KANNUR UNIVERSITY

(Abstract)

M.Sc. Microbiology Programme-Scheme, Syllabus, Pattern of Question Papers and Model Question Papers of M.Sc. Microbiology programme(I st & II nd Semester under Choice Based Credit Semester System(in Outcome Based Education System-OBE) in Affiliated Colleges-implemented with effect from 2023 Admission- Orders issued.

ACADEMIC C SECTION

ACAD C/ACAD C1/15340/2023 Dated: 25.08.2023

Read:-1. U.O No. Acad C2/429/2017 Dated 08.09.2020

2. U.O.No. Acad C1/21246/2019 Dated 07.12.2020

3. U.O. No. Acad/C1/21246/2019 Dated 16.02.2023.

4. U.O. No. Acad/C1/21246/2019 Dated 20.04.2023

5. Minutes ofthe meeting of the CSMC& Conveners of Adhoc committee held on 15.06.2023

6. Orders of the Vice Chancellor in the file No. Acad C1/21246/2019 Dated 05.08.2023.

7. U.O. No. Acad/C1/21246/2019 Dated 09.08.2023

8. The Minues of the meeting of the Ad hoc Committee for M.Sc. Microbiology Programme held on 10.08.2023

9. Syllabus of M.Sc. Microbiology Programme (I & II nd Semester) submitted by the Convenor, Ad hoc Committee for Microbiology Programme vide e-mail dated 16.08.2023

ORDER

1. A Curriculum Syllabus Monitoring Committee comprising the members of Syndicate was constituted for the Syllabus revision of U G& P G Programmes in Affiliated Colleges, vide paper read (1) above and as per the recommendation of this Committee in its meeting held on 20.11.2020, constitute a sub Committee to prepare the Regulation for PG programmes in Affiliated Colleges vide paper read (2) above.

2. As the reconstitution of Board of Studies of the University is under the consideration of the Hon'ble Chancellor, and considering the exigency of the matter, Ad hoc Committees were constituted vide paper read (3) above and it has been modified vide paper read (4) above, to revise the Curriculum and Syllabus of PG Programmes in Affiliated Colleges w.e.f 2023-24 academic year.

3. The combined meeting of the Curriculum Syllabus Monitoring Committee & Conveners of Ad hoc committee held on 15.06.2023 at syndicate room discussed in detail the draft Regulation, prepared by the Curriculum Syllabus Monitoring Committee, for the PG programmes under Choice Based Credit and Semester System to be implemented in Affiliated Colleges w. e. f. 2023 admission and proposed the different phases of Syllabus revision process such as subject wise workshop, vide the paper read (5) above.

4. The revised Regulations for Post Graduate Programmes under Choice Based Credit and Semester System (In OBE-Out Come Based Education System) was approved by the Vice-chancellor on 05.08.2023 and implemented w.e.f 2023 Admission vide Paper read (7) above.

5. Subsequently, as per the paper read (8) above, the Ad hoc Committee for M.Sc. Microbiology

programme finalized the Scheme, Syllabus, Pattern of Question Papers and Model Question Papers of M.Sc. Microbiology programme(I st & II nd Semester) to be implemented with effect from 2023 Admission

6. As per the read (9) above, the convenor, Ad hoc Committee for M.Sc. Microbiology programme submitted the finalized copy of Scheme, Syllabus, Pattern of Question Papers and Model Question Papers of M.Sc. Microbiology programme(I st & II nd Semester) for implementation with effect from 2023 Admission.

7. The Vice Chancellor after considering the matter in detail and in exercise of the powers of the Academic Council conferred under section 11(1) Chapter III of Kannur University Act, 1996 and all other enabling provisions read together with ***accorded sanction to implement the Scheme, Syllabus, Pattern of Question Papers and Model Question Papers of M.Sc. Microbiology programme(I st & II nd Semester) under Choice Based Credit Semester System (in OBE-Outcome Based Education System) in Affiliated Colleges under the University with effect from 2023 Admission, subject to report to the Academic Council.***

8. The Scheme, Syllabus, Pattern of Question Papers and Model Question Papers of M.Sc. Microbiology programme under Choice Based Credit and Semester System (in OBE- Outcome Based Education System) in Affiliated Colleges under the University with effect from 2023 Admission is uploaded in the University website.

