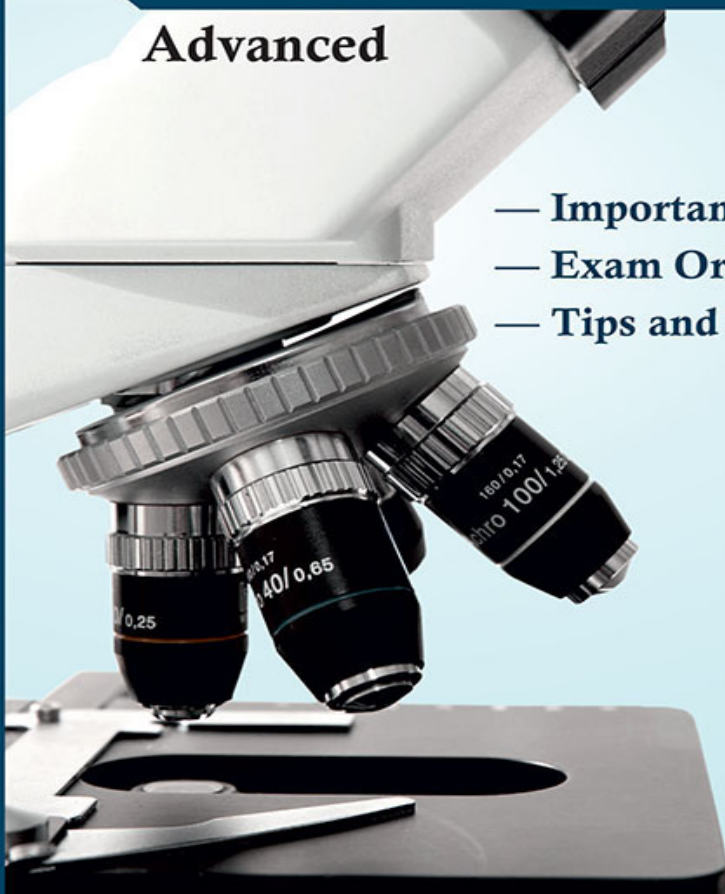


# MCQ's in **Microbiology:**

**Advanced**

- Important Objectives
- Exam Oriented Q&A
- Tips and Trick of Microbiology



**Balaram Mohapatra | Swati Pattnaik**  
**Deepak Kumar Verma | Poulomi Sarkar**  
**Shivlata Landhanam | Jaya Chakraborty**  
**Jyotirmayee Pradhan**



# **MCQ's in Microbiology: Advanced**



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## **FOREWORD**

Microbiology, a dynamic discipline, has grown to its present status by drawing strength from several allied disciplines and serving as the bedrock for new emerging science wherein the basic and applied aspects of life processes are being looked afresh. Possibly, being the most primitive life form that, in the course of evolution, has given rise to the present life forms, importance of microorganism can't be overemphasized. They are found everywhere from geothermal vents in the deep ocean depths to the coldest arctic ice and are major contributors to the functioning of the biosphere and maintenance of the ecosystem services. Even a human body with an average of  $10^{13}$  cells hosts  $10^{14}$  microbial cells, the later directing the body functions and as per current research even the moods of the host. Society in general benefits from the science of Microbiology and indeed modern translational research on different aspects of life sciences has gained momentum from the experience gathered with the study of microbial models. The array of different biomolecules and bio-products discovered, has given new impetus for the use of microorganisms and microbial processes as the basis of greening of industry and the environment.

This overwhelming importance of Microbiology has an awe-inspiring impact on the career of young Indians, both in study and research, and industry. Indeed several agencies like, CSIR, UGC, ICMR, ICAR, ASRB and DBT carry out nationwide eligibility tests (NET) and graduate aptitude test in engineering (GATE) for screening students for awarding fellowship for higher studies and research in biology and biotechnology. In this backdrop, the book “**MCQ's in Microbiology: Advance**” could be the choice of the student community for preparation and gathering knowledge through a collection of MCQ questions with wide coverage of all the branches of Microbiology.

