APPENDIX-9 (R)
UNIVERSITY OF MADRAS
M.Sc. DEGREE COURSE IN APPLIED MICROBIOLOGY
(CBCS)
(To take effect from the academic year 2013-2014)

I. That in the Regulations relating to M.Sc. Degree Course in Applied Microbiology – under Regulation No. 5 - Scheme of Examinations be modified to read as follows.

REVISED SCHEME OF EXAMINATIONS:

FIRST SEMESTER

<table>
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<tr>
<th>Semester</th>
<th>Course Components</th>
<th>Name of the Subject</th>
<th>Inst. Hrs.</th>
<th>Credits</th>
<th>Exam Hours</th>
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<tbody>
<tr>
<td>I</td>
<td>Core Paper-I</td>
<td>Microbial Taxonomy</td>
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<td>Core Paper-II</td>
<td>General Microbiology and Laboratory Animal Science</td>
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<td>Core Paper-IV</td>
<td>Practical - I * General Microbiology, Physiology and Immunology</td>
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<td>I</td>
<td>Elective - I</td>
<td>Metabolic Pathways</td>
<td>4</td>
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# SECOND SEMESTER

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<td>Virology</td>
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<td>II</td>
<td>Core Paper-VI</td>
<td>Systematic Medical Bacteriology</td>
<td>5</td>
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<td>Core Paper-VII</td>
<td>Mycology and Parasitology</td>
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<td>Core Paper-VIII</td>
<td>Practical - II * Systematic Bacteriology, Mycology, Parasitology and virology</td>
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# THIRD SEMESTER

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### FOURTH SEMESTER

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<td>Food, Dairy and Environmental Microbiology</td>
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* University Practical Examinations will be conducted in even semester only.

** Internship will be carried out during the summer vacation of the second semester and the report will be evaluated by two examiners within the department of the College / Institution. The marks should be sent to the University by the College and the same will be included in the third semester statement of marks.

# For the students undergoing M.Sc. (Applied Microbiology) in affiliated colleges, it shall be mandatory to do the project component of the curriculum only in the respective college, instead of doing it in Private / Commercial Laboratories.

II. The above amendment to the Regulations take effect from the academic year 2013-2014 and thereafter.

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AC.S’12
APPENDIX-9(S)
UNIVERSITY OF MADRAS
M.Sc. DEGREE COURSE IN APPLIED MICROBIOLOGY
(CBCS)
REVISED SYLLABUS
(To take effect from the academic year 2013-2014)

SEMMESTER - I

CORE PAPER I - MICROBIAL TAXONOMY

UNIT I
Taxonomy, systematics, identification: Taxonomical hierarchy-species- type strains: culture collections; binomial nomenclature; systems of classification- phenetic, numerical taxonomy- similarity matrix, dendrograms with examples; phylogenetic with examples; general characteristics used in classification- five kingdom, six kingdom and eight kingdom systems.

UNIT II
Classification of bacteria according to Bergey's Manual of systematic bacteriology 9th edition (up to level of section); characteristics of major sections; classification of archaea, photosynthetic bacteria, Entrobacteriaceae, Mollicutes.

UNIT III
Classification of Fungi - characteristics of zygomycetes, ascomycetes, basidiomycetes and dueteromycetes.

UNIT IV
Classification of Protozoa - classical 1980; official system & 1993 Cavalier- Smith. Distinguishing characteristics of ciliates; flagellates; sporozoa; heliozoans; amoeba.

UNIT V
Classification of Algae - major characteristics of chlorophycophyta, crisophycophyta, cryptophycophyta, euglinophycophyta & rhodophycophyta. Classification of viruses - animal viruses, plant viruses and phages.

*****
CORE PAPER II - GENERAL MICROBIOLOGY AND LABORATORY ANIMAL SCIENCE

UNIT I
Microscopy – Its principles and application in the field of Microbiology including the following: Dark field, Phase contrast, Fluorescence microscopy, TEM and SEM. Principles, operation and maintenance of: refrigerated and ultracentrifuges, Spectrophotometer, Lyophilizers. Staining methods – Simple, differential and special methods. Sterilization and disinfection methods and their quality control.