9. Orders are issued accordingly.

Sd/-
Sajesh Kottambrath
Assistant Registrar1
For REGISTRAR

To:
1. Principals of Affiliated Colleges offering M.Sc. Micro Biology Programme
2. Convenor, Curriulum Syllabus Monitoring Committee.
3. Convenor, Ad hoc Committee for M.Sc. Microbiology programme

Copy To:
1. The Examination Branch (Through PA to CE)
2. PS to VC/ PA to PVC/ PA to R/ PA to FO
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6.SF/DF/FC

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SECTION OFFICER

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

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)

KUCBCSSPG23

Ad-hoc committee

Convener:

Mr. Ramesan. C. K.

Asst. Professor, Dept. of Microbiology Sree Narayana College, Kannur

Members:

1. Dr. Ayana. N

Assistant Professor, Dept. of Microbiology, Sree Narayana College, Kannur

2. Dr. N.V. Vinod

Assistant Professor, Dept. of Microbiology St. Pius Xth College, Rajapuram

3. Dr. Sinosh Skariyachan

Assistant Professor, Dept. of Microbiology St. Pius Xth College, Rajapuram

4. Dr. Vijayan. K.T.V

Assistant Professor, Dept. of Microbiology, Govt. Arts and Science College Kozhinhampara

5. Dr. Robert Antony

Assistant Professor, Dept. of Microbiology, Govt. Arts and Science College Kozhinhampara

6. Mrs. Nimi Narayanan

Assistant Professor, Dept. of Microbiology, Govt. Arts and Science College Kozhinhampara

7. Mrs. Deepthi. K.S

Assistant Professor, Dept. of Microbiology, Govt. Arts and Science College Kozhinhampara

ABOUT THE POST GRADUATE MICROBIOLOGY PROGRAMME

Microorganisms have 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 are 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 course for each paper, 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 are 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

SEMSESTER 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 or at the vacation period the students must undergo internship for not less than 10 days 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 online platforms not less than 15 hours duration. 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, Beijerink 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. Jaflrey C Pommerville. Jones and Bartlett Publishers.
4. Brock Biology of microorganisms. Michaelf. 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

1. Illustrate various methods of sterilization by using heat
2. Explain different methods of cultivation of bacteria
3. Comment on the contributions of various scientists in the field of Microbiology
4. Discuss the ultrastructure of bacteria
5. Explain the principle, types and applications of electron microscopy

(3X 6 = 18 Mark)

CORE COURSE II : FUNDAMENTALS OF BIOCHEMISTRY

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

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, agammoglobunemia 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, oratic 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 HRS

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 HRS

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, Hoogstein 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

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 Hoogstein 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
16. Isolation of fungi using suitable media.
17. 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 9
th 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 Manuel 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. Gerhaldt 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 II. 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 B_{12}

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 Manuel 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 Hours)

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 Hours)

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 Hours)

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/softwares/web based tools.

(15 Hours)

Reference Books

1. Xinog J, Essentials of Bioinformatics, Texas A & M University, Cambridge University press. 2006. ISBN: 9780521600828
2. Baxevanis AD, Ouellettee 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.

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

MODULE 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.)

MODULE 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.)

MODULE III

Affinity and avidity; cross reactivity; properties and types of precipitation and agglutination reactions; Immunodiffusion and its types, immunoelectrophoresis; ELISA and it's types;

immunofluorescence; FACS, CFT, RIA, immune electron microscopy, immunohistochemistry, immunoblotting. Antibody array, immunosensors, ELISPOT assay and Cytokine assay immunotherapeutic strategies; vaccine types.

(15 Hrs.)

MODULE 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.)

Reference Books

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.

Model question paper

SECOND SEMESTER MSc. DEGREE EXAMINATIONS 2023
Core Course in Microbiology
MSMBG02C08 – Immunology and Immunotechniques

Time : 3 Hrs. **Max. Marks : 40**

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 hapten. 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

1. 7. Evaluate the role of innate and adaptive immune components in protecting us against an offending pathogen.
2. Suggest the various immunoprophylactic measures currently in use with examples for each type.
3. Suggest the various immunosuppressive therapies currently in use to tackle the graft rejection mechanisms.
4. Analyze the immune responses produced by body against cancerous cells and mechanisms used by cancerous cells to evade the immune system
5. "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

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, Ouellettee 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 01: 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, CO_2 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 metabolism1995, brown publishers
4. Leningers principles of biochemistry, Nelson L D and M M Cox. Macmillion 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 phosphofructoinase-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 Jercy.

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 YoY

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	HOURSPER 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 Km and Vmax. 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)