response. Cell mediated effector responses, cytokines, CTL, NK cell mediated cytotoxicity, ADCC

(15 Hrs)

UNIT III:

Affinity and avidity; cross reactivity; properties and types of precipitation and agglutination reactions; Immunodiffusion and its types, immunoelectrophoresis; ELISA and its types; immunofluorescence; FACS, CFT, RIA, immune electron microscopy, immunohistochemistry, immunoblotting, Antibody array, immunosensors, ELISPOT assay and Cytokine assay immunotherapeutic strategies; vaccine types.

(15 Hrs)

UNIT IV:

Hypersensitivity; classification and mechanism. Immunological tolerance: central and peripheral tolerance; autoimmune disorders: organ specific and systemic, Immunodeficiency diseases: Primary and secondary immune deficiencies, Immunohematology: blood group antigens, Blood transfusion; transplantation: Types of grafts, immunologic basis of graft rejection, properties and types of rejection; tissue typing, immunosuppressive therapy and transplants to immunologically privileged sites; cancer and the immune system, tumor antigens. Immune response to tumors. Immuno therapy of tumors.

(15 Hrs)

Books for Reference:

1. Immunology. Richard A Goldsby, Thomas J Kindt, Barbara A Osborne, Janis Kuby. W H Freeman and Company.
2. Immunology. Roitt, Brostoff, Male Mosby.
3. Immunobiology. Janeway, Travers Walport, Shlomchik. Churchill Livingstone.
4. Immunology. Tizard. Thomson Publishers.
5. Medical Immunology. Tristram G Parslow, Daniel P Stites, Abba I Terr, John B Imboden. Mc Graw Hill.
6. Practical immunology. Frank C Hay and Olwyn M R Westwood. Black Well science
7. Abbas AK, Lichtman AH, Shiv Pillai (2019) Basic Immunology. 6th Edition. Elsevier.

Section A

Answer any five questions. Each question carries 2 marks

1. Differentiate natural active and natural passive immunity?
What are the advantages and disadvantages of using attenuated organisms as vaccines?
2. Differentiate antigen and haptan. List the properties of an immunogen
3. Differentiate B cells and T cells. Describe the differences in immune response they induce
4. Explain Antibody affinity and avidity. Describe cross reactivity with examples
5. Differentiate ELISA and RIA. Describe two methods of ELISA in use
6. What are HLAs and its significance? Describe any one method used for HLA typing.
(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Evaluate the role of innate and adaptive immune components in protecting us against an offending pathogen.
8. Suggest the various immunoprophylactic measures currently in use with examples for each type.
9. Suggest the various immunosuppressive therapies currently in use to tackle the graft rejection mechanisms.
10. Analyze the immune responses produced by body against cancerous cells and mechanisms used by cancerous cells to evade the immune system
11. "Monoclonal antibodies are proved to be useful tools in diagnostic and therapeutic purposes". justify the statement with examples
(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Contrast the structure and functions of primary and secondary lymphoid organs
13. Make a comparison of the classical and alternative pathway of complement. Describe the biological consequences of complement activation
14. Contrast the various precipitation and agglutination reactions. Explain their applications with examples.
15. Compare the mechanisms of type I and Type IV hypersensitivity and their clinical symptoms.
16. What is MHC restriction? Compare the processing and presentation of endogenous and exogenous antigens
(3X 6 = 18 Marks)

CORE COURSE IX : GENETIC ENGINEERING

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	MSMBG02C09	4	4	3

COURSE OUTCOME

- CO1: Understand the use of modern tools and techniques in DNA cloning and basic steps of gene cloning**
- CO2: Familiarize with various gene transfer methods**
- CO3: Learn the techniques of genome mapping, gene amplification, gene sequencing, *in vitro* mutagenesis and gene silencing.**
- CO4: Become aware of various applications of rDNA technology in crop improvement, in human health care and forensic medicine.**

UNIT I :

Introduction to rDNA technology; Tools and techniques used in rDNA technology- DNA manipulating enzymes and their uses: Restriction endonucleases- Discovery, types and uses- restriction site elucidation, restriction mapping; DNA ligases; DNA polymerases; Polynucleotide kinases; Alkaline phosphatases; RNA polymerases; Nucleases. Cloning vectors and their application- plasmid vectors, phage vectors, cosmids, phagemids, Yeast vectors, Expression vectors, Shuttle vectors, Artificial chromosome- BAC, YAC, HAC, PAC; construction of cloning vectors.

(15 Hrs)

Unit II :

DNA cloning- Methods of introduction of rDNA in to bacterial, plant and animal cells; Identification of transformants and recombinants- HART, HRT, immunological screening, selectable marker and reporter genes; homopolymer tailing, use of adapters and linkers; Genomic and cDNA libraries – construction of cDNA libraries, cloning of cDNA; PCR based cloning; chemical synthesis of oligonucleotides; Blotting – Western, Southern and Northern, hybridization techniques.

(15 Hrs)

Unit III:

DNA sequencing- Maxam-Gilbert method, Sanger method, modified Sanger (fluorescent method), short gun sequencing, automated sequencing, Next gen sequencing; PCR Technology concept- types of PCR, primer designing, applications of PCR; DNA fingerprinting- AFLP, RFLP, RAPD, SSLP, FISH; Chromosome walking, In vitro mutagenesis- random and site directed mutagenesis; Gene silencing; Antisense RNA; Si RNA; miRNA- applications.

(15 Hrs)

Unit IV:

Transgenic plants and animals, Vectors for gene cloning in plants and animals; Gene transfer methods; Applications of transgenic plants and animals; Applications of rDNA technology in medicine- Strategies for the production recombinant medicine- Insulin, human growth hormone; Recombinant vaccine & recombinant MoAbs; Gene therapy; DNA based diagnosis of genetic disorders; Applications of rDNA in forensic science, CRISPER Caspase.

(15 Hrs)

Books for Reference

1. Gene Cloning and DNA analysis. TA Brown. Balckwell publishing.
2. Principles of gene manipulations and Genomics. SB Primrose and RM Twyman, Blackwell publishing.
3. Recombinant DNA. James D. Watson, Scientific American books.
4. Molecular Biotechnology. Bernard R Glick, ASM press.
5. Molecular Cloning Vol 1-3. Sambrook and Russel, CSHL press.
6. Recombinant DNA. Genes and Genomes. James D Watson, CSHL press.
7. PCR primer. Carl W Dieffenbach, CSHL Press.

Model Question Paper

SECOND SEMESTER MSc. DEGREE EXAMINATION 2023

Core Course in Microbiology

MSMBG02C09 – Genetic Engineering

Time : 3 Hrs.

Max. Marks : 40

Section A

Answer any five questions. Each question carries 2 marks

1. Mention the applications of antisense RNA
2. Describe about Real Time PCR
3. Write a note on RNase H
4. Explain chromosome walking
5. Write the importance of genetically modified organism
6. Compare Northern blotting and Southern blotting

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Build your view about molecular based diagnosis of genetic disorders
8. Discuss on Random and site-specific mutagenesis
9. Discuss about Restriction endonucleases
10. Construct a flowchart showing steps of PCR based cloning

11. Discuss different approaches for gene silencing

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Describe briefly about various cloning vectors used in rDNA technology

13. Discuss on various strategies for the introduction of rDNA in to suitable host cells

14. Explain DNA sequencing methods

15. Describe about production and applications of transgenic plants

16. Explain on recombinant vaccines

(3X 6 = 18 Marks)

CORE COURSE X PRACTICAL : III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	MSMBG02C10	4	2	3

PART I. IMMUNOLOGY AND IMMUNOTECHNIQUES

1. Differential count of WBC
2. Immunodiffusion tests- ODD, RID, Immunoelectrophoresis
3. Latex agglutination tests- RA, ASO, RPR
4. Coomb's test
5. Blood grouping (A, B, O and Rh)
6. ELISA (HIV/HBsAg)
7. Immunochromatography (HBsAg/HCG)
8. WIDAL test
9. Western Blotting

Books for Reference

1. A Hand book of Practical and clinical immunology, Vol 1 2ed (PB 2017): Volume I Paperback – 9 July 1905 by Talwar (Author)
2. Essential Immunology; Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt
3. Immunology: Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Janis Immunology Kuby
4. Basic and clinical immunology: Mark Peakman, Diego Vergani
5. Clinical immunology: Robert R. Rich MD, Thomas A Fleisher MD FAAAAI FACAAI, William T. Shearer MD PhD, Harry Schroeder, Anthony J. Frew MD FRCP, Cornelia M. Weyand MD PhD
6. Text book of Microbiology: Anantha Narayanan and Jayaram Panicker

PART II. MICROBIAL PHYSIOLOGY AND METABOLISM

1. Demonstration of cultural characteristics of bacteria on different media- NA, NB, MA, BA, EMB agar
2. Biochemical tests-Sugar fermentation, O/F test, IMViC, Nitrate reduction, Urease, Catalase, Oxidase, use of TSI media and Mannitol motility media
3. Determination of TDT and TDP
4. Effect of pH on bacterial growth
5. Effect of temperature on growth
- 6.. Effect of salt concentration on bacterial growth
7. Effect of heavy metals on bacterial growth (Oligodynamic action)
8. Study of growth curve of bacteria

Books for Reference

1. Cheesbrough M (2006) District Laboratory Practice in Tropical Countries. Vol.2. Cambridge University Press. 2nd ed.
2. Collee JG & Mackie TJ (1996) Mackie and McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh. 14th ed.
3. Gradwohl RBH, Sonnenwirth AC, & Jarett L (1980) Gradwohl's Clinical Laboratory. Methods and Diagnosis Mosby, St Louis, Mo.; London. 8th ed.
4. Dubey RC & Maheshwari DK (2002) Practical Microbiology (S. Chand & Company Limited.

