

KADI SARVA VISHWA VIDYALAYA,
GANDHINAGAR

Ph.D. Course Work

in

MICROBIOLOGY

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GANDHINAGAR

PhD Course work for
Microbiology
2020-21

Course structure

| Paper | Title | University Examination | |
|------------------|---------------------------------|--------------------------------------|---|
| | | (marks) | |
| | | Section A (General) | Section B (Specialization) |
| Paper-I | Research Methodology | 60 | 40 |
| Paper-II | Scientific Communication | 60 | 40 |
| Paper-III | Advances in Microbiology | 100 | |

Paper-I Research Methodology

Syllabus

SECTION-A (Common to all faculty)

60 marks

- 1) Introduction to Research Methodology : Meaning of Research, Objectives of Research, Motivations in Research, Types of Research, Research Approaches, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research (2 Marks)
- 2) Defining the Research Problem : What is Research Problem?, Selecting the Problem, Necessity of and Techniques in defining the problem (3 Marks)

- 3) Research Design: Meaning, Need, Features of Good Design, Concepts, Types. Basic Principles of Experimental Design, Developing a Research Plan (3 Marks)
- 4) Sample Design : Implication, Steps. Criteria for selecting a sample procedure, Characteristics of Good sampling Procedure, Types of Sample Design, Selecting Random Samples, Complex random sampling Design. (4 Marks)
- 5) Measurement and Scaling Techniques: Measurement in Research, Measurement Scales, Sources of Errors in measurement, Tests of Second measurement, Technique of developing Measurement Tools, Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques. (6 Marks)
- 6) Methods of Data Collection: Collection of Primary Data, Observation Method, Interview method, Collection of Data through questionnaire and Schedules, Other methods. Collection of Secondary Data, Selection of appropriate method for data collection, Case Study Method, Guidelines for developing questionnaire, successful interviewing. Survey v/s experiment. (6 Marks)
- 7) Processing and Analysis of Data: Processing Operations (Meaning, Problems), Data Analysis (Elements), Statistics in Research, Measures of Central Tendency, Dispersion, Asymmetry, Relationship. Regression Analysis, Multiple correlation and Regression, Partial Correlation, Association in case of Attributes (6 Marks)
- 8) Sampling Fundamentals: Definition, Need, Important sampling Distribution, Central limit theorem Sampling Theory, Sandler's A-test, Concept of Standard Error, Estimation, Estimating population mean, proportion. Sample size and its determination, Determination of sample size Based on i) Precision Rate and Confidence level ii) Bayesian Statistics. (7 Marks)
- 9) Testing of Hypothesis: Meaning, Basic concepts, Flow diagram, Power of a hypothesis test, Important parametric tests, Hypothesis Testing of Means, Differences between Means, Comparing Two related samples, Testing of Proportion, Difference between proportions, Comparing variance to hypothesized population variance, Equality of variances of two normal populations, hypothesis testing of Correlation coefficients, Limitations of Tests of hypothesis. (7 Marks)
- 10) Chi- square test : Applications, Steps, characteristics, limitations (2 Marks)
- 11) Analysis of Variance and Covariance: Basic Principles, techniques, applications, Assumptions, limitations. (6 Marks)

- 12) Analysis of Non-parametric or distribution-free Tests : Sign Test, Fisher-Irwin Test, McNemer Test, Wilcoxon Matched pair Test (Signed Rank Test), Rank (4 Marks)
- 13) Sum Tests : a) Wilcoxon-Mann-Whitney Test b)Kruskal-Wallis Test, One sample Runs Test, Spearman's Rank Correlation, Kendall's Coefficient of Concordance, Multivariate Analysis Techniques: Characteristics, Application, Classification, Variables, Techniques, Factor Analysis (Methods, Rotation), Path Analysis. (4 Marks)

SECTION-B (For Microbiology Candidates only)

40 marks

1. Microbiology Techniques:

(10 Marks)

- Sampling technique, sterilization technique, various methods for isolation of pure culture.
- Maintenance and preservation of microbes (pure culture).
- Antibiotic susceptibility techniques: disc diffusion and Minimum Inhibitory Concentration.
- Definition, Mathematical expression of growth, Growth curve, Methods for measurement of microbial growth, Effect of environment on microorganisms

2. Basic Analytical Techniques :

(20 Marks)

- Chromatographic techniques – Gel filtration, ion exchange chromatography, hydrophobic interaction and reverse phase chromatography, affinity chromatography, gas chromatography, high performance liquid chromatography; Application in separation of proteins including enzymes.
- Polymerase Chain Reaction (PCR), Denaturing Gradient Gel Electrophoresis (DGGE), Restriction Fragment Length Polymorphism (RFLP), Amplified Ribosomal DNA and Restriction Analysis (ARDRA), PFGE., Blotting techniques
- Electron microscopy, phase contrast and fluorescence microscopy & scanning tunneling microscopy.
- Introduction to Osmosis, diffusion, Fick's law of diffusion and Donnan Equilibrium.
- Principle of sedimentation, Sedimentation rate, types of centrifuges, Centrifugation techniques; Rate Zonal; Isopycnic; High speed; Ultra; preparative; Gradient Centrifugation.

