

University of Kota, Kota

M.Sc. (P/F) MICROBIOLOGY -2013

Eligibility: B.Sc. under the 10+2+3 scheme with Chemistry, Zoology, Botany/Microbiology/Biotechnology/Medicine/Pharmacy/Agriculture with a minimum of 50 % marks.

(45% for candidates belonging to the reserved category SC/ST/OBC)

Selection: Common Entrance Test to be conducted by Scheme of Examination and Courses of Study

1. The number of papers and the maximum marks for each paper/practical are shown in the syllabus. It will be necessary for a candidate to pass in the theory part as well as in the practical part (wherever prescribed) separately.
2. A candidate for a pass at each of the Previous and the Final Examinations shall be required to obtain (i) at least 36% marks in the aggregate of all the papers prescribed for the examination and (ii) at least 36% marks in practical(s) / wherever prescribed at the examination, provided that if a candidate fails to secure at least 25% marks in each individual paper at the examination and also in the Test / Dissertation/ Survey Report / Field Works, wherever prescribed, he shall be deemed to have failed at the examination notwithstanding his having obtained the minimum percentage of marks required in the aggregate for that examination.
No division will be awarded at the previous Examination. Division shall be awarded at the end of the Final Examination on the combined marks obtained at the Previous and the Final Examinations taken together, as noted below:

First Division 60%

On the aggregate mark taken together in the Prev. & Final Exam.

Second Division 48%

3. If a candidate clears any paper(s) prescribed at the Previous and/ or Final Examination after a continuous period of three years, then for the purpose of working out his division the minimum pass marks only viz. 25% (36% in the case of Practical) shall be taken into account in respect of such paper(s)/Practical(s) are cleared after the expiry of the aforesaid period of three years; provided that in case where a candidate requires more than 25% marks in order to reach the minimum aggregate as many marks out of those actually secured by him will be taken into account as would enable him to make up the deficiency in the requisite minimum aggregate.
4. A total of eight theory papers (3 hours duration each) are prescribed (4 in previous and 4 in final). A combined Practical Examination (10 hrs. duration in two days) shall be conducted each year. Paper setter shall be asked to set total 9 questions for each theory paper (which have been divided into three sections) or 10 questions for each theory paper (which have no sections) out of which the examinee shall be asked to attempt any five questions. The list of papers is as below:

A candidate failing at M.Sc. Previous examination may be provisionally admitted to the M. Sc. Final Class, provided that he passes in at least 50% papers as per Provisions of 0.235 (i)

A candidate may be allowed grace marks in only one theory papers up to the extent of 1 % of the total marks prescribed for that examination.

Teaching & Examination Scheme –2013
M.Sc. (P) Microbiology

A. Theory Papers	Max. Marks
1. General Microbiology & Bacteriology	100
2. Microbial Physiology & Biochemistry	100
3. Microbial Genetics & Molecular Biology	100
4. Biostatistics & Computer Application	100
Combined Practical	200
I Experimental Work	120
II Project Work & Record	50
III Viva-Voce	30
TOTAL	600

M.Sc. (F) Microbiology

B. Theory Papers	Max. Marks
5. Microbial Technology	100
6. Microbial Ecology & Environmental Biotechnology	100
7. Geomicrobiology, Soil & Agriculture Microbiology	100
8. Medical Microbiology, Immunology & Virology	100
Combined Practical	200
I Experimental Work	120
II Project Work & Record	50
III Viva-Voce	30
TOTAL	600
GRAND TOTAL	1200

M.Sc. Microbiology (P/F) Practical Examination 2013

Skeleton Paper

Max. Marks –200	Time - 3 hrs
Major Exercise	40
Minor Exercise (Two)	40 (2*20)
Preparations	10
Spotting (10) 2 marks each	20
Project / Experimental study / Review / Seminar	50
Record	20
Viva-voce	20
Total	200

M.Sc. (P) Microbiology Exam-2013

Paper- I General Microbiology & Bacteriology

Min. pass marks: 36

Duration: 3 hours

Max. marks: 100

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

Unit I

History-Contribution of Antonie Von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus Beijerinck, Sergei Winogradsky, Alexander Fleming, Selman Waksman; the spontaneous generation controversy; Scope of Microbiology. Microbial diversity (functional and genetic) Classification upto class level and distinctive characters of major groups : Viruses, Bacteria, Fungi, Algae and Protozoa.

Principles, Function & application of Microscopy: Light, dark field, phase contrast, fluorescent interference confocal and electron (transmission and scanning) microscopy.

Stains and Staining techniques: Simple, Gram, Capsule, Endospore, Flagella, Acid fast staining.

