

## MASTER OF SCIENCE MICROBIOLOGY

### *INTRODUCTION*

The Department of Biological Sciences (College of Science) offers a Master of Science Program in **Microbiology**. Only full-time students are admitted to this program. English is the language of instruction and research.

*According to the University Council decision dated 4/2/2007, Thesis students admitted with effect from September 2007 are exempted from the comprehensive examination.*

### **PROGRAM REQUIREMENTS**

#### **31 TOTAL COURSE CREDITS**

##### **10 COMPULSORY (credits in parenthesis)**

0480-385	Statistical methods in Research	(3)
0494-501	Research Techniques	(3)
0494-502	Seminar	(1)
0495-551	Microbial Taxonomy	(3)

##### **12 ELECTIVES\* (3 credits each)**

0495-511	Plant Virology
0495-513	Plant Pathogen Interaction
0495-515	Biology of Actinomycetes
0495-521	Marine Microbiology
0495-523	The Biology of Photosynthetic Bacteria
0495-541	Aspects of Biotechnology
0495-561	Stress Tolerant Micro-organisms
0495-562	Petroleum Microbiology
0495-571	Biology of yeast
0495-581	Advanced Immunology

\*The graduate students will be allowed to take 6 credit hour courses from different disciplines of the Department of Biological Sciences. **The student can only take these courses with the approval of the thesis supervisor.**

The graduate students in the Department of Biological Sciences will be allowed to take three credit hour course/s in Medical/Science faculty **with the approval of thesis supervisor.**

**9 COMPULSORY**

0495-597	Thesis	(0)
0495-598	Thesis	(0)
2000-599	Thesis	(9)

***COURSE DESCRIPTION*****0495-511: PLANT VIROLOGY  
CR: 3**

Nomenclature and classification; infection process; resistance to infection; effect of virus infection on plants; effects of virus infection on the host metabolism; Virus-vector interaction; composition and structure of virus particles; Ecology of viruses; plant pathogens confused with viruses; sub-viral pathogens; Control of viral diseases; Economically important viral diseases.

**0495-513: PLANT PATHOGEN INTERACTION  
CR: 3**

Lectures are confined to diseases caused by fungi and bacteria and will deal with the following topics. Concepts and definitions: Plant diseases, pathogens and parasites, pathogenicity and disease reaction types, definitions and problems of terminology; Interaction between pathogens and other organisms: Initial stages of pathogenesis, attraction of pathogens to plant contact and penetration, colonization of host plants; Mechanisms of attack: cell wall degrading enzymes, toxin in plant diseases; Growth regulating substances; Responses of host plants to infection: pathological alterations in structure, function and in host metabolism; Mechanisms of disease resistance: all types of disease resistance will be discussed in this section. The practical course includes: Inoculation of plants by pathogens, penetration as well as disease development in both a susceptible and a resistant cultivator; Methods of production of enzymes, toxins and growth regulators by different plant pathogens, The chemical analysis and characterization of these factors and their role in disease development. Investigation of disease resistance using advanced techniques such as

electron microscopy, extraction, chromatography etc.

**0495-515: BIOLOGY OF ACTINOMYCETES  
CR: 3**

Isolation from soil by selective media. Cultivation on solid and liquid media. Primary-secondary metabolism, antibiotics. Developmental biology, followed by biochemical and morphological methods. Auto regulatory factors (hormones). Degradation of organic materials - chitin, keratin, organic soil component, mineral oil. Regulating mechanisms. Genetics. Industrial applications.

**0495-521: MARINE MICROBIOLOGY  
CR: 3**

The marine environment. The benthic and planktonic microflora: Sampling, counting and biomass determination; responses to environmental variations, role in oceanic productivity and chemical transformations with reference to fouling problems, symbiotic associations with higher marine organisms, role in and control of pollution. In the practical course the student will be asked to isolate and characterize predominant phytoplankton from the Arabian Gulf. The effect of environmental variables on growth of individual isolates will be investigated.

**0495-523: THE BIOLOGY OF  
PHOTOSYNTHETIC BACTERIA  
CR: 3**

Classification of cyanobacteria, purple and green bacteria; Cell structure and composition; Oxygenic and anoxygenic photosynthesis; Photosynthesis; Effect of light irradiance and quality on photosynthesis, pigment composition and growth; Carbon metabolism in cyanobacteria and the assimilation of Carbon Heterotrophic growth and

metabolism in cyanobacteria; Nitrogen fixation: mechanism, regulation of nitrogenase biosynthesis and activity. Hydrogenase-nitrogenase interrelationship; Interaction of cyanobacteria with heterotrophic bacteria. The practical course includes: Isolation and identification of photosynthetic bacteria. Effect of light on photosystem II, I and NADP photoreduction. Enzyme assays such as glycolate dehydrogenase I oxidase, acetate dehydrogenase, Malate dehydrogenase. Nitrogen fixation experiments using acetylene reduction method.