3. Recent advances in Bacterial Taxonomy

(10 Marks)

- Identification of Prokaryotes
- A phylogenetic backbone and taxonomic framework for prokaryotic systems
- A road map to the use of the current Bergey's Manual
- Computer taxonomy
- 16s rRNA fingerprinting and lipid profile by GLC

Reference Books: Latest Editions of following Books

- 1) Kothari, C.R., Research Methodology (Methods and Techniques), New Age Publisher
- 2) Fundamentals of modern statistical methods By *Rand R. Wilcox*
- 3) Power Analysis for Experimental Research A Practical Guide for the Biological, Medical and Social Sciences by *R. Barker Bausell, Yu-Fang Li* Cambridge University Press
- 4) Design of Experiments: Statistical Principles of Research Design and Analysis, by *Robert O. Kuehl* Brooks/Cole
- 5) Applied Microbial Systematics, *F.G. Priest, Michael Goodfellow*, 2012
- 6) Bergey's Manual of Systematic Bacteriology

Paper-II Scientific Communication

SECTION-A (Common for all candidates)

60 marks

Syllabus

1. Basics of Communication skill.
 - a) English Grammar: Word Choice, Sentence Structure, paragraph structure,
 - b) Comprehension
2. Types of Scientific Communications.
3. Importance of publishing research papers
4. Publishing Research paper :
 - a) Preliminaries, Format, Choosing Journal
 - b) Title, Running Title
 - c) Authors: Single and Multi authorship
 - d) Writing Abstract
 - e) Introduction section
 - f) Materials and Methods Section
 - g) Result Section
 - h) Figures : Design Principles, Legends, Table components, Graphs: Types, Style, Tables v/s Graph
 - i) Discussion Section: Format, Grammar Style, Content.
 - j) Acknowledgements
 - k) References : Different Styles
 - l) Selecting Keywords
 - m) Communication with the Editor, Handling Referees' Comments, Galey Proofs
5. Writing Review Articles
6. Preparing and Delivering of Oral and Poster Presentations
7. Avoiding Plagiarism
8. Preparing documents for MoUs, Confidentiality Agreements.
9. IUPAC symbols and Terminology for physicochemical quantities and Units, SI prefixes, Fundamental Constants, Standard Abbreviations and Symbols

SECTION-B**40 marks****(For Microbiology candidates only)**

1. Exercises on writing Microbiology related research papers, preparing project proposals for funding agencies and preparing a power point presentations (20 Marks)
2. Assignment on Critical analysis of research papers of interest published in refereed journals with respect to language, content, title, reference style, data, figures, tables, Discussion etc. and preparing a report on the same. (10 Marks)
3. IPR : Patentable subject matter and patent types, Basic requirement of patentability, process of patenting, patenting biological materials, National and International patent laws, Biosafety regulations ; Biosafety issues, Ethical, legal and social issues in Scientific research. (10 Marks)

Reference Books:

- 1) Study and Communication Skills for the Biosciences by *Stuart Johnson and Jon Scott*, Oxford University Press
- 2) Write and Publish a Scientific Paper by *Robert A. Day* Oryx Press
- 3) Scientific Easy when you know how by *Jennifer Peat* BMJ Books
- 4) Research Projects and Research Proposals A Guide for Scientists Seeking Funding by *Paul G. Chapin* Cambridge University Press
- 5) Biotechnology by R C Dubey

Paper-III Advances in Microbiology

100 Marks

- **Advanced Techniques in Microbiology:** Phenotypic Identification of bacteria and fungi including automated method by Biolog and other methods. Sequencing including next generation sequencing techniques. Techniques of metagenomics. (**20 Marks**)
- **Extremophiles:** Introduction, Concept of extremophiles versus conventional microbial forms and archaea – Genetic basics of adaptation, Habitat, Physiology and applications of Acidophilic, Alkaliphilic. Thermophilic, Psychrophilic, Barophilic, Halophilic microorganism and Microorganism resistant to radiations. Biotechnological importance of extremophilic microorganisms: psychroenzymes, anti-freeze proteins, novel antibiotics and other bioactive compounds. (**20 Marks**)
- **Bioprocess Technology:** Types of Fermenters. Fermentation in batch culture: Media formulation, Solid State and submerged fermentation; Fermentation processes: optimization, and factors affecting downstream processing and recovery. (**20 Marks**)
- **Role of Microbes in Environmental Sustainability:** Role of microorganisms in the cycling of bio-elements (carbon, nitrogen, phosphorus, Sulphur); bioremediation, microbial degradation of pesticides and other recalcitrant chemicals- xenobiotics). Microbial degradation of petroleum and hydrocarbons; Bio-deterioration of paper-leather-wood- textiles-cosmetics; Metal corrosion and control. Microbial inoculants in agriculture; GMO and their impact; Microbial plastics. Microbes as fertilizer and pesticides. (**20 Marks**)
- **Emerging and re-emerging infectious diseases** - Epidemiological triad of disease - Factors contributing to emergence: Microbial agents, Antimicrobial drug resistance, Host and Environmental factors. Role of Microbiology in diagnosis - Role of public health professionals- Strategies to reduce threats. (**20 Marks**)

References:

1. Principles of Fermentation Technology by Stanbury and Whittaker
2. Environmental Microbiology by Atlas and Bartha
3. Microbiology by Prescott
4. Brock Biology of Microorganisms, Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl
5. Bergey's Manual of Systematic Bacteriology
6. Medical Microbiology by Ananrnarayan

Format for Question paper: Paper-III Advances in Microbiology

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|---|----------------------|
| Q-1. Multiple Choice questions: | (50 x 1 mark= 50 M) |
| Q-2. Fill in the Blanks: | (10 x 1 mark = 10 M) |
| Q-3. True/False (correct the false statement) | (10 x 1 mark = 10 M) |
| Q-4. Match the Following | (10 x 1 mark= 10 M) |
| Q. 5. Write Short Notes on any two | (2*10 marks =20 M) |