CORE COURSE XI PRACTICAL: IV

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	MSMBG02C11	4	2	3

PART I : BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

1. Similarity searching of molecular sequences using BLAST and its variants
2. Pairwise and multiple sequence alignment using various Bioinformatics tools
3. Phylogenetic and evolutionary analysis of molecular sequences using Bioinformatics tools.
4. Prediction of genes and secondary structures of molecular sequences by Bioinformatics tools
5. Prediction of the three-dimensional structure of the protein sequence by homology modelling and refinement and validation of the hypothetical model by various Bioinformatics tools
6. Study of protein-ligand and protein-protein interactions by molecular docking

Books for Reference

1. Xinog J, Essentials of Bioinformatics, Texas A & M University, Cambridge University press. 2006. ISBN: 9780521600828
2. Baxevanis AD, Ouellette BFF. Bioinformatics. A practical guide to the analysis of genes and Proteins. Third edition. John Wiley & Sons. 2006. ISBN: 978-0-471-47878-2.
3. Tramontano A. Introduction to Bioinformatics. Chapman and Hall/CRC Press, 2006. ISBN 13: 9781584885696.
4. Cohen NC. Guidebook on Molecular Modeling in Drug Design. Academic Press, Elsevier. 1996. ISBN: 9780121782450
5. Pevsner J. Bioinformatics and Functional Genomics, 3rd Edition. Wiley-Blackwell. 2015. ISBN: 978-1-118-58178-0
6. Campbell AM. Discovering Genomics, Proteomics, and Bioinformatics. CSHL Press, 2007. ISBN-13: 978-0805382198.

PART II : GENETIC ENGINEERING

1. Isolation of genomic DNA from plants.
2. Isolation of DNA from animal tissue
3. SDS-PAGE of proteins.
4. DNA amplification by PCR.
5. Detection of PCR products
6. Restriction digestion.
7. Isolation of auxotrophic mutants
8. Gene cloning
9. Blue white screening of transformants
10. Southern Blotting

Books for Reference

1. Laboratory Manual for Genetic Engineering By VENNISON, S. JOHN
2. Cell and Molecular Biology Lab Manual David A Thompson 2009
3. Molecular Cloning- A Laboratory Manuel Sambrook, J., Fritsch, E. F. and Maniatis, T. 1989. Second Edition. Cold Spring Harbor Laboratory Press
4. Methods in Molecular Biology Vol. 28. Protocols for Nucleic acid analysis by non - radioactive probes. Edited by Issac P. G. Human Press

ELECTIVE COURSE I : MICROBIAL PHYSIOLOGY AND METABOLISM

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	MSMBG02E01	4	4	3

COURSE OUTCOME

CO1: Understand the microbial growth, sporulation and various transport systems

CO2: Familiarise with bacterial photosynthesis and respiration

CO3: Understand the metabolism of carbohydrates and amino acids

CO4: Understand the metabolism of lipid

UNIT I :

Growth physiology- Nutritional requirements and classification, Factors affecting microbial growth, growth curve, synchronous growth, measurement of microbial growth; architecture of endospore, mechanism of resistance, sporogenesis and spore germination. Bacterial permeation; membrane transport in bacteria-simple, passive and facilitated diffusion, group translocation, different mechanisms of active transport- role of permease in transport- different permeases in *E.coli*, siderophores and iron transport- protein export in microbes- transport of sugars, amino acids and inorganic ions

(15Hrs)

UNIT II :

Bacterial photosynthesis and respiration- photosynthesis in microbes-photosynthetic pigments and generation of reducing power by cyclic and non-cyclic photophosphorylation- ETC in photosynthetic bacteria, CO₂ fixation pathway- bacterial aerobic and anaerobic respiration, chemotrophism, heat shock response, bioluminescence, survival at extreme environments- adaptive mechanisms of extremophiles. Fungal physiology: nutrient transport in fungus, fungal nutrition and cellular biosynthesis. Physiology of growing hyphae, hyphal aggregates- quorum sensing in fungus

(15Hrs)

UNIT III:

Metabolism of carbohydrates – mono, di, oligo and polysaccharides, Glycolysis- TCA cycle, glyoxylate path way, gluconeogenesis- glycogen metabolism-biosynthesis of poly saccharides, biosynthesis of peptidoglycan, Metabolism of amino acids: transamination, deamination and decarboxylation reactions of amino acids. Biosynthesis and degradation of non-essential amino acids. Urea cycle.

(15Hrs)

Unit IV:

Lipid metabolism: biosynthesis of saturated, unsaturated, hydroxyl and branched chain fatty acids. Oxidation of fatty acids. ATP yield from fatty acid oxidation. Metabolism of triacylglycerols. Biosynthesis and degradation of phospholipids – cholesterol biosynthesis.

(15 Hrs)

Books for Reference

1. Microbiology Lansing M Prescott, John P Harley, Donald A Klein, McGraw-Hill
2. Adam Dricks. Eichenberger, The bacterial spore: from molecule to systems 2016, Wiley
3. Caldwell D R Microbial physiology and metabolism 1995, Brown Publishers
4. Leninger's principles of biochemistry, Nelson L D and M M Cox. Macmillan Worth publications.
5. Biochemistry Donald Voet, Judith G Voet, Charlotte Pratt. John Wiley and sons.

Model Question paper

SECOND SEMESTER MSc. DEGREE EXAMINATIONS 2023

Elective Course in Microbiology

MSMBG02E01 – Microbial Physiology and Metabolism

Time : 3 Hrs.

Max. Marks : 40

Section A

Answer any five questions. Each question carries 2 marks

1. Recall the molecular architecture of spore
2. List the functions of siderophores
3. What are the applications of quorum sensing?
4. Explain the role of phosphofructokinase-1 in regulation of glycolysis
5. Write examples of thermophilic bacteria and their features
6. Write on proton motive force.

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Explain ETC in photosynthetic bacteria
8. Explain iron transport in bacteria
9. Construct Growth curve of bacteria
10. Comment on Bioluminescence
11. Explain in detail nutrient transport in fungus

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Explain in detail about the membrane transport system in bacteria.
13. Explain cyclic and non-cyclic photophosphorylation
14. Describe anaerobic respiration in bacteria
15. Explain the biosynthesis degradation of phospholipids
16. Explain breakdown of purine and pyrimidine nucleotides.

(3X 6 = 18 Marks)

ELECTIVE COURSE II : MICROBIAL TAXONOMY AND SYSTEMATICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	MSMBG02E02	4	4	3

COURSE OUTCOME

CO1: Understand the basic concepts of Microbial taxonomy and systematics

CO2: Familiarize with the diversity of bacteria

CO3: Understand the taxonomy of fungi and viruses

CO4: Understand the taxonomy of algae and protozoans

UNIT I :

Bacterial systematics: Definitions: concepts of systematics, taxonomy, taxa, species, strains. Brief account on three kingdom and five kingdom classification, scientific nomenclature, taxonomic hierarchy and domains. Modern approaches in classification: natural, Phenetic and phylogenetic classification. Numerical taxonomy. Various criteria used in bacterial classification – morphological, cultural, biochemical, serological, ecological and molecular characteristics.

(15Hrs)

UNIT II :

Bergey's Manual of systematic Bacteriology: brief outline. Distinguishing features of prokaryotes-Archea and bacteria. Characteristic features of the important groups under archea: crenarchaeota: sulfolobus and euarchaeota: methanogens, acidophiles, thermophiles and halophiles. Bacteria: proteobacteria (alpha, beta, gamma, delta & epsilon), nanoproteobacteria (Dienococcus photosynthetic bacteria, planctomycetes, Chlamydiae, spirochetes and bacteriodetes), gram positive (low G+C Gram positive bacteria & High G+C Gram positive bacteria)

(15 Hrs)

UNIT III:

Taxonomy of fungi : classification and general characteristics of fungi - habitat, distribution, nutritional requirements, fungal cell structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction of fungi, Fungal dimorphism, economic importance of fungi. Taxonomy and general characteristics of virus- Classification of viruses – animal, plant and bacteriophages.

(15Hrs)

UNIT IV:

Algae: General characteristics of algae including occurrence, thallus organization, algal pigments, flagella, eyespot, food reserves, heterocyst. Sexual, asexual and vegetative reproduction. Classification of algae. Protozoa: General characteristics, cyst, classification of protozoa with examples

(15Hrs)

Books for Reference

1. Alexopoulos, C. J. and Mims, C. W. 1979. Introductory Mycology. III edition, Wiley Eastern, New Delhi.
2. Dimmock, N. J., Easton, A. J. and Leppard, K. N. 2001. Introduction to Modern Virology. 5th edn. Blackwell publishing, USA. Ghosh, A. 2003. Natural Resource Conservation and Environment Management. Aph Publishing Corp. Calcutta.
3. Landecker, E. M. 1972. Fundamentals of Fungi. Prentice-Hall, Angelwood Cliff, New Jersey.
4. Madigan M.T., Martinko M. J. and Parker, J. 2003. Brock Biology of microorganisms. Pearson education., New Jersey.
5. Parte, A. (2012). Bergey's Manual of Systematic Bacteriology: Volume 5: The Actinobacteria. United Kingdom: Springer New York.
6. Pelczar, (Jr.) M. J., Chan, E. C. S. and Kreig, N. R.1993. Microbiology. McGraw Hill, New York Perry, J.J. and Staley, J.T. 1997. Microbiology. Dynamics and Diversity. 4th edn. Wesley Longman pub. New York

Model Question paper

SECOND SEMESTER MSc. DEGREE EXAMINATIONS 2023
Elective Course in Microbiology
MSMBG02E02 – Microbial Taxonomy and Systematics

Time : 3 Hrs.

Max. Marks : 40

Section A

Answer any five questions. Each question carries 2 marks

1. Define Dendrogram
2. Recall the morphological characteristics of eubacteria
3. Explain food reserve in algae
4. Explain flagellates
5. Write on serotyping
6. what are sac fungi?

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

6. Describe the DNA hybridization techniques used to differentiate bacteria
7. Explain the difference between Phenetic and phylogenetic classification
8. Compare and construct the differences between bacteria and mycoplasmas
9. Explain briefly on slime Molds.
10. Briefly explain the morphological features of protozoa
11. Discuss on numerical taxonomy and its applications

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. write a note on Bergey's manual of systematic bacteriology
13. Discuss in detail on classification of fungi
14. Explain in detail on groups of archaebacteria. Add a note on their significance
15. Mention major criteria used in microbial taxonomy
16. Write in detail on classification of protozoa with suitable example

(3X 6 = 18 Marks)

ELECTIVE COURSE III: ENZYMOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	MSMBG02E03	4	4	3

COURSE OUTCOME

CO1 : Understand the classification, structure, mode of action and purification of enzymes

CO2 : Explain the kinetics and inhibition of enzyme action

CO3 : Understand general mechanism of enzyme action

CO4 : Understand enzyme regulation and enzyme engineering

UNIT I :

An introduction to enzymes: classification and nomenclature, enzyme structure, functions and purification. Specificity of enzyme action. Model of enzyme activity.