Determination of biomass, growth and microbial activity.

Unit II

Culture Disinfection, Sterilization: Principles and Methods of sterilization- Physical and Chemical methods.

Isolation Techniques: Streak plate, pour plate and spread plate method. Enrichment and Selection techniques, single cell isolation, bait techniques, trophic grouping and types of media.

Methods of anaerobic cultivation, Maintenance and methods of preservation of pure microbial culture.

Growth Curve -Environmental factors affecting growth and Nutrition: Types of bacteria on the basis of energy and nutritional requirement.

Unit III

Past and present state of bacterial taxonomy: Phylogenetic and phenetic approaches. Numerical taxonomy, Chemotaxonomy, Molecular or Genetic.

Protheca: Functional role, morphogenesis, growth, differentiation and cell cycle in prothecate bacteria.

Morphology, Fine structure, elementary chemistry and functions of bacterial processes of their formation.

Morphology, physiology and diversity of bacterial endospores and the processes of their formation.

Major characteristics of bacteria. Morphological, Biochemical, Cultural, Physiological. Metabolic, antigenic, genetic and ecological.

Unit IV

Characters, Classification, Adaptations and Physiology of Archaeobacteria: Methanogens, Extreme Halophiles, Thermoacidophiles. Parasitic association of bacteria. Bdellovibrio and its interperiplasmic growth cycle.

Characteristics of important genera and salient aspects of the physiology of photosynthetic eubacteria : Anoxygenic and oxygenic photosynthesis. Sulphur and nonsulphur photosynthetic bacteria .

Cyanobacteria: **General characters of Cyanobacteria, their ultrastructure and reproduction; economic importance of Cyanobacteria.**

Unit V

Characteristics of important genera and salient aspects of the physiology of: Chemoautotrophs, Methophilic eubacteria, Gram negative eubacteria (Spirochaetes, Rickettsia, Chlamydiae) Mycobacteria, Enteric group and related eubacteria. Gram negative anaerobic eubacteria

Characteristics of important genera and salient aspects of the physiology of: Unicellular endospore forming eubacteria, Mollicutes, Gilding bacteria (Myxobacteria), Gram positive fermentative eubacteria, Actinomycetes

Recommended Books

1. Prescott, L.M., J.P Harley and D.A Klein, 2007. Microbiology VII Ed. Mc Grow Hill,
2. Davis R.Y. E.A. Adeberg and J.L. Ingram, 1991 General Microbiology
3. Stainer .General Microbiology, V Ed., Printice Hall of India Pvt, Ltd. New Delhi
4. Ronald M. Atlas 1997. Principles of Microbiology. II Ed. Mc Grow Hill Pub.
5. Alexopoulos CJ et al, Introductory Mycology 4th Edition
6. Woese, C.R 1981 Archeabacteria , *Sci. Am.* 244:98-122
7. Salle A.J., Fundamental Principles of Bacteriology.
8. Pelczar M.J., Chan E.C.S. & Kreig N.R., Microbiology: Concepts and Application, Tata McGraw Hill.
9. Stainier RY, Ingraham JL, Wheelis ML & Painter PR General Microbiology. Publisher: MacMillan.
10. Madigan M.T., Martinko J.M. and Parker J., Brock Biology of Microorganisms: Prentice-Hall, Inc USA.
11. Atlas R.M., Principles of Microbiology, Wm C. Brown Publishers.

Paper- II Microbial Physiology and Biochemistry

Min. pass marks: 36

Duration: 3 hours

Max. marks: 100

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

Unit-I

Cellular environment, Structure of water and its properties; Acid base concept and buffers; pH and pH indicators, Solutions, Redox, potential, **Hydrogen bonding; Hydrophobic, Electrostatic and Vander Waal forces. Scope and importance of biochemistry.**

Microbial growth and growth synchronization: cell membrane and cell wall, their structure, synthesis and regulation in bacteria, transport mechanisms in microbial cells. Microbial metabolism and fuelling reactions. Biochemistry of bioluminescence, chemotaxy and magnetotaxy in bacteria.

Unit- II

Optical methods: Colorimetry, photometry, nephelometry, VIS, UV VIS and infra red spectrophotometry. Flame photometry, Photo spectrofluorimetry, Mossebauer spectroscopy, ESR and NMR.

Basic principles and applications of Chromatography (paper, thin layer, column, gel filtration, **ion-exchange and affinity chromatography**); GLC, HPLC. Centrifugation techniques.

Principles and applications of electrophoresis for protein and DNA: **Iso-electric focusing and 2D gel electrophoresis**

Unit- III

Biological nitrogen fixation, nitrogen fixing organisms, difference in symbiotic and nonsymbiotic fixation. The enzyme. Alternative nitrogenases. Oxygen protection mechanisms. Sources of energy and reducing power, nif gene organization and regulation.