UNIT II

UNIT III

UNIT IV
Laboratory Animal Science. Modern methods of care, management, breeding and maintenance of laboratory animals. Detailed account of nutrition, handling, uses of different laboratory animals - rabbits, mice, rats, guinea pigs, monkeys, hamsters, fowl, sheep.

UNIT V
Breeding and handling of specific pathogen free Gnotobiotic animals and their maintenance and uses. Transgenic animal models – Methodology and uses. Disposal of animal house wastes and used animals. Laboratory uses of animals with special reference to microbiology, pathogenicity testing, antibody production, toxin/toxoid testing, hypersensitivity testing, maintenance of microbes in animals.

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CORE PAPER III – IMMUNOLOGY

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Vaccines: Principles and types. Immunization - its rationale, schedules and importance in public health.

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CORE PAPER IV - PRACTICALS - I - GENERAL MICROBIOLOGY, PHYSIOLOGY AND IMMUNOLOGY

UNIT I
Microscopic Techniques: Light microscopy: Hay infusion broth. Wet mount to show different types of microbes, hanging drop. Dark field microscopy: To show motility of spirochetes and others. Phase contrast microscopy: To show Eukaryotic Cell division, morphology etc. Fluorescence microscopy: Fluorescent staining for Mycobacteria, auromine, staining, Fluorescent antibody techniques.

UNIT II

A-9
Washing and cleaning of glass wares: Sterilization principles methods: moist heat, dry heat, filtration. Quality control check for each method:

**UNIT III**

Staining Techniques: Smear preparation, simple staining, Gram’s staining, Acid fast staining, Metachromatic granule staining, Cell wall, spore, capsule, Flagella, Silver impregnation methods.

**UNIT IV**

Media Preparation: Preparation of liquid, solid and semisolid media. Agar deeps, slants, plates. Preparation of basal, enriched, selective, enrichment media. Quality control and uses. Preparation of Biochemical test media, media to demonstrate enzymatic activities.

**UNIT V**

Microbial Physiology: Purification and maintenance of microbes. Streak plates, pour plate, and slide culture technique. Aseptic transfer, growth and growth requirements: Cell number, and cell proteins. Direct counts, viable counts, pour plate, streak plate. Bacterial growth curve – Turbidimetry, Anaerobic culture methods.

**UNIT VI**

Preparation of Bacterial Antigens (Crude preparation) by homogenization or sonication. Raising polyclonal antisera in experimental animals - rabbit or mouse with bacterial antigens, RBC (Demonstration).

**UNIT VII**


**UNIT VIII**

Preparation of Lymphocytes from peripheral blood by density gradient centrifugation. Purification of Immunoglobulins: Ammonium sulphate precipitation. Separation of IgG by chromatography using DEAE cellulose or Sephadex. Anaphylactic reactions in Guinea pigs; Arthus reaction in rabbits (Demonstration only). Skin tests.
ELECTIVE – I - METABOLIC PATHWAYS

UNIT I
Enzymes – nomenclature, components - Mechanism of enzyme reactions - Factors influencing enzymatic activity - Inhibition of enzyme action - Metabolic channeling – Control of enzyme activity – Regulation of enzyme synthesis.

UNIT II

UNIT III

UNIT IV
Lipid Metabolism – Oxidation of lipids; biosynthesis of fatty acids; triglycerides; phospholipids; sterols. Protein and amino acid catabolism – Oxidation of inorganic molecules – Photophosphorylation.

UNIT V
Bio chemical pathways of energy use – Photosynthetic fixation of CO₂ – Biosynthesis of peptidoglycan – Biosynthesis of lipids – Biosynthesis of amino acids -proline, arginine, aspartic acid, histidine- Interconversions - therionine, isoleucine and methionine; isoleucine ,valine and leucine; serine and lysine; Aspartate and pyruvate. Bio synthesis of purines and pyrimidines.

ELECTIVE – II - MICROBIAL DIVERSITY

UNIT I
Biodiversity: Introduction to microbial biodiversity- distribution, abundance, ecological niche. Types – Bacterial, Archael and Eucaryal

UNIT II

UNIT III

UNIT IV

Space Microbiology - Aim and objectives of space research. Life detection methods a) Evidence of metabolism (Gulliver) b) Evidence of photosynthesis (autotrophic and heterotrophic) c) ATP production d) phosphate uptake e) sulphur uptake.