(15Hrs)

UNIT II :

Enzyme kinetics: single substrate – single intermediate, Michaelis – Menten and Briggs – Haldane kinetics, Lineweaver – Burk equation, graphical analysis of kinetic data, determination of K_m and V_{max} . Enzyme inhibition: Mechanism and rate studies, degree of enzyme inhibition; competitive, non-competitive and uncompetitive inhibition. Factors affecting enzyme activity.

(15 Hrs)

UNIT III:

Mechanism of enzyme action: catalytic strategies, covalent catalysis, mechanism of chymotrypsin, metal ion catalysis, central acid base catalysis, catalysis by approximation

(15 Hrs)

UNIT IV:

Enzyme regulation: allosteric regulation, isoenzymes, zymogen activation, reversible covalent modifications, feedback inhibition, Cooperativity; MWC and sequential model of allosteric enzymes. Enzyme engineering: principles and applications

(15Hrs)

Books for Reference

1. Enzyme Science and Engineering. 1." Enzyme Technology: Pacemaker of Biotechnology" by Prasad N K. ...
2. Enzymology and Enzyme Technology. 1." Enzymology and Enzyme Technology" by Bhatt S M. ...
3. Enzymes and Coenzymes. 1." Introduction to Enzyme and Coenzyme Chemistry" by T D H Bugg.
4. Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins Paperback – 11 November 1999 by Lewis Stevens (Author), Nicholas Price (Author)
5. Enzymology and Molecular Biology of Carbonyl Metabolism 7: 463 (Advances in Experimental Medicine and Biology) Paperback – Import, 24 October 2012 by Henry Weiner (Editor), Edmund Maser (Editor), David W. Crabb (Editor), Ronald Lindahl (Editor)
6. Enzymology and Enzyme Technology Kindle Edition by Bhatt S. M. (Author) Format: Kindle Edition

Model Question paper

SECOND SEMESTER MSc. DEGREE EXAMINATIONS 2023

Elective Course in Microbiology

MSMBG02E03 – Enzymology

Time : 3 Hrs.

Max. Marks : 40

Section A

Answer any five questions. Each question carries 2 marks

1. Recall the classification of enzymes
2. Write on the specificity of enzyme action
3. What is cooperativity
4. Explain model of enzyme activity
5. Explain Lineweaver – Burk equation
6. Explain Km

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Illustrate the Michaelis- Menten Kinetics of enzyme action
8. Explain in detail on enzyme inhibition
9. Elaborate the mechanism of chymotrypsin
10. Explain sequential model of allosteric enzymes
11. Discuss the purification of enzymes

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Discuss the regulation mechanism of allosteric enzymes
13. Discuss the principles and applications of enzyme engineering
14. Explain central acid base catalysis
15. Discuss factors affecting enzyme activity
16. Discuss metal ion catalysis

(3X 6 = 18 Marks)

SEMESTER III

CORE COURSE XIII : MEDICAL MICROBIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03C13	4	3	3

COURSE OUTCOME

- CO1: Understand the general aspects of medical microbiology and infections.**
- CO2: Understand the details of diseases caused by important human bacterial pathogens.**
- CO3: Gain knowledge in various diseases caused by important viral pathogens.**
- CO4: Understand the diseases caused by important fungi and protozoans.**

UNIT I :

Infections – classification, sources, mode of transmission, Factors predisposing to microbial pathogenicity. Study on major infectious diseases caused by bacteria- Morphology, culture biochemical characters, pathogenicity, epidemiology, laboratory diagnosis, treatment and prophylaxis of *Staphylococcus aureus*, *Streptococcus pyogenes*, *Neisseria meningitides*, *Haemophilus influenzae*, *Corynebacterium diphtheriae*, *Bordetella pertussis*, *Mycoplasma pneumoniae*

(15 Hrs)

UNIT II :

Study on major infectious diseases caused by bacteria- Morphology, culture, biochemical characters, pathogenicity, epidemiology laboratory diagnosis, treatment and prophylaxis of *Bacillus anthracis*, *Clostridium tetani*, *Clostridium perfringens*, *Mycobacterium tuberculosis*, *Mycobacterium leprae*, *Yersinia pestis*, *Rickettsia prowazekii*, *Salmonella typhi*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Chlamydiae trachomatis*, *Treponema palladium*, *Leptospira interrogans*, *Helicobacter pylori*, *Vibrio cholerae* and *Campylobacter jejuni* and *Acinetobacter baumannii*.

(15 Hrs)

Unit III :

Properties, clinical importance, pathogenesis, symptoms, laboratory diagnosis, treatment, epidemiology & prophylaxis of diseases caused by viruses -Rabies, chikungunya, Variola, Vaccinia, Herpes- Varicella Zoster, Herpes Zoster, Adeno, Dengue, Hepatitis B and C, West Nile fever, Ebola virus, Polio, Mumps, Measles and HIV, Epstein Barr Virus. Emerging viral infections- Nipah, Zika, HINI, Swine flu, Avian flu, SARS CoV 2, West Nile fever.

(15 Hrs)

Unit IV :

Classification of Mycoses in man, superficial mycoses – surface and cutaneous mycoses, Deep mycoses – subcutaneous and systemic mycoses, pathogenesis, clinical aspects, lab diagnosis, treatment and prophylaxis of fungal infections. Opportunistic fungal infections.

Life cycle and pathogenesis of important Protozoan diseases- Amoebiasis, Malaria, Trypanosomiasis and Leishmaniasis. Clinical importance of Giardia, Trichomonas, Toxoplasma, Cryptosporidium.

(15 Hrs)

REFERENCES

1. Ananthanarayan, R., and Paniker, C.K.J. (2006). Textbook of microbiology (Orient Blackswan)
2. Greenwood, D., Slack, R.C.B., Peutherer, J.F., and Barer, M.R. (2007). *Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control*. Elsevier Health Sciences UK.
3. Topley, W.W.C., Wilson, G.S., Parker, T., and Collier, L.H. (1990). *Topley and Wilson's Principles of Bacteriology, Virology and Immunology* (Edward Arnold).
4. Ananthanarayan, R., and Paniker, C.K.J. (2006). *Textbook of microbiology* (Orient Blackswan)
5. Mackie, T.J., McCartney, J.E., and Collee, J.G. (1989). *Mackie & McCartney practical medical microbiology*. Churchill Livingstone,
6. Wilson's principles of bacteriology, virology and immunology. Edward Arnold.
7. Mukherjee, K.L. (2010) Medical Laboratory Technology. Tata McGraw-Hill Education.
8. Forbes, B.A., Sahm, D.F., Weissfeld, A.S., and Bailey, W.R.D.m. (2007). *Bailey & Scott's diagnostic microbiology*. Elsevier, Mosby, London.
9. Fraenkel-Conrat, H., and Wagner, R.R. (1974). *Comprehensive virology* (New York, Plenum Press).
10. Kucera, L.S., and Myrvik, Q.N. (1985). *Fundamentals of medical virology* (Lea &Febiger, Philadelphia)
11. Molyneux, D.H., and Ashford, R.W. (1983). *The biology of Trypanosoma and Leishmania, parasites of man and domestic animals* (New York, International Publications Service)
12. Garraway, M.O., and Evans, R.C. (1991). *Fungal nutrition and physiology* (Malabar, FL, Krieger Pub. Co.)
13. Fields, B.N., Knipe, D.M., and Howley, P.M. (2007). *Fields virology*, 5th edn (Philadelphia, Wolters Kluwer Health/Lippincott Williams & Wilkins)
14. Emmons, C.W. (1977). *Medical mycology* (Philadelphia, Lea &Febiger)
15. Rippon, J.W. (1988). *Medical mycology: the pathogenic fungi and the pathogenic actinomycetes*, (Saunders, Philadelphia)
16. Chatterjee, K.D. (2009). *Parasitology* (CBS Publishers & Distributors)

Section A

Answer any five questions. Each question carries 2 marks

1. Recall the names of diseases caused by Staphylococcus aureus
2. Write on MRSA
3. Write the morphology of *Vibrio cholerae*
4. Explain on the treatment of Tuberculosis
5. Write on prevention of malaria
6. Recall the treatment of dengue

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Summarize various infections caused by streptococcus
8. List the laboratory diagnostic methods in HIV
9. Write on methods of control of typhoid
10. Write on the disease Anthrax
11. Write on epidemiology of polio

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Illustrate various diseases caused by hepatitis virus
13. Explain the pathogenicity and clinical features of leptospirosis
14. Comment on the various disease caused by *E. coli*
15. Discuss the pathogenicity, treatment and diagnosis of Rickettsial infections
16. Explain the pathogenicity and life cycle of malaria

(3X 6 = 18 Marks)

**CORE COURSE XIV : INDUSTRIAL MICROBIOLOGY AND
BIOINSTRUMENTATION**

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03C14	3	3	3

COURSE OUTCOME

- CO1: Familiarize important instruments used in bioprocessing**
- CO2: Understand knowledge about various types of fermentation and understand the procedures involved in isolation and purification of products**
- CO3: Understand various downstream processes in industry**
- CO4: Apply knowledge in the production of industrially important compounds**

UNIT I :

Instruments and techniques for bioprocessing- Centrifugation, filtration, sedimentation, sonication, electrophoresis, chromatography, evaporation, distillation, freeze drying, crystallisation – Principle, procedure and applications

(10 Hrs)

Unit II :

Fermentation: an overview, Upstream processing - isolation, screening, selection & improvement of industrially important microorganisms, Sterilization of media, equipments & air. Media formulation, preparation of inoculum. Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch and continuous fermentations. Preservation: types of preservation, principle and mechanisms; Bioreactors, design and components of fermenter and types. scale up of bioprocess, automation and monitoring

(12 Hrs)

Unit III :

Downstream processing- Purification of extracellular & intracellular products - cell disruption, solvent extraction, Drying, filtration, Centrifugation, sedimentation, Chromatography, electrophoresis, Freeze drying, distillation, crystallization, packaging & transport. Cell and enzyme immobilization, waste management in bioprocess, hygiene and safety in fermentation industries.