Biochemistry of enzymes : Classification, nomenclature and general properties of enzymes, mechanism of enzyme action, enzyme inhibition, enzyme kinetics, Coenzyme, Allosteric and other regulations of enzyme activity.

Unit- IV

Biochemistry of proteins : Classification, structure of proteins and methods to determine the structure. Structure- function relationship of proteins.

Important physiological proteins. Amino-acids, their structure and common pathways of synthesis (Aspartate family, branched chain and aromatic amino acids).

Structure, types and metabolism of nucleotides.

Unit- V

Biochemistry of Carbohydrates: Structure, function and classification. Glycolysis, HMP, TCA. Fermentation. Gluconeogenesis, ETC in bacteria as compared to higher forms.

Biochemistry of lipids and fat metabolism. Recapitulation of structure and classification, fatty acid classification, biosynthesis and catabolism.

Recommended Books:

1. Wilson K. and Walker J. (2008). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
2. Nelson D and Cox MM. (2009). Principles of Biochemistry. W.H. Freeman and Company, New York.
3. Talaro K. P. & Talaro A. (2006). Foundations in Microbiology. McGraw-Hill College Dimensi.
4. Potter GWH and Potter GW (1995). Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques, Kluwer Academic Publishers.
5. Voet D and Voet JG. (2003). Biochemistry. John Wiley and sons New York.
6. White A, Handler P, Smith El, Hill R and Lehman J. (1983). Principles of Biochemistry. Tata Mc-Graw Hill.
7. Zubay G (2000). Biochemistry. W. C. Brown, New York.
8. Berg J, Tymoczko J, Stryer L (2001). Biochemistry. W. H. Freeman, New York.
9. Moat AG and Foster J W (2003). Microbial Physiology. John Wiley and Sons, New York.
10. Robert K., Murray M.D., Granner D.K., Mayes P.A. and Rodwell V.I. Harper's Biochemistry. McGraw-Hill/Appleton and Lange.

Paper- III Microbial Genetics & Molecular Biology

Min. pass marks: 36

Duration: 3 hours

Max. marks: 100

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

Unit-I

Introduction to Molecular Biology, Structure and organization of genomes. Law of DNA constancy, Cot curve and C value paradox, DNA renaturation kinetics and T_m value determination and interpretation, Repetitive DNA, Satellite DNA, Selfish DNA.

Nucleic Acids : Types and topology. DNA replication; Mechanism and enzymology. Differences in prokaryotes and eukaryotes.

Unit-II

Techniques in molecular biology: Methods of DNA –RNA sequencing, DNA finger printing, Nucleic Acid hybridization, Southern and Northern Hybridization, PCR, c-DNA and genomic Library.

Protoplast fusion techniques, Fusion proteins: Method, Application and Problems in expression of fusion proteins.

Unit-III

Central Dogma : Mechanism and regulation of transcription and reverse of mRNA. Translation regulation of transcription. Difference in transcription and translation in prokaryotes and eukaryotes.

Mutations : Types of Mutations and mutagens. Molecular mechanisms of induced mutation : DNA repair mechanisms. SOS and mismatch repair. Repair of UV mutations.

Unit-IV

Molecular mechanisms of recombination in bacteria. Conjugation. Transformation, transduction, sexduction. Gene expression in prokaryotes : Operon concept. Induction and repression. Negative and positive controls. Attenuation regulation and relaxed controls, Lac. His. Tryp Operons. Gene Mapping : Molecular aspects of recombination, complementation and hetrozygotic analysis. Genetic mapping of Escherichia coli.

Unit-V

Genetic Engineering : Principle and basic tools.

Gene cloning vectors: Plasmids (Types, structure and functions with special reference to F1 col E, Psc 101), Bacteriophages, Phagemids, Cosmids, shuttle vectors, Artificial chromosomes (BAC, YAC, HAC), Ti plasmid and viruses (vaccinia. Herpes simples and others) as vectors in plant and human genetic engineering.

Application of genetic engineering . Tracing GEMS.

Reference Books:

1. Concepts of genetics by klug and cummings
2. Genetics: From Genes to Genomes by Leland Hartwell, Leroy E. Hood, Michael L. Goldberg
3. Genetics: Analysis and Principles (3rd Edition) by Brooker
4. Gene cloning by T.A.Brown
5. Genetic Engineering by Nicoll

Paper- IV Biostatistics & Computer Applications

Min. pass marks: 36

Duration: 3 hours

Max. marks: 100

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

Unit-I

Definition of statistics and scope of statistics in bioresearch.

