

Syllabus and Course Scheme

Academic year 2019-20



***B.Sc.- Microbiology
Exam.-2020***

UNIVERSITY OF KOTA

***MBS Marg, Swami Vivekanand Nagar,
Kota - 324 005, Rajasthan, India***

Website: uok.ac.in

B.Sc. -Microbiology Exam. - 2020

Eligibility: 10+2 Science Biology /Agriculture **Scheme of Examination and Courses of Study**

The number of papers and maximum marks for each paper together with the minimum marks required for a pass are shown against each paper separately. It will be necessary for a candidate to pass in the theory papers as well as in practical separately.

First Division 60% of the maximum marks prescribed at part

Second Division 48% I, II and III Examination, taken together.

Rest of the candidates shall be declared to have passed the examination, if they obtain the minimum pass marks in each paper viz. 36%. No division shall be awarded at Part I and Part II Examination.

A candidate may be allowed to appear at the Supplementary examination upto a maximum of two theory papers, provided that she/he has passed in all the practical examination.

A candidate may be allowed grace marks in two theory papers upto the extent of 1% of the total marks prescribed for the examination.

TEACHING AND EXAMINATION SCHEME FOR B.Sc. Microbiology Pt-I Examination

Compulsory paper	Lec Hrs/week	Exam hrs.	Max Marks
BMB – 00 Environmental studies	3	3	50
Core paper (Theory)			
BMB – 01 Principles of microbiology	3	3	50
BMB – 02 Cell Biology and Microbial Genetics	3	3	50
BMB – 03 Biology & Diversity of Microbes	3	3	50
BMB – 04 Fundamentals of Biochemistry	3	3	50
BMB – 05 Fundamentals of Molecular Biology	3	3	50
BMB – 06 Basic Immunology			
Total of Theory Papers			300
Core Paper (Practicals)			
BMB – 07 Principles of microbiology + Cell Biology and Microbial Genetics		3	50
BMB – 08 Biology and Diversity of Microbes + Fundamentals of Biochemistry		3	50

BMB – 09 Fundamentals of Molecular Biology + Basic Immunology	3	50
Total of Practical Papers		150
Grand Total (Theory+ Practicals)		450

B.Sc. Microbiology Pt-II Examination

	Lec Hrs/week	Exam hrs.	Max Marks
Core paper (Theory)			
BMB – 10 Microbial Ecology	3	3	50
BMB – 11 Microbial Physiology and Metabolism	3	3	50
BMB – 12 Medical Microbiology	3	3	50
BMB – 13 Genetic Engineering and rDNA technology	3	3	50
BMB – 14 Food & Dairy Microbiology	3	3	50
BMB – 15 Environmental Microbiology	3	3	50
Total of Theory Papers			300
Core Paper (Practicals)			
BMB – 16 Microbial Ecology+ Microbial Physiology & Metabolism		3	50
BMB – 17 Medical Microbiology+ Genetic Engineering and rDNA technology		3	50
BMB – 18 Food & Dairy Microbiology + Environmental Microbiology		3	50
Total of Practical Papers			150
Grand Total (Theory+ Practicals)			450

B.Sc. Microbiology Pt-III Examination

	Lec Hrs/week	Exam hrs.	Max Marks
Core paper (Theory)			
BMB – 19 Biosafety & IPR	3	3	50
BMB – 20 Soil and Agriculture Microbiology	3	3	50
BMB – 21 Tools and Techniques in Microbiology	3	3	50

BMB – 22 Computer Applications & Biostatistics	3	3	50
BMB – 23 Biophysics and Instrumentation	3	3	50
BMB – 24 Industrial Microbiology	3	3	50
Total of Theory Papers			300
Core Paper (Practicals)			
BMB –25 Biosafety & IPR + Soil and Agriculture Microbiology		3	50
BMB –26 Tools and Techniques in Microbiology+ Computer Applications and Biostatistics		3	50
BMB –27 Biophysics and Instrumentation+ Industrial Microbiology		3	50
Total of Practical Papers			150
Grand Total (Theory+ Practical)			450

The marks secured in the Compulsory paper of Environmental Studies shall not be counted in awarding the division to a candidate.

Maximum of three chances will be given to a candidate to pass compulsory paper.

Non appearing or absent in the Examination of compulsory paper will be counted a chance.

