APPENDIX - 8 (R)
UNIVERSITY OF MADRAS
CHOICE BASED CREDIT SYSTEM
B.Sc. DEGREE COURSE IN MICROBIOLOGY
(for the candidates admitted from the academic year 2013-2014)

I. That in the Regulations relating to B.Sc. Degree Course in Microbiology – under Regulation No. 6-Scheme of Examinations be modified to read as follows.

REVISED SCHEME OF EXAMINATIONS

FIRST SEMESTER

<table>
<thead>
<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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<tr>
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<td>Language Paper – I</td>
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**Part IV – Non-major –elective, EVS, Value education, Extension activity is applicable to B.Sc. Microbiology degree course as followed in the other Under-graduate / 5 year Integrated degree courses.**

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

**AC.S’12**
UNIVERSITY OF MADRAS
CHOICE BASED CREDIT SYSTEM
B.Sc. DEGREE COURSE IN MICROBIOLOGY
(for the candidates admitted from the academic year 2013-2014 onwards)

REVISED SYLLABUS

SEMESTER - I

CORE: PAPER-I

GENERAL MICROBIOLOGY & MICROBIAL PHYSIOLOGY

UNIT I
History of microbiology, microscopy including electron microscope; stains and staining methods. Anatomy of prokaryotic and eukaryotic cells.

UNIT II
Culture media and pure culture techniques. Anaerobic culture techniques. Sterilization and disinfection; Antimicrobial chemotherapy. Methods of bacterial identification - morphological, physiological, biochemical and serological properties.

UNIT III

UNIT IV

References:


**CORE PAPER II - Major Practical –I**

**GENERAL MICROBIOLOGY AND MICROBIAL PHYSIOLOGY**

**UNIT I**

**UNIT-II**
Pure culture techniques: streak plate, pour plate, decimal dilution. Culture characteristics of microorganisms: growth on different media, growth characteristics and description. Demonstration of pigment production.
UNIT-III

UNIT-IV

UNIT-V
Physiology characteristics: IMViC test, H2S, Oxidase, catalase, urease test. Carbohydrate fermentation test, maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

ALLIED I - Paper I – BIOCHEMISTRY - I

UNIT-I :
Chemistry of Carbohydrates Definition and Classification of carbohydrates, linear and ring forms (Haworth formula) for monosaccharides for glucose and fructose. Disaccharides - sucrose and lactose. Physical properties - mutarotation and kiliani cynohydrin synthesis. Chemical properties-Oxidation, reduction, osazone formation. Disaccharide-sucrose and lactose - occurrence, structure; Physical and chemical properties. Polysaccharides: starch and cellulose-occurrence, structure, physical and chemical properties

UNIT-II :
Chemistry of aminoacids: Definition and classification of aminoacids, common properties of aminoacids, amphoteric nature, isoelectric point, isoelectric pH and Zwitter ion. Reaction with ninhydrin, 1-fluoro-2, 4-dinitronitrobenzene (FDNB) and Sieg Fried’s carbamino reaction.

UNIT-III :

UNIT-IV :
Chemistry of Lipids
Definition, classification and functions. Occurrence, chemistry and biological functions- simple lipids: tertiary compound lipids (e.g. phospholipids), derived lipids: steroids (e.g. cholesterol). Saturated fatty acids: Butyric, arachidic and stearic acid. Unsaturated fatty acids: Oleic, linoleic and linolenic acid. Physical property emulsification. Chemical properties-saponification, rancidity, definition of acid number, saponification number, iodine number and Reichert-Meissl number. Bile acid and bile salt functions.

UNIT-V :
Chemistry of Nucleic acids Definition, nucleoside, nucleotide and polynucleotide. Double helical model of DNA and its biological functions. Structure of RNA: tRNA, mRNA and rRNA-occurrence, chemistry and its biological functions. Differences between DNA and RNA properties: cot curve and cot value, Tm, hypo and hyper chromicity.

References
4. Biochemistry-Dr. Amit Krishna De, S. Chand & Co., Ltd.
5. Biochemistry-Dr. Ambika Shanmugam, Published by Author.

ALLIED I – Paper II
PRACTICAL I - BIOCHEMISTRY - I

PRACTICAL I Volumetric Estimation

1. Estimation of HCl using Na2CO3 as link and NaOH as primary standard.
2. Estimation of Iron in Ferrous Ammonium Sulphate using potassium permanganate as link solution and oxalic acid as primary standard.
4. Estimation of Glycine by formal titration.
5. Estimation of Ascorbic acid.