Symbols, notations and terminology of statistics, mathematics and computer applications.

Sampling Techniques : Quantity, frequency and number of samples, type of samplers, place and time of sampling, choice of analytical methods, precision and accuracy.

Sampling and estimation of population parameters: Random sampling. Sampling size in random sampling stratified two stage Cluster and Sequential sampling. Bias in sampling. Presentation of research results. Graphic presentation and methods of least squares.

Unit-II

Summarizing data: Central tendency and dispersion. Mean, mode, median.

Variance and coefficient of variation, Standard deviation, Standard error.

Confidence intervals. Normal distribution and its properties.

Testing of hypothesis: Some basic concepts, Errors in hypothesis testing; critical region, Students t-test for the significance of population mean and the difference between two population means; Paired t-test.

The analysis of variance. One way and nested ANOVA, Assumptions of ANOVA.

Unit-III

Probability: **Mathematical, Statistical and Axiomatic Definitions; Addition and multiplication. Theorems; Probability Distribution Function-Binomial, Poisson and Normal; Area under Normal Probability Distribution Curve.**

Regression and Correlation; Simple linear regression.

Coefficient of determination. Brief introduction to the need and application of curvilinear and multiple regression. Searching for the best regression. Common misuses of the technique. Correlation coefficient and the tests of its significance.

Use of partial correlation and partial covariance. Detecting association between a pair of species. Cole's measure of association and point correlation coefficient.

Unit-IV

Stochastic models of exponential growth. Verhulst's logistic equation. Population growth in a limited environment.

Estimate of Error. Control of Error. Proper interpretation of results. Parametric and non-parametric tests of significance . Chi square F.t.T. Hand U.test.

Experimental Designs: **Principles of experimental designs, completely randomized, randomized block and Latin square designs.**

Unit-V

Computer Application: Computers and their organization. Hardware software. Operating system (command line and WIMP) Elementary ideaspont programming languages and application packages for microbiologists. LIMS.

Clinical microbiology, Fermentation technology. Imaging simulation and mathematical modeling. Use of computer as audio visual aid.

Introduction in MS Office software concerning Word processing, spreadsheets and presentation software.

Recommended Books:

1. Biostatistics-A foundation for Health Science, Daniel WW, John Wiley (1983).
2. Statistical Methods, Medhi J, Willey Eastern Limited, (1992).

M.Sc. Microbiology (P) Practical List**Major Exercise**

1. Techniques of pure culture isolation-pour plate, spread plate, streaking.
2. Determination of blood group.
3. Determination of Rh factor.
4. Estimation of haemoglobin content.
5. Triple Sugar Iron Test.
6. IMVIC Test
7. H₂S Production
8. MR – VP test
9. Measurement of bacterial growth by colony counting.
10. Antibiotic sensitivity test by disc diffusion
11. MPN of Coli form MacConkey lactose bile broth.
12. Characterization of (Enterobacter) Organism with the help of IMVIC Test.
13. Determination of the quality of milk samples by methylene blue reduction test.
14. Estimation of protein by Lowry's method.
15. Estimation of chlorophyll.
16. Isolation of DNA from goat liver.
17. Isolation of plasmid DNA from E.coli.
18. Estimation of DNA by diphenyl amine method.
19. TLC separation of amino acids.

Minor Exercise

1. Gram Staining of bacteria.
2. Simple staining of bacteria.
3. Negative staining of bacteria.
4. Differential staining of bacteria.
5. Staining of endospore.
6. Litmus Milk Test
7. Catalase Milk Test
8. Isolation of Microbial colony from Soil
9. Isolation of Microbial colony from Water
10. Isolation of Microbial colony from Air
11. Isolation of Microbial colony from Milk
12. Isolation of Microbial colony from food Samples
13. Isolation of Microbial colony from rhizosphere.
14. Isolation of Microbial colony from Phyloplanes.
15. Isolation of Microbial colony from water
16. Isolation of staphylococcus from skin.
17. Isolation of azotobacter from soil
18. Isolation of rhizobia from root nodule.
19. Isolation of E. Coli from sewage water.
20. Synder agar test for dental caries.
21. Calibration of an ocular micrometry.
22. Measurement of microorganism by ocular micrometry

23. Electrophoresis of isolated DNA sample.
24. Preparation of buffer.
25. Titration curve of Glycine.

Preparations

1. Preparation of Basic Liquid Medium (Broth)
2. Preparation of Basic Potato Dextrose Agar
3. Preparation of Basic Nutrient Agar.
4. Preparation of Basic Peptone Water.