A candidate shall be eligible to appear in supplementary examination in maximum of two Core theory papers as per University Rules.

One percent of the maximum marks may be awarded as Grace Marks to the candidates in accordance to the University Rules as applicable to all other Under Graduate examinations.

Minimum requirement of lectures completing each core theory and compulsory paper shall be 78 hours, and for each practical 156 hours.

MICROBIOLOGY PRACTICALS – (I, II, III)

Distribution of Marks

Min. pass marks: 18	Duration: 3 hours	Max. Marks: 50
	REGULAR	EX-STUDENT
1. Major Exercise	12	12
2. Minor Exercise	10	10
3. Preparation	8	8
4. Spots (5)	10	10
5. Record	5	-
6. Viva-voce	5	10
TOTAL	50	50

BMB – 01 PRINCIPLES OF MICROBIOLOGY

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT- I

Contributions of the following scientists in various areas of Microbiology - Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Alexander Fleming, Waksman. Branches of Microbiology. Economic importance of microbes.

Microscopy –Principle, construction, operation and application.

UNIT- II

Culture of microbes: Preparation of culture media, aseptic transfer of bacteria, serial dilution technique, Pure Culture techniques, preservation and maintenance of cultures, concept of stock culture.

Microbial stains: Auxochrome ,chromophores, Stains v/s Dyes, various types of stains.

Staining techniques: Simple staining, Differential (Gram and Acid fast),Special staining (Spore, capsule, negative).

UNIT-III

Sterilization – Physical Methods: Heat, Pasteurization, filtration, tyndallization, radiation.

Chemical methods: Alcohol, Halogen, Aldehyde, Ethylene Dioxide.

Determination of phenol coefficient of disinfectant.

Culture media: Simple media, Synthetic or defined media, Complex media, Enriched media, Selective media, Differential media.

UNIT- I V

Microbiology of soil and biogeo-chemical cycles. N₂-fixing microbes in agriculture. Industrial products of microorganisms with special reference to food and food supplements(Prebiotics and Probiotics), beverages and pharmaceuticals.

UNIT- V

Microbial interactions like symbiosis and antibiosis *etc.* Host defense mechanism against pathogens.

Symptoms, Etiology and control measures: Human diseases (Tuberculosis, HIV, candidiasis, polio, malaria) and Plant diseases (Root knot, nematode galls, little leaf of brinjal, bacterial blight of rice, green ear disease of bajra, TMV).

Reference Books:

1. Microbiology, Authors- Pelczar, Chan and Kreig.
2. Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
3. General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter.
4. Microbial Physiology, Authors- Moat and Foster.
5. A Text book of Microbiology, Authors- P. Chakraborty.
6. Textbook of Microbiology, Authors- Dubey and Maheshwari.
7. Microbiology, A Practical Approach. Authors- Patel and Phanse
8. General Microbiology, Authors- Powar and Daginawala.
9. Microbiology, Author- S.S. Purohit.
10. Microbiology, Authors- Prescott, Herley and Klein.
11. Bacteriology, Authors- Topley and Wilson.

BMB 02- CELL BIOLOGY AND MICROBIAL GENETICS

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT- I

Ultra Structure of Prokaryotic and Eukaryotic Cell.

Structure and Function of Cell components: Cell Wall, Plasma Membrane, Endoplasmic Reticulum, Golgi apparatus, Lysosome, Peroxisome, Ribosome, Chloroplast, Mitochondria, Nucleus, cytoskeleton(Microfilament, Microtubule and Intermediate Filaments).

UNIT- II

Structure of chromosome –Prokaryotic and Eukaryotic Chromosome. Nucleosome model, euchromatin and heterochromatin, karyotype. Special types of Chromosomes (Polytene and Lampbrush Chromosome.)

UNIT- III

Cell cycle: Amitosis, mitosis and meiosis. Components of cell cycle control system, Programmed cell death (Apoptosis). Cell signalling.

UNIT- IV

Methods of genetic recombination: Conjugation, transformation, transduction and sexduction. Plasmid- Structure, properties and types. Genetic recombination and site-specific recombination.

UNIT -V

Mutation: spontaneous and induced mutation. Mutagens –Physical and chemical mutagens. DNA damage and repair. Transposable elements of prokaryotes– Types and significance.