UNIT V


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SEMESTER II

CORE PAPER V - VIROLOGY

UNIT I

Brief outline of virology- discovery of virus- general properties of viruses- general methods of diagnosis and serology- virioids, prions, satellite RNAs and virusoids.

UNIT II

Bacterial viruses - ΦX 174, M13, MU, T4, lambda, Pl; structural organization, lifecycle and phage production. Lysogenic cycle-typing and application in bacterial genetics.

UNIT III

Plant viruses-TMV- general characters- morphology-replication-RNA as its initiator of infection. Cauliflower mosaic virus; Transmission of plant viruses; common viral diseases of crop plants- paddy, cotton, tomato, and sugarcane. Viruses of cyanobacteria, algae, fungi and insects.

UNIT IV

DNA Viruses- Pox viruses, Herpes viruses, Adeno viruses, Papova viruses and Hepadna viruses; RNA Viruses- Picorna, Orthomyxo,
Paramyxo, Toga and other arthropod borne viruses, Rhabdo, Rota, HIV and other Hepatitis viruses.

UNIT V
Epidemiology, Diagnosis and Treatment of Viral Diseases; Viral Vaccines and Antiviral agents.

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CORE PAPER VI – SYSTEMATIC MEDICAL BACTERIOLOGY

UNIT I

UNIT II
Host Parasite relationships – Nonspecific host immune mechanisms. Ground rules for collection and dispatch of clinical specimens for microbiological diagnosis.

UNIT III
Morphology, classification, cultural characteristics, Pathogenicity, pathology, Laboratory diagnosis and prevention – Control and treatment of diseases caused by the following organisms: Staphylococci, Streptococci, Pneumococci, Neisseriae (Gonococci & Meningococci), Corynebacterium, Mycobacterium, Clostridium, Bacillus.

UNIT IV
Studies on Salmonella, Shigella, Vibrios, Brucella, Gram negative anaerobes, Spirochetes, Rickettsiae, Chlamydiae, Mycoplasmas and ureaplasmas.

UNIT V
Zoonotic diseases and their control – Hospital acquired infections – Hospital Infection control committee – functions – Hospital waste disposal – Ethical committee – functions.
CORE PAPER VII - MYCOLOGY AND PARASITOLOGY

UNIT I

UNIT II

UNIT III

UNIT IV
Introduction to Medical parasitology – classification, host-parasite relationships. Epidemiology, life cycle, pathogenic mechanisms, lab diagnosis, treatment, etc. for the following: Protozoa causing human infections – Entamoeba, Aerobic and Anaerobic amoebae. Toxoplasma, Cryptosporidium, Leishmania, Trypanosoma, Giardia, Trichomonas, Balantidium.

UNIT V

CORE PAPER VIII – PRACTICAL-II - SYSTEMATIC BACTERIOLOGY, MYCOLOGY, PARASITOLOGY AND VIROLOGY

UNIT I
Collection and transport of clinical specimens -Prerequisites - Proforma -Methodologies. Direct examinations - wetfilms/stainings for Faeces (V.cholerae, Shigella, Salmonella) Pus, Sputum,
throat/ear/nasal/wound swabs, CSF and other body fluids. Simple, differential and special staining methods.

UNIT II

UNIT III
Antibiotic sensitivity tests - Stokes & Kirby Bauer methods - Disc diffusion - Dilution - Agar dilution & broth dilution - MBC/MIC - Quality Control for antibiotics and standard strains.

UNIT IV

UNIT V

UNIT VI

*****

ELECTIVE III - INDUSTRIAL & PHARMACEUTICAL MICROBIOLOGY

UNIT I
Isolation, preservation and improvement of industrially important micro organisms; Raw materials and media design for Fermentation processes; Sterilization; Development of inoculums for industrial
fermentations; Types of fermentation: Batch, continuous, dual or multiple, surface, submerged, aerobic and anaerobic.

UNIT II

UNIT III

UNIT IV
Production of primary metabolites: Alcohols (Ethanol and Butanol); Beverages (Beer and Wine); Aminoacids (Glutamic acid and Lysine); Organic acids (Citric acid and acetic acid).