(12 Hrs)

UNIT IV :

Pharmaceutical and industrial products: Antibiotic fermentations – production of beta lactam antibiotics - penicillins, and cephalosporins, amino-glycosides -streptomycin, macrolides - Erythromycin. Production of proteins in bacteria and Yeast - Chymosin production. Organic acids – production and applications of citric acid, lactic acid, acetic acid. Production of industrial alcohol, acetone-butanol fermentation. Enzymes -amylase, and protease)

(11 Hrs)

Books for Reference

1. Sankaranarayanan, A., Amaresan, N. and D. Dhanasekaran (2020). Fermented Food Products. CRC Press, Taylor & Francis Group, New York, USA.
2. Patel, AH. (2011). Industrial Microbiology, Macmillan India Ltd, 2nd Edition.
3. Stanbur, PF, Whitaker, A. (2008). Principles of fermentation technology, 2nd Edition, Pergamon Press, New York.
4. Cruegar W, and Cruegar A. (1990). Biotechnology: A text book of Industrial Microbiology, 2nd Edition, Sinauer Associates, Inc., Sunderland, Massachusetts.
5. Modern Industrial Microbiology and Biotechnology (2007) by Nduka Okafor. Published by Science Publishers, Enfield, NH, USA
6. Practical Fermentation Technology Edited by Brian McNeil and Linda M. Harvey 2008 John Wiley & Sons, Ltd. ISBN: 978-0-470-01434-9
7. Industrial Microbiology: An Introduction (2001); Michael J. Waites, Neil L. Morgan, John S. Rockey & Gary Higton
8. Bioprocess Engineering Principles by Pauline M. Doran (1995), Elsevier Science & Technology Books, ISBN: 0122208552 12
9. Basic Biotechnology 2nd Ed. (2001); Colin Ratledge and Bjorn Kristiansen. Cambridge University Press.
10. Bioreaction Engineering Principles 3rd Ed. (2011); John Villadsen, Jens Nielsen, Gunnar Lide'n, Springer
11. Industrial Microbiology by Casida. LE, New age International (P) Limited, Publishers.
12. Industrial Microbiology by Prescott & Dunns, AVI Publishing Company Inc.
13. Principles of Fermentation Technology by P.F. Stanbury, A. Whitaker and S.J. Hall, Butterworth Heineman, Aditya Books (P) Ltd.
14. Batch Fermentation Modeling: Monitoring, and Control. Authors: Ali Cinar; Satish J. Parulekar; Cenk Undey

Model Question Paper

THIRD SEMESTER MSc. DEGREE EXAMINATIONS 2023
Core Course in Microbiology
MSMBG03C14 – Industrial Microbiology and
Bioinstrumentation

Time: 3 Hrs.

Maximum marks: 40

A Part

Answer any **five** questions. Each question carries **two** marks

1. Differentiate between batch culture and fed batch culture.
2. Define freeze drying.
3. Write a note automation of fermentation process.
4. Define enzyme immobilization.
5. What is acetone butanol fermentation?
6. Write a short note microbial protease.

(5 × 2 = 10 Marks)

B Part

Answer any **three** questions. Each question carries **four** marks

7. Give an account on crystallisation.
8. Explain the sterilisation of air and media in fermentation process.
9. Inspect the principles of electrophoresis.
10. What are beta lactam antibiotics? Describe the producer strain and recovery process.
11. Outline the production of chymosin.

(3 × 4 = 12 Marks)

C Part

Answer any **three** questions. Each question carries **six** marks

12. What is filtration? Outline the various types of filtration used in bioprocess.
13. Explain the major approaches used for the preservation of microbial cultures for bioprocess.
14. Give an account on the industrial production of benzyl penicillin.
15. Investigate the steps involved in the industrial production of citric acid.
16. Elaborate the waste management in bioprocess with the major approaches.

(3 × 6 = 18 Marks)

CORE COURSE XV :
ENVIRONMENTAL AND SANITATION MICROBIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03C15	3	3	3

COURSE OUTCOME

- CO1: Understand the compositions of microorganisms and familiarise various interactions among soil microorganisms, their role in biogeochemical cycles and nutrient fixation**
- CO2: Analyse the composition, sources and factors involved in the distribution of microorganisms in air and water**
- CO3: Apply various microbiological techniques to sanitise the air and water as per the standards**
- CO4: Investigate the role of microbial techniques in bioremediation and bioleaching**

UNIT I :

Soil Microbiology: Soil structure, Humus, Microbial composition of soil, Microbial interactions in soil-Positive and negative interactions- Mutualism, commensalisms, antagonism, synergism and proto cooperation, predation, parasitism, competition, antibiosis. Biogeochemical cycles- Nitrogen, Carbon, Sulphur, Phosphorous- Role of microorganisms in each cycle. Biological nitrogen fixation-Symbiotic, non symbiotics, associate symbiotic with examples, Mechanism of nitrogen fixation. Nitrogenase enzyme and subunits.

(10 Hrs)

UNIT II :

Air Microbiology: Microbial composition of air, sources of microorganisms in air, factors influencing the presence of microorganisms in air, Airborne-microbial infections, microbiological sampling of air, Air sampling devices- principle and working, merits and demerits of each air sampler.

Aquatic Microbiology: Types of aquatic ecosystems, various zones and microbial distributions in aquatic environment, Factors affecting the distribution of microorganism in aquatic environment-physical, chemical and biological. Algal blooms & eutrophication- relevant examples, impact of eutrophication in aquatic ecosystem. waterborne-microbial infections.

(12 Hrs)

UNIT III :

Sanitation Microbiology: Introduction, need and scope of environmental sanitation, Overview of United Nations Sustainable Development Goals- Importance of sanitation. Sanitation of Air, Air sanitation methods and systems. Air sanitation methods in hospitals, surgical theatres, laboratories, industries, indoors and outdoors. Air quality standards-International and National standards. Water sanitation-Drinking water- sources and supplies, Indicator microorganisms, Water purification methods, microbiological examination of water – conventional and advanced methods. Waste water- DO, COD, BOD, treatment methods- Physico chemical, Biological and advanced treatment methods.

(12 Hrs)

UNIT IV :

Soil sanitation: Role of organisms in municipal solid waste management. Bioremediation- *Ex situ* and *in situ* strategies, Myco and phytoremediation. GMOs in bioremediation, Composting and Vermicomposting, Methanogenesis and Biogas production, Bioleaching- Overview, role of microorganisms in the recovery of metals, Bioleaching of copper, sulphur and uranium. Biofilms - steps in biofilm formation, maturation and release.

(11 Hrs)

Books for Reference

1. Ronald M. Atlas. Principles of Microbiology, Mosby
2. Michael J Pelczar, ECS Chan, Noel R Krieg. Microbiology: Concepts and Applications, McGraw-Hill.
3. Richard Bartha, Ronald M Atlas. Microbial Ecology: Fundamentals & Applications, Benjamin/Cummings
4. Ian Pepper, Raina M Maier, Charles P Gerba. Environmental Microbiology, Academic Press.
5. Eugene L. Madsen. Environmental Microbiology: From Genomes to Biogeochemistry
6. David L. Kirchman. Processes in Microbial Ecology, John Wiley & Sons.
7. Eldor Paul. Soil Microbiology, Ecology and Biochemistry, Academic Press.

MODEL QUESTION PAPER

MSMBG03C15: ENVIRONMENTAL AND SANITATION

MICROBIOLOGY

Time: 3 hours

Maximum: 40 Marks

PART A

Answer any **FIVE** questions. Each question carries 2 Marks

1. Define humus.
2. What do you mean eutrophication?
3. Inspect the salient features of indicator microorganisms?
4. Describe syntrophism.
5. What do you mean by air quality index?
6. Differentiate between droplet and droplet nuclei.

(5 × 2=10 marks)

PART B

Answer any **THREE** questions. Each question carries 4 Marks

7. Illustrate sulphur cycle and extend a note on the applications of microorganisms in sulphur cycle.
8. Elaborate the mechanism of nitrogen fixation with the special emphasis on the role and structure of nitrogenase enzyme complex.
9. Outline various water-borne diseases with suitable examples.
10. Examine major steps and microbiological process involved in the sanitation of air in hospitals, surgical theatres and microbiology laboratories.
11. Investigate various step involved in biofilm formation and extend a note on the role of microbial biofilm in bioleaching.

(3 × 4=12 marks)

PART C

Answer any **THREE** questions. Each question carries 6 Marks

12. Investigate various types of negative interactions found among microorganisms in soil with suitable examples.
13. Outline the process of bacteriological quality testing of drinking water with a special emphasis on most probable number and membrane filter techniques.
14. What are air samplers? Describe briefly. Critically outline the merits and demerits of various air sampling devices.
15. Classify bioremediation. Narrate the applications of genetically engineered microorganisms in the bioremediation of oil spills and aquatic environments.
16. What are SDGs? Critically discuss the role of sanitation microbiology to promote the SDGs?

(3 × 6=18 marks)

CORE COURSE XVI : BIOSTATISTICS AND RESEARCH METHODOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03C16	3	3	3

COURSE OUTCOME

CO1: Understand basics concepts of Biostatistics

CO2: Understand the methods and tools in biostatistics

CO3: Understand the basic concepts in research

CO4: Understand the basic techniques in research and develop research writing skills

UNIT I :

Introduction to Biostatistics. Scope of Biostatistics, probability and probability distribution analysis. Variables in biology- collection, classification and tabulation of data- graphical and diagrammatic representation- scatter diagrams, histograms- frequency polygon- frequency curve-logarithmic curves. Descriptive statistics- measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic mean. Measures of dispersion, standard deviation, standard error, variance, coefficient of variation. Correlation and Regression

(11 Hrs)

UNIT II :

Test of significance. Basic idea of significance test- hypothesis testing, levels of significance. Testing of single mean, double mean, single proportion, double proportion in large sample. Testing of single mean, double mean in small samples. ANOVA- One way and Two way; Chi-square test of goodness of fit and Chi-square test of independence, comparison of means of two samples, three or more samples. Fundamentals of field experiments- randomization, replication and local control. CRD and RBD. Statistical packages

(12 Hrs)

UNIT III :

Meaning and Objective of research, features of a good research study, Scientific method. Study designs and variations: basic, applied, historical, exploratory, experimental, ex-post facto, case study, diagnostic research, crossover design, case control design, cohort study design, multifactorial design. Hypothesis, theory and scientific law: development, structure, conditions, sources, formulation, explanation of hypothesis; structure, identification, elements, classification, functions of theory; scientific laws and principles. Sampling frame, importance of probability sampling, simple random sampling, systematic sampling, stratified random

sampling, cluster sampling, problems due to unintended sampling, ecological and statistical population in the laboratory. Variables: nominal, ordinal, discontinuous, continuous, derived
(10 Hrs)

Unit IV :

Methods and techniques of data collection: types of data Methods of primary data collection- observation/ experimentation/ questionnaire/ interviewing/case/pilot study methods of secondary data collection- internal/ external, schedule method.