Reference Books:

1. Molecular Biology of Cell- Bruce Alberts et al, Grand publications.
2. Cell Biology- Ambrose & Dorothy Masty, ELBS Publications.
3. Fundamentals of Cytology- Sharp, McGraw Hill Company.
4. Cytology- Wilson & Morrison, Reinform Publications.
5. Cell Biology and Molecular Biology- EDP Robertis and EMF Robertis, Sauder College.
6. Cell Biology, Genetics and Evolution & Ecology P.S. Verma and Agarwal.
7. Cell Biology: A lab manual. Shanmucan. Mc Millan India Ltd.
8. Genetics- Strickberger, 2nd.
9. Microbial Genetics – D. Frifielder.
10. Baltimore- Molecular Biology of the Cell

BMB 03- BIOLOGY AND DIVERSITY OF MICROBES

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit.

The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT – I

Whittaker's classification system of prokaryotes. Hackel's three kingdom, Carl Woes classification. Important archaeal and eubacterial groups according to Bergey's Manual of Systematic Bacteriology.

Archaea: General characteristics, structure, metabolic character, function, reproduction and application.

Cyanobacteria: General characteristics and importance.

UNIT – II

Classification and General characteristics of algae - Occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae. Applications of algae in agriculture, industry and environment.

UNIT – III

Classification and General characteristics of fungi - habitat, nutritional requirements, ultra-structure, thallus organization, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance.

Protozoa :General characteristics with special reference to *Amoeba*, *Paramecium* and *Plasmodium*.

UNIT – IV

Classification, structure and General Characteristics of viruses, viroids, virusoids, satellite viruses and Prions. Isolation, purification and cultivation of viruses. Multiplication of bacterial viruses (lytic and lysogenic cycles).

UNIT – V

Eubacteria: Cell morphology, function, reproduction of Photosynthetic eubacteria, Gram positive eubacteria (Actinomycetes), Spore forming bacteria (spore formation and germination), Sulfur bacteria, Nitrogen fixing bacteria and mycoplasma.

Reference Books:

1. Microbiology: An Introduction by Tortora GJ, Funke BR and Case CL., 9th Ed., Person Education, 2008.
2. Microbiology by Pelczar Jr MJ, Chan ECS and Krieg NR. 5th Ed. Tata McGraw Hill, 2011 (Reprint),
3. Black JG (2008) Microbiology: Principles and Explorations. 7th edition. Prentice Hall.
4. Madigan MT and Martinko JM (2006) Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.
5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005) General Microbiology. 5th edition. McMillan 4.
6. Srivastava S and Srivastava PS (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.

BMB-04 FUNDAMENTALS OF BIOCHEMISTRY

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit.

The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT – I

Bioenergetics:Principles of bioenergetics.First and second laws of Thermodynamics. Definition of Gibb's Free Energy, Enthalpy and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant.

Energy rich compounds: Phosphoenolpyruvate, 1, 3- Bisphosphoglycerate.

UNIT – II

Carbohydrate: Definition, classification, stereochemistry, cyclic structures and anomeric forms, Haworth projections. Monosaccharide, Disaccharides, Polysaccharides: structural and storage .

UNIT – III

Protein Structure (Primary, Secondary, Tertiary and Quaternary).

Purification(chromatographic and electrophoresis). Protein Folding. Protein Sequencing.

Properties of amino acids their nature and peptide bond.

UNIT – IV

Lipids: classification and structure of fatty acids (Palmitic and stearic acid), Properties of oils and fats. Biological functions of lipids.

Structure of nucleic acids.Nucleoside, nucleotide

UNIT – V

Enzymes: General properties, Classification. Role in metabolism, anabolism and catabolism. Coenzymes and Cofactors. Enzyme Kinetics (derivation of Michaelis–Menten constant, linear transformation of the equation). Enzyme Inhibition. Allosteric Enzymes and Isoenzymes. Mechanism of Enzyme Regulation.