SEMESTER II

CORE PAPER – III IMMUNOLOGY AND MICROBIAL GENETICS

UNIT I

UNIT II

MHC – structure & types ; Immuno haematology; Hypersensitivity reactions – types ; Transplantation Immunology (types & graft rejection) Immunological techniques – precipitation, agglutination, CFT, RIA, ELISA, IFT, Western blot.

UNIT III


UNIT IV


References:


**CORE PAPER -IV – MAJOR PRACTICAL-II
(IMMUNOLOGY AND MICROBIAL GENETICS)**

**UNIT-I**

Blood groups and typing - Coombs’s test. Precipitation reaction in

UNIT-II

Complement fixation test. Titration of amboceptor and complement (demonstration only). Immunofluorescence, (Demonstration only), ELISA

UNIT-III

Isolation of Buffy coat, using heparin lymphocytes (T cells, B cells), Enumeration of different cell types, Peripheral blood cell counts, absolute cell counts.

UNIT-IV

Antibody productions in rabbits against sheep RBC and its titration (Demonstration). Anaphylactic reactions in guinea pigs. Arthus reaction in rabbits, (Demonstration).

UNIT-V

Skin tests, both immediate and delayed hypersensitivity reactions to egg proteins, bacterial, fungal antigens.

ALLIED I – Paper III - BIOCHEMISTRY- II

UNIT-I:

Metabolism Glycolysis, TCA cycle, HMP shunt and its energy yield. Deamination, transamination reaction, SGOT and SGPT. Urea cycle, Biosynthesis of fatty acids, beta oxidation.

UNIT-II:

Metabolic Disorders Jaundice, hypoxia, glycogen storage diseases, pentosuria, ketosis, lipidosis, edema, gout. Dehydration: definition, causes, symptom and prevention.

UNIT-III:

UNIT-IV :

UNIT-V :
Vitamins and Minerals A brief outline of occurrence and biological function of Vitamins and minerals (Na, K, Cl, Ca, P, I , Fe, Mg & S)

References
4. Biochemistry-Dr. Amit Krishna De, S. Chand & Co., Ltd.
5. Biochemistry-Dr. Ambika Shanmugam, Published by Author.

ALLIED I – Paper IV

PRACTICAL II - BIOCHEMISTRY - II

PRACTICAL II Qualitative analysis
1. Carbohydrates: Glucose, fructose, galactose, mannose, maltose, lactose and arabinose and xylulose.
2. Amino acids: Arginine, cysteine, tryptophan and tyrosine.
Colorimetric analysis (only for demonstration)
1. Estimation of protein by Biuret method.
2. Estimation of DNA using diphenyl amine.
3. Estimation of glucose by O-Toluidine.

References:
UNIT I
DNA structure, various forms (A, B, Z & H), Stability of nucleic acid structures; prokaryotic and eukaryotic genome organizations.

UNIT II
DNA replication, repair and recombination: Enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, 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, structure and function of different types of RNA.

UNIT IV
Protein synthesis: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA.

UNIT V
Control of gene expression at transcription and translation level: Regulation of, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

References:


CORE PAPER VI

MAJOR PRACTICAL III (MOLECULAR BIOLOGY)

UNIT I

UNIT II
Isolation of Plasmid DNA by Alkalysis method.
Isolation of Chromosomal DNA from Eukaryotic cells. Eg. Leaves.

UNIT III
Isolation of RNA from yeast.
Isolation of antibiotic resistant mutants.

UNIT IV
Preparation of competent cells.

UNIT V
Transformation of E.coli.

ALLIED II - Paper I - BIOINSTRUMENTATION

Unit –1 Basic laboratory Instruments
Common laboratory equipment – anaerobic incubator – Biosafety Cabinet -
Principle and working of pH meter, Laminar-air flow. Centrifugation: Types & principles
and their applications- Lyophilizer - Flow cytometry.
Unit – 2 Chromatographic techniques
Theory, principles and applications of paper, thin layer, gel filtration, ion exchange,

Unit – 3 Electrophoretic techniques
Basic principles of electrophoresis, theory and application of paper, agarose,

Unit – 4 Spectroscopy
Spectroscopic techniques, theory and applications of UV, Visible, IR, NMR, Fluorescence,

Unit – 5 Radioisotopic techniques
Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, autoradiography and its applications.