Experimental data collection and data processing operations- Editing, coding, Classification, Tabulation & Types of Tables. Challenges in Data Processing

Report writing- types of research reports, guidelines for writing a report, report format, & Citations, plagiarism and plagiarism detection softwares

(12Hrs)

Books for Reference

1. Principles of Biostatistics: Marcello Pagano, Kimberlee Gauvreau, Duxbury Press
2. Fundamentals of Biostatistics: Irfan. A. khan, Atiya Khanum, Ukaaz publications
3. Statistical methods in Biology- Briley N.J.T
4. Introduction to Biophysics-Sokal R.R & Rohl F.J
5. Biostatistics: Pardeep. K. Jasra, Gurdeep Raj, Krishna Prakashan Media. (P) Ltd
6. Kothari, C.R., 1985, Research Methodology- Methods and Techniques, New Delhi, Wiley Eastern Limited
7. Kumar, R., 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed.), Singapore, Pearson Education.
8. Fundamental of Research Methodology and Statistics – Yogesh Kumar Singh

Model Question Paper

THIRD SEMESTER MSc. DEGREE EXAMINATIONS 2024

Core Course in Microbiology

MSMBG03C16 – Biostatistics and Research Methodology

Time : 3 Hrs.

Max. Marks : 40

Section A

Answer any five questions. Each question carries 2 marks

1. Define standard error.
2. Write on dispersion.
3. Describe chi-square test.
4. Explain systematic sampling.
5. What is discontinuous variable?
6. Recall the plagiarism detection software.

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Summarize various methods used for the representation of the data.
8. List the steps involved in probability sampling.
9. Write a sort note on one way and Two-way ANOVA
10. Describe the challenges in data processing.
11. Write on the guidelines for writing a report.

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Illustrate various methods used for measures of central tendency.
13. Explain the significance of Chi-square test of independence.
14. Comment on cohort study design with appropriate examples.
15. Outline the major types of variables with examples.
16. Investigate the major methods and techniques of data collection with relevant examples.

(3X 6 = 18 Marks)

CORE COURSE XVII PRACTICAL: V

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03C17	4	2	3

MEDICAL MICROBIOLOGY

1. Isolation of the normal bacterial flora of human body
2. Collection and processing of clinical specimens
3. Isolation and identification of bacteria from clinical samples (urine, sputum, pus and blood)
4. Antibiotic sensitivity testing by Kirby Bauer method
5. Isolation and identification of fungal pathogens from different samples (skin, nail and hair)
6. Germ tube test
7. Identification of parasites from clinical samples (blood and stool)
8. Serodiagnosis – VDRL, RPR, ASO, CRP, WIDAL-slide and tube test, HIV ELISA, HIV Western blotting

REFERENCES

1. Medical Laboratory Manual for Tropical Countries Vol.2 Monica Cheesbrough ELBS, 2009
2. Mackie & McCartney Practical Medical Microbiology Churchill Livingstone, 1996

CORE COURSE XVIII PRACTICAL: VI

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03C18	4	2	3

INDUSTRIAL MICROBIOLOGY AND ENVIRONMENTAL MICROBIOLOGY

1. Bacteriological examination of water – MPN, MF, SPC
2. Estimation of DO, COD and BOD
3. Demonstration of antibiosis – crowded plate technique
4. Enumeration of microorganisms in air and water
5. Isolation of cellulose degrading bacteria
6. Isolation of amylase and protease producing organisms
7. Isolation of caseinase, lipase producing bacteria
8. Immobilization of yeast cells
9. Production of ethanol
10. Estimation of ethanol

REFERENCES

Industrial microbiology

1. "Industrial Microbiology: An Introduction" by Michael J. Waites, Neil L. Morgan, John S. Rockey, and Gary Higton
2. "Manual of Industrial Microbiology and Biotechnology" edited by Richard H. Baltz, Julian E. Davies, and Arnold L. Demain
3. "Biotechnology: A Textbook of Industrial Microbiology" by Wulf Crueger and Anneliese Crueger
4. "Fermentation Microbiology and Biotechnology" edited by E.M.T. El-Mansi, C.F.A. Bryce, Arnold L. Demain, and A.R. Allman
5. "Microbial Biotechnology: Fundamentals of Applied Microbiology" by Alexander N. Glazer and Hiroshi Nikaido

Environmental Microbiology

1. "Environmental Microbiology" by Ian L. Pepper, Charles P. Gerba, and Terry J. Gentry
2. "Environmental Microbiology: Fundamentals and Applications" by Jean-Claude Bertrand, Pierre Caumette, Philippe Lebaron, Robert Matheron, Philippe Normand, and Thomas Sime-Ngando
3. "Manual of Environmental Microbiology" edited by Marylynn V. Yates, Christine H. Nakatsu, Robert V. Miller, and Suresh D. Pillai
4. "Environmental Biotechnology: Principles and Applications" by Bruce E. Rittmann and Perry L. McCarty
5. "Microbial Ecology: Fundamentals and Applications" by Ronald M. Atlas and Richard Bartha

OPEN ELECTIVE COURSE I : SKILL DEVELOPMENT AND ENTREPRENEURSHIP

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03O01	4	4	3

COURSE OUTCOME

- CO1: Understand the concept of entrepreneurship, Idea generation, Feasibility Study and opportunity assessment and Business Plan**
- CO2: Understand the difference between start-ups and MSMEs and different agencies supporting entrepreneurship**
- CO3: Understand the difference between start-ups and MSMEs and different agencies supporting entrepreneurship.**
- CO4: Gain direct exposure to an enterprise project.**

UNIT I :

Entrepreneurship: Concept and Functions, An entrepreneur: Types of Entrepreneurs, Competencies and Characteristics, Entrepreneurial Values, Difference between startups and MSMEs. NISP (NATIONAL INNOVATION AND STARTUP POLICY), Brief Insight into National Innovation Foundation (NIF), MoES Innovation Council (MIC), Kerala start-up mission, IEDC.

(15 Hrs)

UNIT II :

Edible mushrooms and poisonous mushrooms, common Indian mushrooms, Nutritional value and medicinal value. Morphology, structure (Agaricus) and distribution. Cultivation – Paddy straw mushroom and Oyster Mushrooms – substrate, spawn making, method of cultivation – bed method, polythene bag method and field cultivation, Pretreatment of substrate. Processing – blanching, steeping, sun drying, canning, pickling, freeze drying. Production level, economic return, foreign exchange from mushroom cultivating countries and international trade.

(15 Hrs)

UNIT III :

History of fermented foods- microorganisms involved in fermentation- advantages of fermented foods. Fermented foods- bread, cheese, yoghurt, soy sauce -brief account on raw materials, organism involved- starter culture, steps in production. Fermented beverages- wine, beer brief account on raw materials, organism involved- starter culture, steps in production. Types of wine.

(15 Hrs)

UNIT IV :

Biofertilizer production – introduction, importance of biofertilizer, different microorganism used- isolation and strain improvement. Production of rhizobium, phosphate solubilizers, Azolla cultivation, Biocontrol agents' production – Trichoderma. Field application, storage.

(15Hrs)

Books for Reference

1. Mohanty, Sangram Keshari. Fundamentals of entrepreneurship. PHI Learning Pvt. Ltd., 2005.
2. Kumar, S. Anil. Entrepreneurship development. New Age International, 2008.
3. Jayaraman, Selvaraj, et al. "Microbiology-Based Entrepreneurship." Industrial Microbiology Based Entrepreneurship: Making Money from Microbes. Singapore: Springer Nature Singapore, 2022. 1-9.
4. Text book of fungi – Pandey.B.P
5. Mushroom- the art of cultivation – Harander Singh
6. Vijaya Ramesh K (2007). Food Microbiology. First edition, MJP Publishers, Chennai.
7. Adams MR - Moss (2004). Food Microbiology. Second edition, Panima publishing house New Delhi.
8. BanwartGJ (2004). Basic Food Microbiology. Second edition, CBS Publishers and Distributors, New Delhi.
9. Frazier WC and West Hoff DC (1988). Food Microbiology. Fourth edition, McGraw Hill, New York.

Model Question Paper

THIRD SEMESTER MSc. DEGREE EXAMINATIONS 2024

Open Elective Course in Microbiology

MSMBG03O01 – Skill development and Entrepreneurship

Time : 3 Hrs.

Max. Marks : 40

Section A

Answer any five questions. Each question carries 2 marks

1. Recall the nutritional value of mushrooms
2. Write on the important bacteria used as biofertilizer
3. Write on types of wine
4. Explain on startup mission
5. Write on different poisonous mushrooms
6. Recall the importance of biofertilizer

(5X2=10 Marks)

Section B

Answer any three questions. Each question carries 4 marks

7. Summarize the steps involved in bread production
8. List the raw materials used for mushroom production
9. Write on biocontrol agent production
10. Write on the production of yoghurt
11. Write on NISP

(3X4=12 Marks)

Section C

Answer any three questions. Each question carries 6 Marks

12. Illustrate procedure in mushroom cultivation
13. Explain the cultivation of Azolla
14. Comment on the steps involved in wine production
15. Discuss the production of Rhizobium
16. Explain the steps involved in cheese production

(3X 6 = 18 Marks)

**OPEN ELECTIVE COURSE II : BIODEGRADATION AND WASTE
MANAGEMENT**

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03O02	4	4	3

COURSE OUTCOME

- CO1 : Understand the role of microorganisms in biodegradation**
- CO2 : Understand biological management of biodegradation**
- CO3 : Develop interest in hazardous waste management through microorganisms**
- CO4 : Understand the recovery and reuse of solid waste**

UNIT 1 :

Biodegradation – definition, Microorganism in biodegradation, stages & factors affecting biodegradation. Solid waste- Definition, sources and types. Municipal solid waste- biodegradable and non-biodegradable solid waste, nature and characteristics of solid waste, potential risk of diseases, nuisance and hazardous solid waste.