Developed and written by the students for the students, the book “**MCQ's in Microbiology: Advance**” is a quick-guide for gathering knowledge in the discipline of Microbiology. The authors, all bright students pursuing their study and research in Microbiology and applied subject of Life sciences in advanced and most prestigious institute of the country, IIT-Kharagpur, have arrived at the present state of their career by shifting through the vast literature of Microbiology. This has obviously convinced them of the necessity of such a book that covers all the branches of Microbiology and provides the students an answer. The book includes chapters on early days of microbiology, microbial growth and metabolism, microbial genetics, microbial ecosystems, microbial interactions, environmental microbiology, disease microbiology, industrial

microbiology, culture and culture independent study of microbes in a simple and lucid manner and probably an encyclopedia of questions. As a senior student of Microbiology, I appreciate the efforts made by the authors in preparing such a book.

I sincerely hope that the book will earn praise from all who are keen to study microbiology.

A handwritten signature in black ink, appearing to read 'T.K. Adhya', with a stylized flourish at the end.

**(T.K. Adhya)**

## About the Authors

**Balaram Mohapatra:** An environmental microbiology enthusiast and currently as Post-doctoral fellow at Department of Biosciences and Bioengineering, IIT Bombay. He has received PhD doctorate in the area of Environmental microbiology and genomics from Department of Biotechnology, IIT Kharagpur. He has research expertise on cutting edge state of the art Geomicrobiology techniques viz. whole genome sequencing, comparative genomics, metagenomics, proteomics, and molecular systematics. During his work, he proposed three novel bacterial species (*Rhizobium arsenicireducens*, *Pseudoxanthomonas arseniciresistens*, *Achromobacter arsenitransformans*) from arsenic-contaminated groundwater of West Bengal, India. He has many international publications of high repute (Plos One, Genomics, BMC Microbiology, Frontiers in Microbiology, Bioresource Technology, etc.). He has received university gold medal in MSc Microbiology (2011) from Odisha University of Agriculture and Technology (OUAT-ICAR), DST-INSPIRE fellowship (2013-2018), Young scientist award at IISF, DST with ICAR NET- 2013, 2014, ICMR-SRF 2013, GATE- 2013, 2014 in Microbiology and Life Science subjects. He has also worked on agricultural management based project at Central Rice Research Institute (CRRI-ICAR), Cuttack, Odisha and has won prestigious national entrepreneurship challenge-2015 by ABLE-DBT for pitching his idea on developing arsenic detection kit. He is life member of many scientific associations viz. international association on hydrological sciences (IAHS), global microbial identifier (GMI), society for human ecology (SHE), We the Microbiologists of India (WTM), Genomics standard consortium (GSC), DCO deep life. In near future, he aims to work on integrated OMICS based insight into geo-microbiology of ecological hotspots and soil-root-plant interface.

**Swati Pattnaik:** An environmental and agricultural microbiologist, presently working as a project associate at Odisha University of Agriculture and Technology (OUAT-ICAR). She completed her Ph.D. in environmental microbiology and crop production from Department of Microbiology, OUAT-ICAR, Bhubaneswar. Her field of expertise lies in the study of bioactive potential assessments of multi-metal resistant bacteria, plant-microbe interactions, bio-control of phyto-pathogens, bio-fertilizer technology. Her efforts also take on the production of polyhydroxyalkanoates and biofilm. Aside from being researcher, she is an educator, avid traveler and dilettante photographer. She believes education has a possible role in social, economical and cultural development of the society. So in upcoming days, she aims to ensure quality education for every child.

**Deepak Kumar Verma:** An agricultural science professional and is currently Ph.D. Research Scholar with specialization in Food Processing Engineering at Agricultural and Food Engineering Department, Indian Institute of Technology Kharagpur (West Bengal), India. In 2012, he received a DST-INSPIRE Fellowship for Ph.D. study by the Department of Science & Technology (DST), Ministry of Science and Technology, Govt. of India. Mr. Verma is currently assigned for research on “Isolation and Characterization of aroma volatile and flavoring compounds from Aromatic and Non-aromatic Rice Cultivars of India” whereas during master degree, his research was assigned entitled “Physico-chemical and Cooking Characteristics of Azad Basmati (CSAR 839-3) - A Newly Evolved Variety of Basmati Rice (*Oryza Sativa* L.)”. He earned his B.Sc. degree in agricultural science in 2009 from the Faculty of Agriculture, Gorakhpur University, Gorakhpur and M.Sc. (Agriculture) in Agricultural Biochemistry in 2011 with the First rank and also received a department topper award from the Department of Agricultural Biochemistry, Chandra Shekhar Azad University of Agricultural and Technology, Kanpur, India. Apart from his area of specialization as Plant Biochemistry, he has also built-up a sound background in Plant Physiology, Microbiology, Plant Pathology, Genetics & Plant Breeding, Plant Biotechnology & Genetic Engineering, Seed Science

and Technology, Food Science & Technology, etc. In addition, he is a member of different professional bodies and his activities and accomplishments include conferences, seminar, workshop, training and also the publication of research articles, books and book's chapter.