ALLIED II – Paper II
PRACTICAL III (BIOINSTRUMENTATION)
1. Studies on pH titration curves of amino acids/ acetic acid and determination of pKa values and Henderson-Hasselbach equation.
2. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography.
4. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
6. Demonstration of PCR, DNA sequencer, Fermenter, Flow cytometry
References

Laboratory / online


3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.


5. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.


7. Analytical Biochemistry by Holme.


SEMESTER - IV

CORE PAPER VII - SOIL AND AGRICULTURAL MICROBIOLOGY

UNIT I

Soil microbiology - quantitative and qualititative micro flora of different soils-role of microbes in soil fertility-tests for soil fertility - soil structure, soil formation - characterization of soil types and importance.

UNIT II

UNIT III

Microbial interactions between microorganisms, plant and soil. Rhizoplane, rhizosphere, phyllosphere, spermosphere, mycorrhizae. Microbial association with insects-gut micro flora - symbiosis between microbes and insects; organic matter decomposition.

UNIT IV

Nitrogen cycle; ammonification- nitrification- de-nitrification- nitrogen fixation- Bio-fertilizers (bacterial, cyanobacteria and azolla) and crop response-bio-pesticides (bacterial, viral and fungal) saprophytes for pathogen suppression.

UNIT V

Principles of plant infection and defense mechanisms. 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.

References:


CORE PAPER VIII - MAJOR PRACTICAL IV
(SOIL AND AGRICULTURAL MICROBIOLOGY)

UNIT I
Methods to study soil microorganisms - Isolation and enumeration of Bacteria, Fungi, Bacterio-phages, Algae, Protozoa etc., Microbiological test for fertility - Bacterial and Fungal

UNIT II
Microbiological demonstration of soil enzymes – Amylase, Protease, Lipase, Gelatinase etc.

UNIT III

UNIT IV
Isolation and identification of nitrogen fixing Cyanobacteria-Anabaena, Nostoc etc., Demonstration of Azolla Demonstration of antagonistic activity – bacterial and fungal.

UNIT V
Study of the following diseases: Tobacco mosaic; Bacterial blight of paddy; Downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Leaf spot of paddy, Red rot of sugar cane, Root knot of mulberry.

ALLIED – II PAPER III - BIOSTATISTICS

UNIT I
Introduction:
Types of biological data; frequency distributions; cumulative frequency distributions.
Populations and samples:
Populations; samples from populations; random sampling; parameters and statistics.

UNIT II
Measures of Central Tendency:
Mean; median; mode; geometric mean; harmonic mean.

Measures of Dispersion:
Range; variance; standard deviation, coefficient of variation; standard error.

UNIT III
Probability:
Mathematical probability and statistical probability; Laws of probability; addition law and multiplication law; conditional probability.

Probability Distribution:
Normal distribution; binomial distribution and poisson distribution.

UNIT IV
Testing for goodness of fit:
Chi-square test for goodness of fit; statistical significance; statistical errors in hypothesis testing; chi-square test for contingency tables; heterogeneity chi-square test.

Test of hypothesis:
Normal deviation test, tests for proportions, t-test.

UNIT V
Simple linear regression and correlations:
Simple linear regression; testing the significance of a regression; comparison of two slopes; correlation coefficient – hypothesis testing about correlation coefficients; comparison of two correlation coefficients; rank correlation; intraclass correlation.

Analysis of variance:
One-way classification; two-way classification.
ALLIED- II Paper IV

PRACTICAL IV - BIOSTATISTICS

UNIT I
Frequency distribution – Univariate – Bivariate; Measure of central tendency

UNIT II
Measure of dispersion; Correlation, Regression

UNIT III
Fitting distribution – Binomial – Poison – Method of least squares

UNIT IV
Tests of significance – T – F; Tests of significance – Chi-square – Attributes

UNIT V
ANOVA; Design of experiments – CRO, RBD, LSD

References:


SEMESTER - V

CORE PAPER IX - MEDICAL BACTERIOLOGY

UNIT I
Classification and general properties of medically important bacteria. Recommendation for collection, transport of specimens, isolation of bacteria from clinical specimens.
UNIT II

Primary media for isolation and their quality control - Antibiotic sensitivity discs, testing procedures and their quality control.

UNIT III

Staphylococcus; streptococci and related catalase negative Gram-positive cocci; Neisseria and Branhamella Corynebacterium and related organisms. Mycobacterium - typical and atypical. Aerobic pathogenic actinomycetes.