(15Hrs)

UNIT II :

Solid waste management: need and importance. Different methods of solid waste disposal- land fill, composting in detail- aerobic and anaerobic composting. Vermicomposting and biogas production.

(15 Hrs)

UNIT III :

Hazardous waste management - definition, characteristics, sources and types of hazardous waste. Biomedical waste management- definition, sources, generation, segregation and storage of biomedical waste, packaging, handling and transport of biomedical waste, treatment and disposal techniques.

(15 Hrs)

UNIT IV :

Recovery and reuse of solid waste- biodiesel production, Industrial production of bioethanol- raw material and microorganism used, upstream and downstream process. Plastic degradation- various strategies, role of aerobic and anaerobic microorganisms, saprophytes, thermophilic bacteria, role of microbial consortia, biohydrogen production.

(15 Hrs)

Books for Reference

1. Environmental Microbiology- Ian L Pepper , Raina M Maier, Charles P Gerba
2. Microbiology : Michael.J.Pelczar, E.C.S Chan, Noel.R.Krieg
3. Hand book of Environmental Microbiology -Volume I, II and III- S C Bhatia
4. Microbial Ecology : Fundamentals & Applications- Richard Bartha, Ronald M Atlas
5. Prescott, Harley,and Kleins Microbiology- Prescott
6. Applied microbiology by Sanjay Saxena

Model Question Paper

III SEM M Sc DEGREE EXAMINATION

BIODEGRADATION AND WASTE MANAGEMENT

Time: 3 Hrs

Max marks: 40

SECTION A

Answer any 5 questions. Each question carries 2 marks (5x2=10)

- 1) Hazardous waste
- 2) Thermophilic bacteria
- 3) Composting
- 4) Methanogenesis
- 5) Characteristics of solid waste
- 6) Bioremediation

SECTION B

Answer any 3 questions. Each question carries 4 marks (3x4=12)

- 7) Explain vermicomposting methods and various strategies
- 8) Note on bio hydrogen production
- 9) Write a detailed note on potential risk of disease caused by solid waste
- 10) Explain treatment and disposal technique of biomedical waste
- 11) Define solid waste and its source and types
- 12)

SECTION C

Answer any 3 questions. Each question carries 6 marks (3x6=18)

- 12) Explain Industrial production of bioethanol
- 13) Write a detailed note on plastic degradation
- 14) Explain Microorganisms involved in biodegradation, stages and factors effecting biodegradation
- 15) Write a note on biomedical waste management
- 16) Explain composting in detail

**OPEN ELECTIVE COURSE III : NANOTECHNOLOGY IN BIOLOGICAL
SCIENCE**

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	MSMBG03O03	4	4	3

COURSE OUTCOME

- CO1 : Understand the structure and properties of nanomaterials and its functions**
- CO2 : Understand the methods for synthesis and characterization of nanostructures**
- CO3 : Understand the basic concepts of bionanomolecules and its applications**
- CO4 : Familiarize biomedical applications of nanotechnology in various fields**

UNIT I :

Introduction to Nanotechnology; Nanoscale structures and functions- Zero dimensional, One dimensional and two-dimensional nanostructures; Properties of nano compounds- Size and shape dependent properties

(15 Hrs)

UNIT II :

Synthesis of nanomaterials-Physical methods, Chemical Methods, Green synthesis of nanomaterials; Biological methods of preparation by bacteria, fungi, algae and plants; Characterization of nanomaterials: Structural and chemical characterization: FTIR, XRD, SEM

(15 Hrs)

UNIT III :

Biomaterial based nanowires; DNA nanotechnology, Protein nanotechnology, Glyconanotechnology and Lipid nanotechnology; Bio nanomachines; Carbon nanotubes and its applications; Nanomaterials as active antibacterial and antibiofilm agents; Mechanism of action of nanoparticles, In vitro methods to study antibacterial and antibiofilm activities of nanomaterials; Nanotoxicology and Genotoxicity

(15 Hrs)

UNIT IV :

Biomedical applications of nanotechnology; Nanotechnology in regenerative medicine; Nanotechnology in cell and tissue engineering; Nanotechnology in cancer diagnosis and therapy; Nanotechnology in Imaging and diagnostics; Nanopharmacology and drug targeting

(15 Hrs)

Books for Reference

1. M.Ferrari, A.P. Lee and J Lee. Biological and Biomedical Nanotechnology. Springer 2016.
2. G.L. Hornyak, J Dutta, H.F. Tibbals and A. K Rao. Introduction to Nanoscience. 2008, Boca Raton , CRC Press.
3. Goodsell, D.S. Bionanotechnology Lessons from Nature. Hoboken, New Jersey: Wiley-Liss, Inc, 2004
4. Encyclopedia of Nanosciences and Nanotechnology, Nalwa H.S Ed. 2004.
5. Malsch, N H, Biomedical Nanotechnology. CRC Press.2005
6. Kumar, C.S. S.R., Homes, J and Leuschner C, Nanofabrication Towards Biomedical applications: Techniques, Tools, Applications and Impact , Wiley – VCH. 2005.

Model Question Paper

III SEMESTER MSc MICROBIOLOGY

MSMBG03O03 : Nanotechnology in Biological Sciences

Time: 3 Hrs

Max Marks: 40

Section A

Answer any five questions, each question carries 2 marks

- 1 AFM for characterization of nanoparticles
 - 2 Zero dimensional nanoparticles
 - 3 Write a note cytotoxicity and genotoxicity of nanoparticles
 - 4 Explain applications of nanotechnology in regenerative medicine
 - 5 Write the importance of targeted drug delivery using nanocomposites
 - 6 Compare chemical and green synthesis methods of preparation of nanoparticles.
- (5X2=10 Marks)**

Section B

Answer any three questions, each question carries 4 marks

- 7 Build your view about cellular uptake of nanoparticles
 - 8 Predict the future of nanotechnology in diagnostics
 - 9 Discuss the structure of carbon nanotubes
 - 10 Construct a model of two dimensional nanomaterial
 - 11 Discuss different optical spectroscopy techniques for characterization of nanoparticles
- (3X4=12 Marks)**

Section C

Answer any three questions, each question carries 6 Marks

- 12 Describe briefly about various properties of nanoparticles.
- 13 Discuss on various strategies for characterization of nanoparticles.
- 14 Explain briefly about synthesis of nanoparticles
- 15 Describe about applications of nanotechnology in cancer treatment and diagnosis
- 16 Explain various methods to study antibacterial and antibiofilm activities of nanoparticles

(6X 3 = 18 Marks)

SEMESTER IV

CORE COURSE XIX: FOOD AND DAIRY MICROBIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	MSMBG04C19	3	2	3

COURSE OUTCOME

- CO1 : Understand general knowledge on various factors affecting microbial spoilage of food**
- CO2 : Understand different types of fermented foods , food spoilage and preservation**
- CO3 : Elaborate different foodborne infections.**
- CO4 : Understand physical and chemical properties of milk and fermented dairy products**

UNIT I :

Detection and enumeration of microorganisms in food, rapid and automated methods, indicator microorganisms and microbiological criteria. Factors affecting microbial growth in food- intrinsic and extrinsic factors, analysis of microbial quality of food, plate count, bio burden analysis, applications of biosensors for food quality control analysis. HACCP and FSO systems in food safety.

(10 Hrs)

UNIT II :

Fermented food products: food fermentations – principles and classification. Starter and nonstarter cultures in food fermentation. Fermentation of wine and beer. Fermented vegetables - sauerkraut, pickle, Fermented cereals – idly, bread. Fermented meat-sausages. Other fermented foods –vinegar, soy sauce, SCP. Mushroom production. Food spoilage and preservation: general principles underlying food spoilage. Spoilage of meat, fish, egg, vegetables, fruits and stored grain. Spoilage at low temperature, spoilage of canned food. Principles of food preservation, physical and chemical methods

(12 Hrs)

UNIT III :

Food borne infections- bacterial, fungal and viral infections. Bacterial infections – Salmonella, Staphylococcus, Listeria, Brucella, Bacillus, Clostridium, Escherichia, Shigella, Vibrio, Yersinia, Campylobacter. Fungal – aflatoxins and ergotism. Viral- hepatitis A & E, bovine spongiform encephalopathy

(10 Hrs)

UNIT IV :

Physical and chemical properties of milk, microbial analysis of milk- MBRT, DMC, SPC, alkaline phosphatase test, resazurin test. Fermented dairy products- Production of fermented

milk (acidophilus milk. Yoghurt), cheese production, types of cheese. Microbial and non-microbial spoilage of milk, preservation methods. Probiotics and prebiotics.

(13Hrs)

Books for Reference

1. James M Jay and Martin J, Loessner and David A Golden. Modern food microbiology seventh edition. Springer. 2005
2. Bibek Ray and Arun K. Bhunia. Fundamental food microbiology. CRC press. 1996
3. Martin R. Adams and Maurice O Moss. Food microbiology. Royal society of chemistry. 2008
4. Frazier, W.C. and Westhoff, D .C. food microbiology 4th Edn. TATA McGraw Hill publishing company ltd., Newdelhi
5. Dairy microbiology- Robinson RK

Model question paper

FOURTH SEMESTER MSc MICROBIOLOGY DEGREE EXAMINATION

MSMBG04C19 - FOOD AND DAIRY MICROBIOLOGY

Time: 3Hrs

Max Marks: 40

SECTION A

Answer five questions. Each question carries two marks

1. Explain the production of sauerkraut
2. MBRT
3. Explain physical and chemical properties of milk
4. ergotism
5. SCP
6. Idly

(5×2=10)

SECTION B

Answer three questions. Each question carries four marks

7. Write down the principles of food preservation
8. Probiotics and prebiotics
9. Microbial spoilage of milk
10. Explain spoilage of canned food
11. Write about bovine spongiform encephalopathy

(3×4=12)

SECTION C

Answer any three questions. Each carries six marks

12. Explain any three food infections caused by bacteria
13. Explain types of cheeses and method of production
14. Physical and chemical methods of food preservation
15. Explain in detail about mushroom production technology
16. Discuss in detail the terms probiotics and prebiotics

(3×6=18)

Core course XX: AGRICULTURAL MICROBIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	MSMBG04C20	3	2	3