**Poulomi Sarkar:** is an engineering professional. She has obtained her M.Tech in Biotechnology in 2012 from Department of Biotechnology, BIT-MESRA, Ranchi (Jharkhand). Following that she obtained her PhD degree in Environmental Biotechnology from Department of Biotechnology, Indian Institute of Technology Kharagpur (West Bengal). Her research work got selected in a number of reputed conferences including 6th Congress of European Microbiologist's FEMS-2015. She also has publications in Bioresource Technology and BMC Microbiology to her credit.

**Shivlata Landhanam:** is a microbiology lover and science enthusiast. She completed her doctorate degree from Department of Microbiology, University of Delhi South Campus (UDSC), New Delhi. She has excellent research experience on industrial enzymes and microbial ecology and has published couple of research papers of international repute. She endeavors to become a revolutionary scientist for motivating young minds to pursue science.

**Jaya Chakraborty:** is an enthusiastic research personnel specialized in the field of Environmental Microbiology. She is now presently associated with CSIR-National Chemical Laboratory, Pune, India as a National Post Doctorate fellow. She was selected for the National Post Doctorate Fellowship by SERB, Department of Science and Technology, Govt. of India in 2018. She completed her doctorate from National Institute of Technology, Rourkela, Odisha, India from the Department of Life Science. She is an active member of Association of Microbiologists of India and has presented several oral and poster presentations in national and international conferences. She has nine years of research experience and has published numerous research papers and book chapters in international journals. She endeavours to become a revolutionary scientist in the field of microbial ecology and functions using next generation sequencing technologies. This could be motivation for many students in developing inquiring minds and curiosity about science.

**Jyotirmayee Pradhan:** Assistant Professor in Zoology (OES-Group A) earned M.Sc. degree in Zoology from SCS College, Puri (Utkal University) in 1999. Immediately after M.Sc. she joined as SRF in ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar and continued her research work on fish pathology for which Utkal University conferred the Ph.D. degree in 2012. Subsequently in 2008, she availed DST-Women's Scientist (WOS-A) Scheme from Ministry of Science and Technology, Government of India. She has worked on development of DNA vaccine to combat *Edwardsiella tarda* infection in commercially important food fishes, a DBT funded project at CIFA-ICAR, and in 2013 she joined as Research Associate in DST- PURSE programme at PG Department Zoology, Utkal University. She has been received Congress of Zoology Medal for outstanding Research and Academic Contribution in the Field of Biochemistry, from Zoological Society of India in 29th All India Congress of Zoology, 2017. So far she has published numbers of international reputed journals. Research fields of her principal interest include microbial diseases in fishes, development of alternative antimicrobial drugs for the treatment of infectious diseases from natural resources. Her topics also include the extraction methods and purification of active metabolites from algae and knowing the in vivo specific and non specific immune system, oxidative stress and antioxidant defense mechanisms. She is an active member of several learned scientific societies. She is the life member of Indian Science Congress Association (ISCA) Calcutta, Association of Aquaculturists, Odisha Bigyan Academy (OBA), Odisha and Zoological Society of India (ZSI), Kolkata.

## PREFACE

The beauty and introduction of “**microbiology**” starts with the most famous quote by famous microbiology lover and enthusiast: “*There are more animals living in the scum on the teeth in a man’s mouth than there are men in a whole kingdom*”:

**Antony van Leeuwenhoek**  
**(The father of Microbiology)**

Microbiology is considered as the science of modern biology and has been defined as the study of organisms and agents too small to be seen clearly by the unaided eye, called microorganisms. However, some microorganisms (*Thiomargarita* and *Epulopiscium*) and some eukaryotic microbes are visible without microscopes (algae, fungus). Over all it includes bacteria, archaea, fungi, microalgae, protozoa and infectious particles; virus, viroids, virusoids and prions. The importance of these tiny, omnipresent and omnipotent organisms can’t be overemphasized. Microbes are all over the world and in every unimaginable, extreme environments (oligotrophic, high-low pH, geothermal vent, arctic tundra, ocean depth and even every person’s organs) and their diversity and abundance are really amazing in such habitat. It is estimated that microbes contribute about 50% of the organic carbon and 90% of the organic nitrogen on this planet which counts to be most dominant and only representative organism on Earth. For example in a typical forest soil, only one gram contains  $10^{12-14}$  numbers of microorganisms and all their associated activities. Their critical role in organizing the biosphere, cycling of the elements, producing nutrients for ecological food chains are indispensable. The role of photosynthetic microbes for creating oxygen rich environment is also a crucial part of evolution of life on Earth. As symbiotic life, they also play important roles, including nitrogen fixation that help in plant growth promotion, helping the body digest food and producing vitamins B and K in the gut. In addition, they are the essential need for production of different fermented foods and food products, tools for studying fundamental science as model organisms and modern biotechnological use of these microorganisms pose it as the basic tool for conducting research as most of the enzymes and factors are derived from these microbes only. So, understanding the diverse population, their metabolism and function in diverse ecosystem, exploring novel potential and developing strategies to harness and manipulate their activities is of necessary value for benefit of the society which can create a better and sustainable living conditions on the planet.

The trend of microbiology in India is very emerging and growing fast in the context of research, industrial jobs and higher study carrier. Microbiology is offered at three levels: undergraduate, post-graduate and PhD and it is offered by several universities with and without specialization in the course curriculum. In Indian context, study of bacteriology, virology, microbial biotechnology, medical microbiology, food and dairy microbiology, environmental microbiology, veterinary & agricultural microbiology and applied microbiology are the most preferred subjects. Undergraduates and graduates students opt for higher studies (PhD and post doctoral research) and dream to enter into teaching profession. So, in India, various funding agencies; **CSIR-UGC**, **ICMR**, **ICAR** carry out nationwide national eligibility test (**NET**) and

graduate aptitude test in engineering (GATE) for selecting the best students for providing fellowship for higher studies in Indian universities. So, all these apex bodies conduct examinations nationwide to uplift the education system and research skills to produce world class researchers and scientists with the best knowledge in the field of microbiology and biotechnology. **So, in this present context, our book “MCQ's in Microbiology: Advance” will be appropriate for preparation and qualifying all the competitive examinations through MCQ based questions with thorough covering of all the aspects of microbiology for uplifting the scientific temper in microbiology. The book also contains short answer based questions cum notes important for Life science students to clear the fundamental and know the technical details. Besides, in the last part of the book, the tools and tricks describe the commonly used microbiological facts and up-to-date knowledge for skill development in microbiology.**

**MCQ's in Microbiology: Advance, “is by the student, of the students, and for the students”** is specifically designed to boost the cutting edge knowledge of students in the field of microbiology and to improve their focus on next generation developmental skills on this subject for making it as their carrier. **This book can bring a light for people those are going to seat in the examinations like: CSIR-UGC NET, ICMR-NET, DBT-JRF, PG-Combined entrance exams, ICAR-NET, ASRB-NET, GATE, SLET, SAUs and various combined entrance exams.** All the questions of this book are assembled from standard textbooks of microbiology covering all the areas of microbiology; Introduction to microbiology, microbial growth and metabolism, microbial genetics, microbial ecosystems (Marine, Freshwater, Soil, Atmospheric and Subsurface), microbial interactions, wastewater microbiology, disease microbiology, industrial microbiology, remediation of polluted environments, culture techniques for detection of microbes and environmental omics (a culture independent approach). We hope this book will surely help the young minds to crack the examinations in a easy and simple way and will definitely useful to the researchers to clarify the doubts that often come during the research work. We also request and welcome our judging audience (readers) to send their valuable suggestions for further improvement of this book.

With esteem wishes

**Balaram Mohapatra  
Swati Pattanaik  
Deepak Kumar Verma  
Poulomi Sarkar  
Shivlata Landhanam  
Jaya Chakraborty  
Jyotirmayee Pradhan**

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## INTRODUCTION TO MICROBIOLOGY

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History and scope of microbiology, evolution of microbial life, theory of spontaneous generation, important groups of prokaryotes – bacteria, actinomycetes, fungi, mycoplasma, viruses, bacteriophages. Heterotrophic bacteria, nitrobacteria, nitrogen-fixing bacteria and cyanobacteria, lactic acid bacteria, halophiles, thermophiles acidophiles and methanogens. Structure and classification of viruses, viroids, prions.