UNIT IV


UNIT V

Clostridia, Mycoplasma, Rickettsiae, Spirochetes, Trepenema, Leptiospira and Borrelia.

References:


CORE PAPER X - MEDICAL MYCOLOGY AND PARASITOLOGY

UNIT I
Morphology, Taxonomy, Classification of fungi. Characteristics of Zygomyces, Ascomycetes, Basidiomycetes and Duteromycetes.

UNIT II
UNIT III
Collection, transport of specimens, isolation of fungi from clinical specimens. Newer methods in diagnostic mycology. Mycotoxins, Antifungal agents, testing methods and quality control.

UNIT IV

UNIT V

References:
CBS Publishers & Distributors, New Delhi.


CORE PAPER XI - MEDICAL VIROLOGY

UNIT I

UNIT II

UNIT III
Pox, Adeno, Herpes, Reo, Rota and HIV Viruses, Oncogenic viruses, Viral vaccines, their Preparation and their immunization schedules.

UNIT IV
Viruses of importance to bacteria – Bacteriophages – Their Structure, types – Uses in Microbiology.

UNIT V

References:


CORE PAPER XII – MAJOR PRACTICAL V
(Medical Bacteriology, Mycology, Parasitology and Virology)

UNIT I

GENERAL requirements of collections, transport of clinical Specimens – Methods of enriched, selective and enrichment culture techniques used to isolate organisms from clinical materials. Simple, differential and Special staining of clinical materials viz: Throat swab, Pus, Urine, Sputum, Stool etc. Enumeration of Bacteria in Urine, Quantitative Urine Culture.
UNIT II
Isolation and identification of bacterial pathogens from clinical specimens their biological reactions. Antimicrobial Sensitivity testing by disc-diffusion technique and determination of MIC.

UNIT III

UNIT IV
KOH and Lactophenol preparations for skin scrapings for dermatophytes. Microscopic identification and cultural characteristics of medically important fungi and lab contaminants. Germ tube, carbohydrate assimilation and fermentation tests for yeasts.

UNIT V

ELECTIVE I - GENETIC ENGINEERING

UNIT I
Vectors: Plasmid vectors: pSC101, pBR322, pUC series and Ti plasmids based vectors; Bacteriophage vectors: Lambda phage based vectors, phagemids, cosmids, and M13 based vectors; Viral vectors: Vaccinia, Retroviral, SV40 and Baculoviral system;

UNIT II
Principles and methods in genetic engineering: Host cell restriction; Restriction modification; Restriction enzymes: Types and applications;; DNA finger printing; RFLP Nucleases, Ribonucleases, DNA ligases, Tag DNA Polymerases, Methylases, Topoisomerases, Gyrases, and Reverse Transcriptases.

UNIT III
Basic steps of cloning techniques; Genomic DNA and cDNA library Construction; Screening methods; Cloning in E. coli, Expression systems; Gene fusion and Reporter genes; Gene targeting; Methods of Gene transfer – transformation, transfection, Electroporation, microinjection and biolistics.
UNIT IV
Analysis of Recombinant DNA; Polymerase chain reaction; Principles and techniques of nucleic acid hybridization; Southern, Northern, Western blotting techniques; Microarray technique.

UNIT V
DNA and protein sequencing; Applications of genetic engineering in agriculture; health and industry.

References:
17. DNA Cloning, Vols, 1,2,3 and 4, IRL Press

SEMESTER – VI
CORE PAPER XIII - ENVIRONMENTAL MICROBIOLOGY

UNIT I
Introduction: Organization of the biosphere and components of ecosystem, Natural habitats of microorganisms, Microbial communities in aquatic and terrestrial habitats, Microorganisms as components of ecosystem-as producers and decomposers.

UNIT II
Microbial life in extreme environments: Effect of temperature, pH, Pressure, salt and heavy metals such as As, Sb,Hg, Pb and Cd, Microbial life in conditions of high irradiation, Radiosensitivity; mechanism of damage and recovery, Growth in nutrient limited environment – mechanism of adaptations, Microbes in space.