COURSE OUTCOME

- CO1: Understand the role of microbes in agriculture**
- CO2: Familiarise microbial resource utilization in crop production and microbial technology in secondary agriculture.**
- CO3: Understand plant disease mechanism, develop the skills to manage applications of microbes for crop protection and productivity.**
- CO4: Understand common plant diseases and their control & get awareness on the impact of chemical fertilizers**

UNIT I :

Microbiology of Soil: Definition and types soil, soil profile and physical characteristics, distribution of microorganisms and its role in soil fertility, Autochthonous, Allochthonous and Zymogenous microbes, quantitative estimation of microorganisms in soil, influence of soil and environmental factors on micro flora, moisture, pH, temperature, organic matter, agronomic practices. Importance of humus. Interrelationships between soil microbes and plants, Rhizosphere concept, R:S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae-types. (11 Hrs)

UNIT II :

Biofertilizers-Definition, types - *Rhizobium*, *Azotobacter*, *Azospirillum*, cyanobacteria. Mass production, mode of applications, advantages and limitations of bacterial inoculants, Novel combination of microbes as biofertilizers, Role of PGPR, *Frankia*, *Azolla-anabaena*, and VAM in agriculture, Microbial transformation of phosphorus, solubilization by phosphobacteria and P- mobilization by mycorrhizal fungi, Microbial transformation of sulphur - sulphur toxicity, Secondary agriculture -Silage, Bio manure and biofuels. (12 Hrs)

UNIT III :

Plant pathogenesis – Mechanism, methods of disease transmission, mode of entry of pathogens, symptoms, plant disease resistance mechanisms (Morphological, functional and protoplasmic resistance), variation in disease resistance, factors affecting disease incidence. Principles and methods of plant disease management, integrated plant disease management. Biopesticides –

Bacillus thuringiensis, *Pseudomonas fluorescens* and *Trichoderma viridae*- Organic farming and its importance in agriculture

(11 Hrs)

UNIT IV :

Phytopathology – Classification of plant diseases, signs and related terminology. Study of symptoms, etiology, epidemiology and management of diseases- Important Microbial disease of plants – Bacterial, fungal, viral – Rice blast, Blight of Paddy, Black stem rust of wheat, Citrus canker, quick wilt of pepper, Bud rot of coconut, abnormal leaf fall of rubber, bud rot of areca nut, coffee rust, Wilt of cotton, Anthracnose of mango, TMV, Vein clearing disease. Plant disease control measures –chemical (Copper, sulphur etc.) and biological (Trichoderma, Pseudomonas) in brief. Adverse effect of chemical agents. Advantages of bio control agents

(11 Hrs)

Books for Reference

1. Subba Rao NS (2004). Soil Microbiology. Fourth edition, Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi.
2. Mishra RR (2004). Soil Microbiology. First edition, CBS Publishers and distributors, New Delhi.
3. Rangaswami G and Mahadevan A (2002). Disease of Crop Plants in India. Fourth edition, PHI Learning (P) Ltd., New Delhi.
4. Rangaswami G and Bagyaraj DJ (2002). Agricultural Microbiology. Second edition, PHI Learning (P) Ltd., New Delhi.
5. Robert, L Tate (1995). Soil Microbiology. First edition, John Wiley and Sons, Inc. New York.
6. R,M, Atlas and Richard Bartha (2000). Microbial Ecology, Fourth edition, An imprint of Addison Wesley Longman, Inc, New York.
7. Objectives in agricultural microbiology – Deepak Kumar Varma
8. Agricultural microbiology and microbial applications – P.C.Trivedi
9. Soil and agricultural microbiology – Umesh Kumar
10. Subha Rao, N. S., 1988. Biofertilizers in Agricultural 2nd ed.Oxford and IBH Pub.Co., New Delhi.

Model Question Paper

FOURTH SEMESTER MSc. DEGREE EXAMINATIONS 2023

Core Course in Microbiology

MSMBG04C20 – AGRICULTURAL MICROBIOLOGY

Time :3 Hrs.

Maximum marks: 40

A Part

Answer any **five** questions. Each question carries **two** marks

1. Give the methods involved in organic farming
2. Distinguish autochthonous and allochthonous microbes
3. How do you make 1% Bordeaux mixture
4. Differentiate Rhizosphere, spermosphere and phyllosphere
5. Give the importance of PGPR and Trichoderma in soil
6. Brief account on *Azolla-Anabaena* association ship and its importance

(5 × 2 = 10)

B Part

Answer any **three** questions. Each question carries **four** marks

7. Explain different types of Mycorrhizae and their importance in agriculture
8. Why is secondary agriculture important? Explain with an example
9. Briefly explain the mechanism of disease resistance in plants
10. Explain classification of plant diseases on the basis of signs and symptoms
11. Give short note on microbes and their role in soil

(3 × 4 = 12)

C Part

Answer any **three** questions. Each question carries **six** marks

12. Explain the importance of biofertilizers used in agriculture. Give details on the production and application of nitrogen fixing biofertilizer.
13. Elaborate on various interrelationships between soil microbes and plants with examples. Give its importance to agriculture
14. Describe the causal organisms, symptoms, etiology and control of following plant diseases
i) Citrus canker ii) Pepper-quick wilt iii) Bud rot of areca nut iv) Coffee rust
15. Elaborate on bio control agents used for management of plant diseases.
16. Explain the microbial inoculants and their applications. Briefly explain the production of *Rhizobium* inoculants

(3 × 6 = 18)

CORE COURSE XXI PRACTICAL: VII

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	MSMBG04C21	4	2	3

FOOD AND DAIRY MICROBIOLOGY

1. MBRT
2. Phosphatase test
3. AMC of milk sample
4. Isolation of bacteria from fish, meat, vegetables, pickles and soft drinks
5. Isolation of fungus from spoiled food, milk, vegetables
6. Isolation of pathogens from packaged foods
7. Mushroom cultivation
8. Wine production
9. Yoghurt production
10. Sauerkraut production

REFERENCES

1. Food Microbiology: A Laboratory Manual, Ahmed E. Yousef, Carolyn Carlstrom, John Wiley & Sons, 05-May-2003
2. Practical Microbiology R.C.Dubey and D.K. Mahaswari 2nd Edition S. Chand & Company Pvt. Ltd. New Delhi, 2002
3. Industrial Microbiology A Laboratory Manual Nupur Mathur& Anuradha Singh Avishkar Publishers and Distributors Jaipur, 2007

CORE COURSE XXII PRACTICAL: VIII

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	MSMBG04C22	4	2	3

AGRICULTURAL MICROBIOLOGY

1. Isolation of Rhizobium / Azotobacter
2. Estimation of R:S ratio and assessment of rhizosphere effect
3. Isolation of bacteria fungi and Actinomycetes from soil
4. Demonstration of heterocyst in cyanobacteria
5. Isolation of phyllosphere microorganisms
6. Identification of common plant pathogens
7. Isolation of phosphate solubilizing organisms from soil
8. Isolation of biocontrol microorganism from soil

REFERENCES

1. Soil Microbiology, Ecology, and Biochemistry by Eldor A. Paul
2. Agricultural Microbiology by G. Rangaswami and D.J. Bagyaraj
3. Plant-Microbe Interactions edited by Gary Stacey and Noel T. Keen
4. Microbial Ecology in Sustainable Agroecosystems edited by T. M. Schmidt and M. F. Leff
5. Microbial Biotechnology in Agriculture and Aquaculture edited by R.C. Ray and O.P. Ward
6. The Rhizosphere: An Ecological Perspective by Zeno Varanini and Paolo Nannipieri
7. "Advances in Agricultural Microbiology" edited by N.S. Subba Rao
8. Principles of Plant-Microbe Interactions: Microbes for Sustainable Agriculture. edited by Ben Lugtenberg
9. Biological Nitrogen Fixation by Frans J. de Bruijn
10. Biofertilizers in Agriculture and Forestry edited by N.S. Subba Rao

ELECTIVE COURSE IV : BIOSAFETY, BIOETHICS AND IPR

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	MSMBG04E04	4	4	3

COURSE OUTCOMES

- CO1: Understand the basic concepts of biosafety**
- CO2: Understanding the regulatory aspects of GMOs**
- CO3: Understand the basic concepts of IPR**
- CO4: Understand patents and its filing**

UNIT I :

Introduction, biosafety issues; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms. Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture.

(15 Hrs)

UNIT II :

Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol. Use of Animals in Research and Testing, and Alternatives for Animals in Research, Animal Cloning, Human Cloning and their Ethical Aspects. Testing of Drugs on Human Volunteers Public and Non-Governmental Organizations (NGOs) Participation in Biosafety and Protection of Biodiversity

(15 Hrs)

UNIT III :

Introduction to Intellectual Property and History. Patents, Trademarks, Copyright, Trade secrets, Industrial Design and Rights, Traditional Knowledge, Geographical Indicators - importance of IPR – patentable and non-patentable – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO), Ethics, Pros and Cons of IP protection.

(15 Hrs)

UNIT IV :

Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement, litigation, case studies, Rights and Duties of patent owner. Agreements and

Treaties: GATT, TRIPS Agreements; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Cooperation Treaty (PCT); Indian Patent Act 1970 & recent amendments. Patenting Living Organisms

(15 Hrs)

Books for Reference:

1. Private Power, Public Law: The Globalization of Intellectual Property Rights By Susan K. Sell Cambridge University Press, 2000
2. Essentials of Intellectual Property: Law, Economics, and Strategy By Alexander I. Poltorak; Paul J. Lerner Wiley, 2011 (2nd edition)
3. Diane O. Fleming, Debra L. Hunt Biological Safety: Principles and Practices, 4th Edition. ASM 2006.