References:

1. Lehninger. Principles of Biochemistry, Nelson & Cox, 4th Edition.
2. Voet&Voet Donald. 3rd Edition. Fundamentals of Biochemistry, J/W.
3. U Satyanarayan, Biochemistry, 3rd Edn, Books and Allied Pvt. Ltd.
4. Stryer – Biochemistry. W.H.Freeman & Co.
5. Price & Steven, Fundamentals of Enzymology,3rd Edition

6. Geoffrey Cooper. The cell with CD- Rom. SinauerAsso. Incorp.
7. Elliott & Elliot.3rd Edition Biochemistry and molecular biology.
8. Boyer, Concepts in biochemistry. Thomson
9. Plummer. An introduction to practical Biochemistry,3rd Edition
10. J.Jayraman. Lab Manual in Biochemistry.

BMB-05 FUNDAMENTALS OF MOLECULAR BIOLOGY

Min. passmarks:18

Duration: 3hours

Max. Marks:50

Note: Attempt any five questions, taking atleast one question from each unit. Each question carries equal marks.

UNIT-I

Organization of genetic material in prokaryotes and eukaryotes. Concept of gene. Evidence for the role of DNA and RNA as the genetic material.

UNIT-II

Structure of DNA. C-value, and C-value paradox. Topology of DNA. DNA replication in prokaryotes and eukaryotes, Enzymes and accessory proteins involved in DNA replication, Fidelity of DNA replication and proof reading.

UNIT-III.

Structural features of RNA (rRNA, tRNA, mRNA). Sn- RNA and HnRNA. Mechanism of transcription in Prokaryotes and Eukaryotes Post transcriptional processing: capping, tailing and splicing. Catalytic RNA.

UNIT-IV

Genetic code, anticodon, Wobble hypothesis. Translation in Prokaryotes and Eukaryotes. translational modification (phosphorylation, glycosylation, and methylation).

UNIT-V

Regulation of gene expression in prokaryotes: Operon concept, positive and negative regulation. Examples of lac and trp- operon. Regulation of gene expression in eukaryotes (In brief)

References:

1. Genes V by Benjamin Lewin, Oxford University Press, New York.
2. Principles of Genetics, Snustad and Simmons, Fourth Edition, John Wiley and Sons, Inc.
3. Molecular Cell Biology, Lodish et al., W. H. Freeman and Company.
4. Genomes by T.A. Brown, John Wiley and sons (Asia) PTE LTD, New York.
5. Principles of Gene Manipulation and Genomics by S.B. Primrose and R. M. Twyman, Seventh edition, Blackwell Publishing, U.K.
6. Cell and Molecular Biology concepts and experiments By Gerald Karp, Third edition, John Wiley and sons, Inc., U.S.A.
7. Molecular Biology by Friefelder, David.

BMB 06- BASIC IMMUNOLOGY

Duration: 3 hrs Max .Marks 50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT I

Concept of Innate and Adaptive immunity.

Structure, Functions and Properties of Immune Cells: Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell

Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT.

UNIT II

Characteristics of an antigen; Haptens, Epitopes (T & B cell epitopes), T-dependent and independent antigens, Adjuvants.

Structure, Types, Functions of antibodies: Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic).

UNIT III

Antigen–Antibody Interaction: Principles of Precipitation, Agglutination, Immunodiffusion (ODD, RID), Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry.

Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules.

UNIT IV

Complement- Components and biological activities. Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells.

UNIT V

Hypersensitivity – (immediate and delayed types).

Autoimmune diseases: Good pastures syndrome, Rheumatoid arthritis (RA), Multiple sclerosis, Systemic lupus erythematosus (SLE), Type 1 diabetes,, Hashimoto's thyroiditis.

Transplantation immunology.

Reference Books:

1. Essentials of Immunology, Author- Roitt, I.M., ELBS. Blackwell Scientific Publishers, London.
2. Immunology II Edition, Author- Kuby, J. WH., Freeman and Company, New York.
3. Immunology. Author- Klaus D. Elger, Wiley-Liss. NY.
4. Text Book on Principles of Bacteriology, Virology and Immunology, IX Edition (5 volumes). Authors- Topley and Wilson's, Edward Arnold, London.
5. The Experimental Foundations of Modern Immunology. Authors- Clark, V.R., John Wiley and Sons, Incl.
6. Fundamental Immunology. Author – W.E. Paul, Raven Press, New York.
7. Fundamentals of Immunology. Authors – R.M. Coleman, M.F. Lombord and R.E. Sicard. 2nd ed. C. Brown publishers.