**0495-541: ASPECTS OF BIOTECHNOLOGY**  
**CR: 3**

1. Genetic Engineering:

Structure of DNA, topology of DNA, restriction enzymes (enzymes used in bioengineering), plasmids (PBR322, PUC8, PUC9); cloning with Plasmids and M13, cloning strategies, expression of cloned genes, sequencing (chemical & enzymatic); Split genes. The genetic element that control gene expression.

2. Plant Cell Structure

History of the technique; description of the technique: callus cultures, suspension cultures, protoplast cultures, green and photosynthetic cultures; The technique as a tool in basic studies (Cytology and genetics, physiology and biochemistry, genetic engineering); Production of valuable metabolites; Agricultural applications: vegetation propagation, programming, generation of stress-tolerant plants.

In the practical part (open laboratory) each student will be provided with seeds of a particular plant. He/She will be asked to establish callus and suspension cultures for this plant under the supervision of the lecturer.

**0495-551: MICROBIAL TAXONOMY**  
**CR: 3**

1. Bacteria: (lectures only)

Origin and evolution of prokaryotes: Chemical, biochemical and phylogenetics evolution with reference to paleomicrobiology and origin of eucaryotes; Problems related to bacterial taxonomy: What is a bacterial species? Variability; Approaches to bacterial taxonomy: Classical,

numerical, biochemical and genetic taxonomy; Nomenclature and classification of bacteria: artificial and phylogenetic keys; description of the major bacterial parts as presented in Bergey's Manual. Emphasis on phylogenetic relationships; Problems related to taxonomy of cyanobacteria.

2. Fungi (Theoretical and Practical)

Historical aspects of microbial taxonomy: Fungal taxonomy and its links with botanical nomenclature and its application in fungal systematic; Introduction to international code of binomenclature; Introduction to world herbaria and culture collections: Preservation procedures for dried specimens; herbarium organization, Presentation procedures for living cultures, freeze-drying, liquid nitrogen storage agar slants, under mineral oil. Taxonomy of anamorphic fungi, taxonomy of telomorph fungi.

This practical session in the taxonomy of fungi will be in the form of open laboratory sessions for identification of taxa using standard and specific keys. An introduction to technology of preservation and maintenance of cultures will be included too.

**0495-561: STRESS TOLERANT MICRO-ORGANISMS**  
**CR: 3**

Review of the naturally occurring extreme ecological environments and niches which support microbial life; Review of man-made environments and conditions. Influence of industrial activity and pollution on the environment; Taxonomic survey of the stress-tolerant and obligate microbes; relationship with the Archaea, Bacteria and Eukarya and the role of natural selection in determining the composition of populations in the extreme environments; Membrane composition and function; Proteins and ribosomes; Stress induced biochemical activity in tolerant and obligate organisms; Interactions of microbes with unconventional or complex nutrient sources; hydrocarbons and heavy metals.

**0495-562: PETROLEUM MICROBIOLOGY**  
**CR: 3**

Introduction: Microorganisms in genesis of petroleum, application of microorganisms in

petroleum prospecting, Introductory petroleum chemistry; Microbially enhanced oil recovery. Microorganisms in deterioration of crude oil production systems, Microorganisms in oil reservoirs; anaerobic corrosion in petroleum systems; Remediation: preventive and combative measures against microbial deterioration of crude oil systems, Petroleum pollution and role of microorganisms in remediation. Lab: classes will be in the form of mini projects to cover topics in petroleum microbiology.

**0495-571: BIOLOGY OF YEAST**

**CR: 3**

The practicals will be in the form of open laboratory and will cover the topics raised in the lectures. The lectures cover: isolation and identification of yeasts; physiology and growth; sugar transport, proteinase production, Polarographic measurements of oxygen uptake; influence of fundamental characteristics of yeast: growth form, ultra structure, taxonomy; biochemistry of yeast: Structure and composition of yeast cell membranes and walls, intermediary metabolism, bioenergetics, Biosynthesis and degradation of molecules; Formal genetics: yeast life cycle, mating type, mapping chromosomes, mating type switching, recombination and gene mapping; Molecular biology & genetics: Yeast plasmids - 2 $\mu$ m and related ones. Killer plasmids in *Saccharomyces* & other yeast using autonomously replicating or integrating vectors. Expression of cloned genes. Protoplast formation, regeneration & fusion; Yeast biotechnology; Pathogenic yeast; Food spoilage. antifungal; protoplast preparation; isolation of petite mutants; adhesion of yeast to host tissues.

**0495-581: ADVANCED IMMUNOLOGY**

**CR: 3**

Basic concepts. Innate immune mechanisms to infection: Cellular mechanisms Humoral mechanisms. Acquired cell-mediated immune mechanisms to intracellular infections: The cytotoxic T lymphocyte population (CTL), The helper T lymphocyte population (TH). Acquired humoral immune mechanisms to extracellular infections. Molecular aspects of immune recognition and regulation. Immune mechanisms to viral-induced tumors. Failures of immune mechanisms to infection: Envasive strategies employed by infectious pathogens, Acquired immune deficiency syndrome (AIDS). Manipulation of the immune response to fight infection.

**0495-597: THESIS**

**CR: 0**

**0495-598: THESIS**

**CR: 0**

**2000-599: THESIS**

**CR: 9**