Model Questions

KANNUR UNUERSITY

FOURTH SEMESTER MSc MICROBIOLOGY DEGREE EXAMINATION

MSMBG04E04 – BIOSAFETY, BIOETHICS AND IPR

Time: 3Hrs

Max Marks: 40

SECTION A

Answer five questions. Each question carries two marks

1. Cloning
2. Biohazards
3. Trademark
4. Copy rights
5. Trips
6. Environmental release of GMD (5×2=10)

SECTION B

Answer three questions. Each question carries four marks

7. Explain biosafety guidelines
8. Write a note on intellectual property right
9. Explain the role of institutional biosafety committee
10. Write a short note on importance of IPR
11. GMO application in food agriculture (3×4=12)

SECTION C

Answer any three questions. Each carry six marks

12. Discuss in detail different types of biosafety cabinet used for handling infectious waste
13. Discuss different types of biosafety guidelines at national level
14. Discuss about human Cloning and ethical issue related to it
15. Discuss different treaties, rights and duties of patient owner
16. Explain patent filing

(3×6=18)

ELECTIVE COURSE V: PHARMACEUTICAL MICROBIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	MSMBG04E05	4	4	3

COURSE OUTCOME

- CO1: Understand the role of microorganisms in pharmaceutical industry and drug development strategies using microbes**
- CO2: Analyse the causes and mechanisms of antimicrobial resistance and study the major approaches used to tackle the antimicrobial resistance.**
- CO3: Apply the principles of pharmacokinetics and pharmacodynamics in drug discovery pipelines**
- CO4: Investigate the applications of natural therapeutics from marine microbial origins and the production of drugs from marine microorganisms.**

UNIT I :

Pharmaceutical Microbiology: Introduction, History and scope of pharmaceutical microbiology. Overview of major microorganisms used to produce microbial pharmaceuticals, Major principles, and concepts of microbial pharmaceuticals. Overview of drug discovery and developments in pharmaceutical biotechnology, strategies of lead discovery from microbial origin, types and classification of pharmaceutical products from microbial origin, Control of microorganisms- major principles and methods. Major classes of disinfectants and their mode of action.

(15 Hrs)

UNIT II :

Antibacterial agents: Classification and mode of action. Antibacterials, antifungals, anti-protozoans, antiviral agents. Classification of antibiotics- mode of action of each class with relevant examples, antimicrobial susceptibility testing, major approaches, and techniques. Antimicrobials susceptibility guidelines- ATCC and CLSI guidelines, Introduction to microbial resistance, major types of microbial resistance, emergence of microbial drug resistance-MDR, XDR, PDR. Microbial drug resistance in bacteria- major mechanism of microbial drug resistance, Priority pathogens by WHO-2019, Drug resistant ESKAPE pathogens, drug resistance against last resort antibacterial agents, mechanism of drug resistance, Latest approaches of tackling antimicrobial resistance.

(15 Hrs)

UNIT III :

Introduction to pharmacokinetics, pharmacodynamics, drug potency, safety and efficacy, dose response curve, half-life of drug, Agonists and antagonists, concepts of drug likeliness, ADME and toxicity. Need of pharmacokinetic and pharmacodynamics study. Pharmacokinetics and dynamics of selected drugs against microbial infections- antimalarial agents, antituberculosis agents, antiviral agents.

(15 Hrs)

UNIT IV :

Microbial natural therapeutics: Various class of natural therapeutics from marine bacteria and actinomycetes. Isolation and screening of marine microorganism for natural therapeutics. Marine derived drugs from microbial origin- typical examples. antimicrobial peptides from marine microorganisms. Upstream and downstream processing and large-scale production natural therapeutics from microbial origin. Various phases of clinical trials with marine derived drugs, FDA approval, case studies of marine microbial derived peptides as natural therapeutics.

(15 Hrs)

Reference Books

1. Tim Sandle. Pharmaceutical Microbiology-Essentials for Quality Assurance and Quality Control. Elsevier.
2. Se-Kwon Kim. Marine Pharmacognosy Trends and Applications. Taylor & Francis.
3. Leo M. L. Nollet. Marine Microorganisms-Extraction and Analysis of Bioactive Compounds. CRC Press/Taylor & Francis Group.
4. Rosaleen Anderson, Paul W. Groundwater, Adam Todd, Alan Worsley. Antibacterial Agents-Chemistry, Mode of Action, Mechanisms of Resistance and Clinical Applications. Wiley.
5. Chetan Sharma, Divya Arora, Eric Lichtfouse, Sundeep Jaglan. Pharmaceuticals from Microbes-Impact on Drug Discovery. Springer International Publishing.
6. Ashutosh. Pharmaceutical Microbiology. New Age International (P) Limited.
7. Nobuhiro Fusetani. Drugs from the Sea. Karger
8. Kok-Song Lai, Mihai Mares, Romeo-Teodor Cristina, Swee Hua Erin Lim. Antimicrobial Resistance-A One Health Perspective. IntechOpen.
9. Prahlad Singh Mehra. A Textbook of Pharmaceutical Microbiology. I.K. International Publishing House Pvt. Limited.

Model question Paper

Fourth Semester MSc Microbiology Examination

MSMBG04E05: PHARMACEUTICAL MICROBIOLOGY

Time: **Three** hours

Maximum: **40** Marks

PART A

Answer any **FIVE** questions. Each question carries **2** Marks

1. Describe microbial pharmaceuticals.
2. What do you mean ADMET?
3. Examine the quality controls used in antimicrobial susceptibility testing?
4. Describe dose response curve and drug half-life.
5. What are ESKAPE pathogens?
6. Differentiate between pharmacokinetics and pharmacodynamics.

(5 × 2=10 marks)

PART B

Answer any **THREE** questions. Each question carries **4** Marks

7. Outline the major microorganisms used to produce biopharmaceuticals with their salient features.
8. Elaborate the major methods used for the susceptibility testing of antimicrobial agents?
9. Outline the need and scope of pharmacokinetics and pharmacodynamics studies of drugs against microbial infections.
10. Examine the steps and applications of antimicrobial peptides isolated from marine microorganisms.
11. Inspect the classification and mode of action of antibiotics with appropriate examples.

(3 × 4=12 marks)

PART C

Answer any **THREE** questions. Each question carries **6** Marks

12. Investigate the major principles employed for the control of microorganisms. Extend a note on various types of disinfectants with their mode of action.
13. Illustrate the major mechanisms of antibacterial resistance. Add a short notes on the antibacterials resistance exhibited by the Priority-I pathogens by WHO.
14. Examine the relevance of drug likeliness, ADME and toxicity profiles of the therapeutic agents from microbial origin.
15. Outline various classes of natural therapeutics from marine bacteria and actinomycetes with appropriate examples.
16. Formulates various protocols involved in the upstream and downstream processing and large-scale production natural therapeutic products from microbial origin with relevant examples.

(3 × 6=18 marks)

ELECTIVE COURSE VI : MARINE MICROBIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	MSMBG04E06	4	4	3

COURSE OUTCOMES:

- CO 1: Understand the marine ecosystem and familiarize the structure and various habitats of marine environment.**
- CO 2: Understand the adaptability in marine organisms and microbial pathogens associated with marine environment.**
- CO 3: Comprehend microbial quality of marine foods, marine pollution and its implications**
- CO 4: Understand various applications of marine microbiology**

UNIT I :

Marine Microbial flora: Marine environment –sea, largest biome, benthic & littoral zone, salt pan, mangroves and estuarine microbes, microbial loop – marine microbial community planktons, bacteria, fungi, protozoa. Methods of collection and estimation of marine microbes. (15 Hrs)

UNIT II :

Adaptation in marine microbes: Influence of physical, chemical and biological factors on marine microbes. Survival at extreme environments - starvation - adaptive mechanisms in thermophilic, alkalophilic, osmophilic, barophilic and psychrophilic microorganisms – hyper thermophiles and halophiles, Microbial Diseases of marine environment: Marine food borne pathogens & Water borne pathogens - Aeromonas, Vibrio, Salmonella, Pseudomonas. (15 Hrs)

UNIT III :

Quality assurance in sea foods, Quality standards, role of EIA, EIC, FSSAI, MPEDA Marine Pollution: Human exploitation, effect of climate change on oceans, Microbial indicators of marine pollution and control – algal bloom, biofouling, biocorrosion, biofilms and bioremediation. (15 Hrs)

UNIT IV :

Marine natural products, valuable chemicals, bioactive compounds from marine microorganisms, marine bio-sensor and transgenic marine organisms. Biosurfactants, biopolymers and novel enzymes from marine organisms,

(15 Hrs)

Books for Reference:

1. Prescott LM, Harley JP, & Klein DA (2005) Microbiology (McGraw-Hill, Boston; London) 6th ed
2. Maier RM, Pepper IL, & Gerba CP (2009) Environmental Microbiology (Elsevier Academic Press)
3. Nybakken JW & Bertness MD (2005) Marine biology: an ecological approach (Pearson/Benjamin Cummings)
4. Belkin S & Colwell RR (2006) Oceans And Health: Pathogens In The Marine Environment (Springer Science BusinessMedia)
5. Gal YL, Ulber R, & Antranikian G (2005) Advances in Biochemical Engineering/ Biotechnology Advances in Biochemical Engineering / Biotechnology Series Vol 96. Marine Biotechnology Vol 1 Series
6. Bhakuni DS & Rawat DS (2005) Bioactive Marine Natural Products (Springer)

Model Question Paper

Kannur University

Fourth Semester M.Sc. Microbiology Examination

MSMBGE06: Marine Microbiology

Time : 3 hours

Total marks 40

PART A

Answer any 5 questions; each question carries 2 marks

1. What are the adaptations in extremophiles? Explain the importance of enzymes from marine extremophiles
2. What are estuaries? Describe the characteristics of microbes inhabiting estuaries?
3. What are biosurfactants and list their types? What are the advantages of biosurfactants over the synthetic one?
4. What is a biosensor? What is the use of biosensors in marine microbiology
5. What are the sources of marine pathogens? List the control measures
6. Give a short account of microbial diversity of mangroves

(5X2=10)

PART B

Answer any 3 questions, each question carries 4 marks

7. Evaluate the adaptations in microorganism to survive in marine environment
8. Give an account of marine microbial pathogens.
9. Suggest the various measures that can be implemented to control marine pollution.
10. Analyze the different exploitation activities of human beings on marine environment?
11. "The ocean is the largest of all the biomes on earth" Corroborate the statement

(3X4=12)

PART C

Answer any 3 questions, each question carries 6 marks

12. Explain steps to be taken for food quality assurance of sea foods? Compare the role of EIA, EIC, FSSAI and MPEDA in sea food quality assurance.
13. Write an essay on biofouling. Add a note on biofouling techniques
14. Write notes on marine microbial microflora
15. Explain the pharmaceutical and industrial applications of metabolites from marine microorganisms
16. What is algal bloom? What are the environmental and economic impacts of algal bloom?

(3X6=18)