UNIT III
Microbes in aquatic environments: The nature of aquatic habitats, Methods used in the study of aquatic (fresh and marine water) microbial community, Pollution of aquatic habitats, Water quality criteria, Water-borne diseases, Microbiological analysis of water purity, Indicator organisms, ground water quality and home treatment system.
UNIT IV
Microbes in air: Composition of Air; Number and kinds of organisms in air; Distribution and sources of air borne organisms; Droplet and droplet nuclei; Assessment of air quality; Air sanitation; Airborne diseases;

UNIT V
Environmental application: Waste –types; Treatment of solid wastes –composting, Vermiform composting, silage, Pyrolysis and scarification; Treatment of liquid wastes, degradation of liquid industrial wastes; Degradation of pesticides and detergents; Degradation of lignin; synthetic polymers; Xenobiotic compounds; Alkyl benzyl sulphonates; Petroleum and hydrocarbon degradation.

References:


UNIT I

Food as a substrate for microorganisms—Microorganisms important in food microbiology; Molds, yeasts and bacteria—General Characteristics—Classification and importance.

UNIT II

Principles of food preservation—Asepsis—Removal of microorganisms, anerobic conditions—High temperature—Low temperature—Drying—Food additives.

UNIT III

Contamination and spoilage—Cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products—Fish and sea foods—poultry, spoilage of canned foods.

UNIT IV

Food borne infections and intoxications—bacterial, non-bacterial—Food borne disease outbreaks—Laboratory testing—preventing measures—Food sanitation—plant sanitation—Employees’ heals standards—waste treatment and disposal—quality control.

UNIT V

Food fermentation: Bread cheese, vinegar, fermented vegetables, fermented dairy products. Spoilage and defects of fermented dairy products—oriental fermented foods.

References:


**CORE PAPER XV - MAJOR PRACTICAL VI**

(ENVIRONMENTAL, FOOD AND DAIRY MICROBIOLOGY)

**UNIT I**

Detection of number of Bacteria in milk by breed count. Detection of number of bacteria in milk by standard plant count.

**UNIT II**

Determination of quality of milk sample by methylene blue reductase test and Resorzin method.

**UNIT III**

Isolation of yeast and molds from spoiled nuts, fruits, and vegetables. Bacteriological examination of specific food a) Curd b) Raw meat c) Fish d) Ice cream.

**UNIT IV**

UNIT V
Quantification of microorganisms in air by settle plate and air sampler methods. Detection of aflatoxin B<sub>1</sub> from moldy grains using thin layer chromatography.

ELECTIVE II - INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

UNIT I
General introduction to fermentation process. Microbial growth kinetics-batch, continuous and fed batch culture. Large scale cultivation of industrially important microbes (Streptomyces, Saccharomyces, Hansenela, Spirulina and Penicillium) Fermentation media-desired qualities- media formulation strategies- carbon, nitrogen, vitamin, mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams.

UNIT II
Types of fermentation-fermentors-basic functions, design and components, asepsis and containment requirement. Specifications of fermentors- sterilization of fermentors- aseptic inoculation methods. Brief idea on monitoring control device.

UNIT III
Microbial products of commercial use-penicillin, ethanol, vinegar, vitamin B12, protease, citric acid and glutamic acid.

UNIT IV
Down stream processing - objective and criteria, foam separation, precipitation methods, filtration, industrial scale centrifugation and cell disruption methods. Liquid-liquid extraction, solvent recovery-chromatography. Two phase aqueous extraction, super – critical fluid extraction, ultra filtration, drying device, crystallization and whole broth processing.

UNIT V
References:

ELECTIVE III - BIOTECHNOLOGY

UNIT I
Biotechnology—definition & history; Microbial production of industrial enzymes; methods for immobilization of enzymes; kinetics of soluble and immobilized enzymes; application of soluble and immobilized enzymes; enzyme-based sensors.

UNIT II
Principles and application of genetic recombinant technology and strain improvement (mutational, rDNA technologies). Production of biotechnological products: Food—SCP (algae, yeast, mushroom). Biofertilizer (BGA, VAM) Biopesticides (Bacillus thuringiensis). Fuel—ethanol; Pharmaceuticals – antigens, interferons, vaccines, insulin, gene-therapy methods.

UNIT III
Architecture of plant genome; plant tissue culture techniques; methods of gene transfer into plant cells; production of secondary metabolites using suspension/immobilized cell culture;

UNIT IV
Methods for plant micro propagation; crop improvement and development of transgenic plants.

UNIT V
Animal cell metabolism and regulation; cell cycle; primary cell culture; nutritional requirements for animal cell culture; techniques for the mass culture of animal cell lines; transgenic animals.

References:


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