PRACTICALS

BMB – 07 PRINCIPLES OF MICROBIOLOGY + CELL BIOLOGY AND MICROBIAL GENETICS

Max. Marks– 50

Min Marks – 18

1. Microbiology Good Laboratory Practices
2. Principles, working knowledge of Instruments like Autoclave, pH meter, Incubator, Hot air oven, Centrifuge, Microscope, Refrigerator, Colony counter,
3. Laminar Air Flow. BOD incubator used in the microbiology laboratory.
4. Cleaning and sterilization of glasswares.
5. Measurement of microorganisms.
6. Preparation of culture media: PDA, BG-11, Nutrient Agar.
7. Preparation of stains.
8. Motility of bacteria by Hanging drop method.
9. Staining procedures I- Simple staining –Negative staining.
10. Staining procedures II- Differential staining - Gram Staining and Acid Fast Staining.
11. Staining procedures III- Special / Structural staining -Capsule staining, Endospore staining.
12. Sterilization of medium using Autoclave and assessment for sterility.
13. Sterilization of glassware using Hot Air Oven and assessment for sterility.
14. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
15. Study of *Rhizopus*, *Penicillium*, *Aspergillus*, *Saccharomyces* using temporary mounts.
16. Mitosis in onion root tip
17. Identification of giant chromosome in chironomous larvae
18. Cell Counting and viability
19. Blood Smear Preparation.
20. Separation of cell organelles by sucrose gradient.
21. Preparation and study of various stages of mitosis and meiosis.
22. Isolation of plasmid DNA from bacteria.
23. Preparation of competent.
24. Restriction enzyme digestions and its analysis by gel electrophoresis.
25. U.V. Induced Mutagenesis.
26. Bacterial transformation by CaCl₂ method)
27. Transduction in *E. coli*.
28. Conjugation in *E. coli*.

PRACTICALS

BMB – 08 BIOLOGY AND DIVERSITY OF MICROBES + FUNDAMENTALS OF BIOCHEMISTRY

Max. Marks– 50

Min Marks – 18

1. Study of *Rhizopus*, *Penicillium*, *Aspergillus*, *Saccharomyces* using temporary mounts.
2. Study of *Spirogyra* and *Chlamydomonas*, *Volvox* using temporary mounts
3. Study of the following protozoans using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*.
4. Analysis of Sugars
 - a) Monosaccharide-Glucose, Fructose, Galactose, Mannose, Pentose.
 - b) Disaccharides-Sucrose, Maltose and Lactose.
 - c) Polysaccharides-Starch and Dextrin.
5. Analysis of Amino Acids
6. Lipid Analysis [Group Experiments]
 - a) Determination of Saponification number.
 - b) Determination of Acid number.
 - c) Determination of Iodine number
7. Demonstration Experiments
 - a) Separation of amino acids by TLC.

PRACTICALS BMB – 09 FUNDAMENTALS OF MOLECULAR BIOLOGY + BASIC IMMUNOLOGY

Max. Marks– 50

Min Marks – 18

1. Preparation of genomic DNA from bacteria.
2. Isolation of genomic DNA from Blood.
3. Quantitation of DNA by spectrophotometry.
4. Isolation of plasmid DNA from bacteria.
5. Restriction enzyme digestions and its analysis by gel electrophoresis.
6. Identification of human blood groups.
7. Perform Total Leukocyte Count of the given blood sample.
8. Perform Differential Leukocyte Count of the given blood sample.
9. Separate serum from the blood sample (demonstration).
10. Perform immunodiffusion by Ouchterlony method.
11. Perform DOT ELISA.
12. Perform immunoelectrophoresis

B.Sc. Microbiology Pt-II Examination

	Lec Hrs/week	Exam hrs.	Max Marks
Core paper (Theory)			
BMB – 10 Microbial Ecology	3	3	50
BMB – 11 Microbial Physiology and Metabolism	3	3	50
BMB – 12 Medical Microbiology	3	3	50
BMB – 13 Genetic Engineering and rDNA technology	3	3	50
BMB – 14 Food & Dairy Microbiology	3	3	50
BMB – 15 Environmental Microbiology	3	3	50
Total of Theory Papers			300
Core Paper (Practicals)			
BMB –16 Microbial Ecology+ Microbial Physiology & Metabolism		3	50
BMB –17 Medical Microbiology+ Genetic Engineering and rDNA technology		3	50
BMB – 18 Food & Dairy Microbiology 50 + Environmental Microbiology		3	
Total of Practical Papers 150			
Grand Total (Theory+ Practicals) 450			