UNIT V
Production of secondary metabolites: Antibiotics (Penicillin and Streptomycin); Vitamins (Riboflavin and Cyanocobalamin); Steroids; Production of enzymes (Protease, amylase and lipase); Biopolymers (Xanthan gum and PHB); Biopreservatives (Nisin).

*****

EXTRA DISCIPLINARY ELECTIVE I – BIOSTATISTICS AND BIOINFORMATICS

UNIT I
Nature and scope of statistical methods and their limitations compilation, classification, tabulation and applications in life sciences. Graphical representation – measure of average, dispersion - stem and leaf plots; box and whisker plots, coplots. Introduction to probability theory and distributions (concepts without derivation) binomial, poission and normal (only definition and problems).

UNIT II
Correlation and regression – concepts of sampling and sampling distribution – tests of significance based on t-test, chi-square and F-test for means, proportions, variations and correlation efficient, theory of attributes and tests of independence of contingency tables.

UNIT III
Sampling methods - simple, random, stratified, systemic and cluster sampling procedures. Sampling and non-sampling errors. Principles of scientific experiments- analysis of variance- one way and two way classification.

UNIT IV
Overview of bioinformatics- database types. Genomics and human genome project. Computational tools for sequence analysis and similarity searching.

UNIT V
Pair wise and multiple sequence alignment. Macromolecular structure function relationships. DNA micro array. Next generation sequencing. Systems medicine.

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SEMESTER - III
CORE PAPER IX - MICROBIAL GENETICS

UNIT I
Historical perspectives of microbial genetics. Nucleic acid as genetic information carriers: experimental evidence. DNA – types, structure and properties topology, super helicity, linking number.

UNIT II

UNIT III
Plasmids as extrachromosomal genetic elements; types and properties. Structure and replication of different plasmids: Col E1, F1 and Ti plasmids. Plasmid amplification and curing; Gene transfer mechanisms: Transformation, conjugation and transduction.

UNIT IV
Mutation and Mutagenesis – mechanisms, biochemical basis, mutagens. Molecular basis of spontaneous and induced mutations. Reversion and suppression. Environmental Mutagenesis and toxicity testing; Carcinogenicity - chemical carcinogenesis and their testing. Isolation of Mutants.
UNIT V

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CORE PAPER X - GENETIC ENGINEERING

UNIT I
Principles and methods in genetic engineering: Host cell restriction - restriction modification. Restriction enzymes - types and applications, restriction mapping; Enzymes used in genetic engineering - Nucleases, Ribonucleases, DNA ligases, Tag DNA Polymerases, Methylases, Topoisomerases, Gyrases and Reverse Transcriptases.

UNIT II

UNIT III

UNIT IV
Analysis of Recombinant DNA. Polymerase chain reaction. Principles and techniques of nucleic acid hybridization and cot curves - Southern, Northern, Western and South-Western blotting techniques. Dot and Slot blotting.

UNIT V
DNA and protein sequencing. Protein engineering. Protoplast fusion. Hybridoma Technology. DNA finger printing - RFLP, RPAD and AFLP techniques. Applications of genetic engineering in agriculture, health and industry including gene therapy.

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CORE PAPER XI - MOLECULAR BIOLOGY

UNIT I

UNIT II
DNA replication, repair and recombination - unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra-chromosomal replications. DNA damage and repair mechanisms.

UNIT III
RNA synthesis and processing: Transcription factors and machinery - formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination. RNA processing - RNA editing, splicing, polyadenylation, RNA transport.

UNIT IV

UNIT V
Control of gene expression at transcription and translation level - Regulation of phages, viruses, prokaryotic and eukaryotic gene expression - Role of chromatin in regulating gene expression and gene silencing.

CORE PAPER XII - PRACTICAL - III - MICROBIAL GENETICS, MOLECULAR BIOLOGY AND GENETIC ENGINEERING

UNIT I
Isolation of genomic DNA from bacteria and demonstration in agarose gel electrophoresis. Isolation of plasmid DNA by alkali lysis.
UNIT I

Isolation of DNA from yeast. Estimation of DNA by orcinol method. Determination of Tm value of DNA. Quantitation of nucleic acids by UV Spectrophotometer.

UNIT II

Isolation of RNA from yeast. Estimation of RNA by orcinol method. Induced mutagenesis - Isolation of antibiotic resistant auxotrophic mutants.