### MCQ's

3. Who discovered the first vaccine for the prevention of human disease is generally given to
  - (A) Edward Jenner for the prevention of small pox
  - (B) Louis Pasteur for the prevention of rabies
  - (C) Louis Pasteur for the prevention of anthrax
  - (D) Robert Koch for the prevention of tuberculosis
4. Which feature among the following was the most important innovation in Pasteur's 'swan neck flask' experiments?
  - (A) A glass barrier prevented contamination.
  - (B) Heating media prevented microbial growth.
  - (C) Fresh air could directly contact the medium.
  - (D) The experimenter could look for contamination without disturbing the experiment.
5. Which among these is a gram-negative, microaerophilic thermophilic bacteria
  - (A) *Bacillus subtilis*
  - (B) *Xanthomonas* sp.
  - (C) *Citrobacter* sp.
  - (D) *Aquifex pyrophilus*
6. Which of the following component constitute the bacterial cell wall?
  - (A) chitin
  - (B) peptidoglycan
  - (C) cellulose
  - (D) amylopectin
7. Which of the following characteristics are present in the bacteria *Deinococcus*?
  - (A) Its peptidoglycan consists of L-ornithine
  - (B) It lacks teichoic acid
  - (C) Its cell membrane consists of large amount of palmitoleic acid
  - (D) All of the above
8. Differential staining of bacteria on Gram staining is due to which of the following feature
  - (A) Difference in cell structure of Gram-positive and Gram-negative bacteria
  - (B) Difference in mode of nutrition of Gram-positive and Gram-negative bacteria
  - (C) Difference of cell wall layer components of Gram-positive and Gram-negative bacteria
  - (D) None of the above

9. Which of the following genera is included in the family Bacteroidaceae?  
(A) *Bacteroides* (B) *Fusobacterium*  
(C) *Leptotrichia* (D) All of these
10. Which of the following bacteria is acid-fast?  
(A) *Actinomyces* (B) *Nocardia*  
(C) *Streptomyces* (D) *Corynebacterium*
11. Many filamentous cyanobacteria fix atmospheric nitrogen by means of special cells known as  
(A) heterocyst (B) trichome  
(C) akinetes (D) food vacuole
12. Which is the the commonest bacterial cause of cervicofacialactinomycosis is  
(A) *A. naeslundii* (B) *A. viscosus*  
(C) *A. israelii* (D) *A. meyeri*
13. Mycoplasma have all the following features present in them, except  
(A) They lack a cell wall  
(B) They are resistant to  $\beta$ -lactam drugs  
(C) They are the smallest prokaryotic organisms that can grow in cell free culture media  
(D) They are obligate intracellular organisms
14. Which among the following uses light energy to transport chloride ions into the cell to maintain a 5 M intracellular KCl concentration  
(A) Halorhodopsin  
(B) Proteorhodopsin  
(C) Bacteriorhodopsin  
(D) Sensory receptors
15. .... is a green non sulfur bacteria  
(A) *Pelodictyon* (B) *Chloroflexus*  
(C) *Cyanobacteria* (D) *Rhodospirillum*
16. The genetic alteration of a cell's genome is called  
(A) Transformation  
(B) reverse transcription  
(C) genome conversion  
(D) invasion
17. When a bacteriophage is integrated into a cellular genome it is called a  
(A) virulent virus (B) lytic virus  
(C) prophage (D) transducing virus
18. The infectious substance of prions is  
(A) protein (B) glycoprophosphate  
(C) RNA (D) DNA
19. \_\_\_\_\_ are small naked fragments of RNA that infect plant cells.  
(A) Prions (B) Nucleons  
(C) Macrophages (D) Viroids
20. Which of the following is not a viral disease?  
(A) mumps (B) measles  
(C) chicken pox (D) diphtheria
21. Viruses that cause lysis in host cells are called  
(A) temperate viruses  
(B) phagocytic viruses  
(C) virulent viruses  
(D) infectious viruses
22. From among the following, name an emerging virus  
(A) Herpes (B) polio  
(C) rubella (D) Ebola
23. The basic structure of a virus contains:  
(A) a nucleic acid (B) a cell wall  
(C) a protein coat (D) both a and b  
(E) both A and C
24. Copying the HIV virus' nucleic acid depends on  
(A) Replicase  
(B) reverse transcriptase  
(C) transcriptase  
(D) reverse replicase