B.Sc. Microbiology Part-II Exam.-2020

BMB 10- Microbial Ecology

Duration :3hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT-I

Ecology - Development of ecology as a science, its significance and the history and development of microbial ecology. Definition and concept of ecology. Scope of ecology. Autecology and synecology. Ecosystems, components of ecosystems, levels of organizations, trophic levels, food chains, food webs, ecological pyramids and energetics.

UNIT-II

Biogeochemical Aspects of microbial ecology: Role of microorganisms in cycling of carbon, nitrogen, Phosphorus, sulphur and iron.

UNIT-III

Micro organisms and their natural habitats:

Terrestrial environment - Soil, physical and chemical properties of soil, classification of soil, soil profile, soil microflora and soil as a natural habitat for micro organisms. Humus and humification

UNIT-IV

Micro organisms and their natural habitats:

Aquatic environment - Fresh and marine water microflora, eutrophication, biomagnifications.
Atmospheric environment - Aero microflora, droplet nuclei, biofilms.
Extreme environment - Habitats and microbes: Thermophiles, barophiles, halophiles, osmophiles, acidophiles.

UNIT-V

Biological interaction:

Microbe - Microbe interaction - Symbiosis, synergism, neutralism, commensalism, mutualism, amensalism, competition, parasitism, predation. Microbe Plant interaction - Roots, aerial plant surfaces, Introduction of biological nitrogen fixation.
Microbe - Animal interaction - Rumen micro biology, nematophagus fungi.

References:

1. Alexander, M. 1997. Introduction to soil Microbiology. John Wiley and sons Inc., New York.
2. Environmental microbiology: principles and applications by Patrick K. Jjemba. Science publisher, 2004.
3. Environmental microbiology by P. D. Sharma, Alpha Sciences international, 2005.
4. Environmental microbiology by Ian Papper and Charles Gerba, Elsevir Press.
5. Environmental microbiology by Rose Environmental microbiology Vol III-IV, 1999
6. Atlas R M and Bartha, 1993. Microbial Ecology, Bejaminn Cummings Publishing Co. Redwood City CA

BMB 11- Microbial Physiology and Metabolism

Duration :3hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT-I

Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate. Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic.

UNIT-II

Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.
Passive and facilitated diffusion. Primary and secondary active transport, concept of uniport, symport and antiport, Group translocation.

UNIT-III

Concept of aerobic respiration, anaerobic respiration and fermentation. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle.
Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation.

UNIT-IV

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction).

Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.

UNIT-V

Introduction to aerobic and anaerobic chemolithotrophy with an example of each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction).

Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria

Ammonia assimilation. Assimilatory nitrate reduction.

References:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
6. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

BMB-12-Medical Microbiology

Duration :3hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT- I

Infection and disease- Types of infections, Various sources of Infection, Carriers of infection.

Definitions of MID, ID50, MLD, LD50, bacteremia, Septicemia, contagious epidemic, endemic, pandemic, sporadic and prosodesmic diseases. Epizootic and enzootic. Host pathogen interaction

UNIT-II

Bacterial diseases: Causative agents, Symptoms, mode of transmission, prophylaxis and control:

Diphtheria, Influenza, Tuberculosis, Typhoid, Food poisoning, Cholera

UNIT-III

Viral diseases: Causative agents, Symptoms, mode of transmission, prophylaxis and control: Polio, Hepatitis, Small pox, Chicken pox, Mumps, AIDS

Protozoan diseases: Causative agents, Symptoms, mode of transmission, prophylaxis and control: Malaria, Kala-azar.

UNIT-IV

Fungal diseases: Causative agent, transmission, symptoms and prevention:

Cutaneous mycoses: Tinea pedis (Athlete's foot).

Opportunistic mycoses: Candidiasis.

UNIT-V

Diseases of human beings-II: Diagnosis, symptoms, toxic components, etiology and disease
Sample collection, transport and diagnosis: Collection, transport and culturing of clinical samples.