UNIT III


UNIT IV

Separation of proteins using Gel filtration and Ion exchange chromatography. Immobilization of enzymes and whole cells. Western blotting. Protoplast and spheroplast isolation. Induction of beta-galactosidase activity in E. coli using IPTG.

UNIT V

Preparation of competent cells. Transformation and Blue-White selection for transformants. DNA amplification by PCR. Separation of PCR amplified product on PAGE and determination of product size. Restriction mapping / Restriction analysis.

ELECTIVE-IV - SOIL AND AGRICULTURAL MICROBIOLOGY

UNIT I

Characteristics and classification of soils; Soil Microorganisms; Interactions between microorganisms - Mutualism, commensalism, ammensalism, synergism, parasitism, predation, competition. Interaction of microbes with plants - rhizosphere, phyllosphere and mycorrhizae.

UNIT II

UNIT III

UNIT IV
Symptoms, Etiology, Epidemiology and management of the following plant diseases: Mosaic disease of tobacco; Bunchy top of banana; Leaf roll of potato; Bacterial blight of paddy; Angular leaf spot of cotton, Late blight of potato; Damping off of tobacco, Downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Blight of maize/sorghum; Leaf spot of paddy, Grassy shoot of sugar cane; Root knot of mulberry.

UNIT V

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EXTRA DISCIPLINARY ELECTIVE-II - ENVIRONMENTAL BIOTECHNOLOGY

UNIT I

UNIT II

UNIT III
UNIT IV

UNIT V
Bioremediation: Strategies for bioremediation - Pollution monitoring, control and remediation (petroleum industry, paper industry, chemical industry etc.). Biomass from the wastes.

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SEMESTER - IV
CORE PAPER XIII - FOOD, DAIRY AND ENVIRONMENTAL MICROBIOLOGY

UNIT I

UNIT II

UNIT III

UNIT IV
Environmental Microbiology: Waste treatment - Wastes - types and characterization. Treatment of solid wastes - composting, vermiform composting, silage, pyrolysis and saccharifications. Treatment of liquid wastes - primary, secondary (anaerobic and aerobic) - trickling,
activated sludge, oxidation pond, and oxidation ditch-tertiary - disinfection.

UNIT V

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CORE PAPER XIV - PRACTICAL-IV - SOIL, AGRICULTURAL, FOOD AND ENVIRONMENTAL MICROBIOLOGY

UNIT I

UNIT II
Estimation of foliar infection by Stoyer's method. Cultivation of oyster mushroom. Study of the following diseases: Tobacco mosaic; Bacterial blight of paddy; Downy mildew of bajra; Powdery mildow of cucurbits; Head smut of sorghum, Leaf rust of coffee; Leaf spot of mulberry, Red rot of sugarcane, Root knot of mulberry.

UNIT III

UNIT IV
Extracellular enzyme activities - phosphatase. Quantification of microorganisms in air-solid and liquid impingement techniques.

UNIT V
Physical, chemical and microbial assessment of water and potability test for water. Physical and chemical - colour, pH, alkalinity, acidity, COD, BOD, anions and cations. Microbiological - MPN index - presumptive, completed and confirmatory tests.

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CORE PAPER XV - PROJECT AND VIVA VOCE

OBJECTIVE OF THE COURSE
To impart advanced practical knowledge in conducting a research project.
To plan and design statistically, retrieve relevant literature, organize and conduct, process the data, photograph relevant observations, evaluate by statistical programmes. Present the project in any regional/national conference/seminar during the Second year of the course and submit for final semester Examinations. The work has to be conducted in department under the guidance of the project supervisor. Interdisciplinary collaborations from external departments / institutions can be organized only for essential areas of the project. The method of valuation of project report submitted by the candidate is outlined as follows:

Internal (2 out of 3 presentations) - 20 Marks
Viva - 20 Marks
Project Report - 60 Marks

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ELECTIVE V - RESEARCH METHODOLOGY

UNIT I

UNIT II
Writing the Research Report (Thesis and publications): Components of research report - Title, Authors, Addresses, Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Summary, Acknowledgements and Bibliography.

UNIT III

UNIT IV

UNIT V

TEXT BOOKS
19. Microbiology: dynamics and diversity by perry.


REFERENCE BOOKS


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AC.S’12