Antimicrobial agents: Modes of action with one example of each Antibacterial agents, Antifungal agents, Antiviral agents

References:

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

BMB-13 Genetic Engineering and r-DNA Technology

Duration :3hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT- I

Introduction of genetic engineering. Methods of DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern- blotting techniques, dot blot, SDS-PAGE and Western blotting.

DNA modifying enzymes and their applications: restriction enzymes, DNA polymerases. terminaldeoxynucleotidyltransferase, kinases & phosphatases, and DNA ligases.

UNIT-II

Polymerase chain reaction. C-DNA synthesis and cloning: mRNA enrichment, reverse transcription, Linkers, adapters, blunt end ligation, homopolymer tailing. Genomic and cDNA libraries: Preparation and uses, Genome sequencing.

DNA Sequencing: traditional and automated sequencing.

UNIT-III

Cloning Vectors: Plasmid vectors(pBR and pUC), Bacteriophage(Lambda and M13), Cosmids, BACs, YACs. Cloning and expression of foreign genes in prokaryotes (*E.coli*). Cloning and expression of foreign genes in eukaryotes(eg. yeast). Gene tagging.

UNIT-IV

Gene transfer-microinjection, electroporation, microprojectile, shot gun method ultra - sonication, Liposome fusion, microlasers. Use of *Agrobacterium tumefaciens* and *A.rhizogenes*, Ti plasmids, Application of molecular cloning.

UNIT-V

Products of recombinant DNA technology: Products of human therapeutic interest (insulin, hGH), antisense molecules, recombinant vaccines. Gene therapy.

Transgenic plants: Bt transgenic (cotton, brinjal), flavosavo tomato, golden rice.

Protein engineering. Transgenic animals(cow, sheep, poultry, fish).

References:

1. Glick B.R and Pasternak J.J. (2010), Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
2. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford,
3. Brown TA. (2007). Genomes-3. Garland Science Publishers.
4. Nigel Halford. (2006). Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. WileyDreamtech India.
5. Bernard, R.G. and Jack, J.P. (2003). Molecular Biotechnology: principles and application of recombinant DNA. ASM Press.
6. Primrose, S. B. Twyman, P.M. and Old, R. W. (2001) Principles of gene manipulation(6th Ed.). Black well publishers.
7. Sambrose and Russell. (2001), Molecular Cloning. 3 volumes. CSH Lab Pres. Hellen, K., Adrian, M. and John W. (2000). Recombinant DNA and Biotechnology.
8. Old and Primrose. (1994). Principles of Gene Manipulation, Blackwell Scientific Publications.

BMB-14 Food & Dairy Microbiology

Duration :3hrsMax .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT- I

Food as a substrate for microorganisms Microbial flora of foods: Milk, fruits, vegetables, meat, eggs , Factors affecting kinds and numbers of microorganisms, intrinsic and extrinsic factors, Sources of contamination.

UNIT- II

Food poisoning: Microorganisms involved, sources of contamination, Role of *Staphylococcus aureus*, *Clostridium botulinum* and *Salmonella* spp.,Molds as poisoning agents.

Microbial Spoilage of food,Causes of spoilage, Biochemical changes caused by microbes.

UNIT-III

Spoilage of milk and milk products, fruits, vegetables, eggs, meat. Spoilage of canned foods
Preservation of food and Milk: General principles and Methods of preservation.

UNIT- IV

Microbes as Food and Food Products: Fermented dairy products, Starter culture, Cheese: Types, curdling, processing, ripening, Other fermented dairy products. Introduction to probiotics, prebiotics and synbiotics. Indian fermented food products: Pickles, idli, Khaman and bread .

UNIT- V

Microbes as food: Mushrooms, spirulina and yeasts in food microbiology. Biological methods: Generalized scheme for microbiological examination, Direct microscopic examination, Most probable number (MPN), Bacteriological analysis of milk. Microbiological criteria of food safety.

Text Books:

1. Pelczar Jr, M J, Chan E C S, Krieg N R, (1986), *Microbiology: An Application Based Approach*, 5th edn. McGraw-Hill Book Company, NY
2. Frazier W C and Westhoff D C (1988), *Food Microbiology*, 4th edn. McGraw-Hill Book Company, NY.
3. Prescott L, Harley J P, and Klein D A, (2008), *Microbiology*, 7th edn. WmC. Brown- McGraw Hill, Dubuque, IA.

BMB 15- Environmental Microbiology

Duration :3hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

UNIT-I

Components of Environment – Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples; Interaction of man and environment. Microbiological sampling of air.

UNIT-II

Aquatic environment, distribution of microorganisms in aquatic environment – fresh water, estuarine and marine water systems. Factors influencing growth and distributions. Water Purification procedures for single dwelling and municipal water supplies,

Concept of indicator organisms, Microbiological examination of water. BOD, COD, Waste water treatment steps and methods. Eutrophication and algal bloom.

UNIT -III

Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; environmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas. Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc), Organophosphates, Heavy Metals, Die-offs, Endocrine disrupting chemicals.

UNIT-IV

Bioremediation techniques (*in situ* – Bioventing, airsparging and *ex situ*- Land farming, & slurry-phase). Biodegradation of paints, rubber, wood, products and plastics.
Degradation of pesticides and other toxic chemicals by microbes Biopesticides
Enrichment of ores by microorganisms (Bioaccumulation and Biomineralisation).

UNIT-V

Environmental Laws, national movements, sustainable development, environmental policies, environmental economics, environmental ethics – holistic approach of environmental protection and conservation, IUCN – role in environmental protection. Concept with reference to UN – declaration, aim and objectives of human right policies with reference to India, recent north-south debate on the priorities of implementation, Environmental Protection Agency (EPA).

References:

1. Environmental microbiology: principles and applications by Patrick K. Jjemba. Science publisher, 2004.
2. Environmental microbiology by P. D. Sharma, Alpha Sciences international, 2005.
3. Environmental microbiology by Ian Papper and Charles Gerba, Elsevir Press.
4. Environmental microbiology by Rose Environmental microbiology Vol III-IV, 1999

PRACTICALS

BMB16-Microbial Ecology & Microbial Physiology and Metabolism

1. To study the bacterial ecology in fresh water environment
2. To study the microbial diversity of soil.
3. To study the microbial ecology of the rhizosphere and determination of rhizospheric effect.
4. Demonstration of nitrate reduction
5. Demonstration of decarboxylation of amino acid.
6. Isolation of photosynthetic bacteria by column method
7. To study and plot the growth curve of *E coli* using turbidometric method and to calculate

specific growth rate and generation time.

8. To study and plot the growth curve of *Aspergillusniger* by radial growth measurements.
9. To study the effect of pH on the growth of *E. coli*
10. To study the effect of temperature of *Aspergillusniger* by dry weight method.
11. Demonstration of the thermal death time and decimal reduction time of *E. coli*.
12. Demonstration of alcoholic fermentation.
13. Effect of different nitrogen sources on growth of *E. coli*.
14. Effect of different carbon sources on growth of *E. coli*.

PRACTICALS

BMB17- Medical Microbiology &Genetic Engineering and r-DNA Technology

1. Identify bacteria, *E. coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*, *Bacillus* (any three)on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests.
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS.
3. Study of bacterial flora of skin by swab method.
4. Perform antibacterial sensitivity by Kirby-Bauer method.
5. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes,
 - a. chicken pox, AIDS, dermatomycoses (ring worms).
6. Study of various stages of Malarial parasite in RBCs using permanent mounts/Photomicrographs.
7. .Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis.
8. Ligation in DNA fragments.
9. Selection of recombinants by selectable markers.
5. Polymerase chain reaction (PCR).
6. Agarose Gel Electrophoresis
7. SDS-PAGE
8. Demonstration of RAPD.
9. Isolation of RNA.
10. Demonstration of Southern blotting.

PRACTICALS

BMB 18-Food & Dairy Microbiology&Environmental Microbiology

1. Microbiological analysis of food
 - A. Standard plate count of food sample
 - B. Determination of MPN of coliforms
2. Microbiological analysis of milk
 - A. Standard plate count of milk sample
 - B. Determination of microbial load of milk by use of MBRT of raw milk, boiled milk and pasteurized milk

3. Detection of acid-fast organisms in milk sample.
4. To determine the microbial biomass from different natural habitats.
5. Determination of dissolved oxygen of water.
6. Determination of BOD of water (raw/ treated).
7. Determination of COD of water (raw/ treated).
8. Demonstration of biological treatment.