POSTGRADUATE PROGRAMMES IN APPLIED MICROBIOLOGY

Postgraduate Diploma in Applied Microbiology
Master of Science Degree in Applied Microbiology

DEPARTMENT OF MICROBIOLOGY
FACULTY OF SCIENCE
UNIVERSITY OF KELANIYA
KELANIYA

1. INTRODUCTION:

Applied Microbiology is the study of microorganisms and their applications. The Masters Degree in Applied Microbiology is a 24-month full-time course designed to provide graduates with the appropriate theoretical and practical skills in different fields in Microbiology. In-depth studies include Food and Dairy microbiology, Recombinant DNA Technology, Environmental Microbiology, Microbial Biotechnology, Agricultural Microbiology, Microbial Physiology and Fermentation Technology. This course is designed to meet the growing demand for personnel with expertise in Applied Microbiology and Microbial Biotechnology.

2. OBJECTIVES:

Objectives of the postgraduate programmes in Applied Microbiology are as follows:

* To promote teaching and research activities in applied microbiology.
* To provide basic understanding of the principles of modern applied microbiology.
* To initiate manpower training and establishment of training facilities in microbiology and related disciplines.

3. BENEFITS OF AN M.SC. IN APPLIED MICROBIOLOGY:

On completion of **M.Sc. in Applied Microbiology** programme, a student

- Will gain a comprehensive understanding of the principles and practices of a variety of key areas in General and Applied Microbiology,
- Will acquire new and /or improved practical skills in microbiology,
- Will have the ability to use various microbiological skills in their future learning and employment,

- Will be able to widen knowledge on a selected field in Applied Microbiology.
- Will be able to plan, carryout and report on an independent scientific research.

4. PROGRAMME STRUCTURE AND DURATION:

The duration of the M.Sc. in Applied Microbiology course is 24 months (2 academic years). During the two year period a student is required to earn a total of 60 credits of which 30 credits should be earned each year. During the first year, the programme covers taught course units and laboratory practical units (Level 5 course units). In addition, the first year of study includes assignments, field visits / case studies etc.

During the second year (Level 6), each student is expected to carry out a research project on a selected topic under the supervision of senior academic staff member (s) and it has to be written up in the form of dissertation.

Note:
Selected students should first register for Postgraduate Diploma in Applied Microbiology irrespective of their choice of study programme.

A student who is admitted to the Postgraduate diploma course could continue the studies further and will be allowed to transfer to the M.Sc. degree programme in Applied Microbiology, on the basis of his/her choice and academic performance at the end of the first year of study.

Postgraduate Diploma in Applied Microbiology

First academic year = Level 5

M.Sc. Degree Programme

First academic year = Level 5
Second academic year = Level 6

For level 5 and 6 course units, credit ratings are as follows:

For Course units with lectures only

15 contact hours = 1 credit

For Course units with Laboratory work only

45- 60 hours of laboratory work = 1 credit
75- 90 hours of laboratory work = 2 credit

For Course units with lectures and laboratory work

10 contact hours + 15 hours of laboratory work = 1 credit

5. EVALUATION CRITERIA

5.1 Evaluation Procedure (First Year):

Performance of the students will be evaluated by combinations of following elements: Assignments, Reports, Presentations, Laboratory reports, Laboratory assessments and an end of course examination for each course unit.
According to the performance a grade will be assigned for each course unit. The method of evaluation will be announced by the Department at the commencement of a course unit.

5.2 Evaluation of the Research Project for M.Sc. degree programme:

The research project will be evaluated through a dissertation, a presentation and an oral examination. The percentage marks given to each of these components will be announced to the students at the commencement of the project. The examiner(s) appointed by the Department of Microbiology will evaluate the dissertation.

A student who fails to submit the dissertation on or before the stipulated date given by the Department of Microbiology, the maximum mark that may be achieved is 50% (i.e. Grade B^-).

5.3 Grading System

Marks obtained in respect of a course unit will be graded according to the grading system as follows:

Range of Marks	Grade	Grade Point Value
85- 100	A^+	4.0
70-84	A	4.0
65-69	A^-	3.7
60-64	B^+	3.3
55-59	B	3.0
50-54	B^-	2.7
45-49	C^+	2.3
40-44	C	2.0
35-39	D+	1.5
25-34	D	1.0
00-24	E	0.0

5.4 Re-sitting and Repeat examinations

A student who obtains a grade below B- for a particular course unit may re-sit the relevant examination in a subsequent academic year for the purpose of improving the grade. However, the best grade obtainable in this instance is B-.

If the relevant examination of the subsequent academic year is not scheduled to be held within twelve months from the date of release of results, a single repeat examination will be held after two months from the release of results.
Sitting for the repeat examination will not disqualify a student from re-sitting the examination in a subsequent academic year.

5.5 Grade Point Average

Grade Point Average (GPA) is the credit-weighted arithmetic mean of the Grade Point Values, i.e., the GPA is determined by dividing the total credit-weighted Grade Point Value by the total number of credits.

GPA shall be computed to two decimal places.

For example, a student who has completed three course units each of four credits and two course units each of two credits having grades A, B, C, C, C respectively will obtain a GPA of 2.75

$$\frac{(4 \times 4.0) + (4 \times 3.0) + (4 \times 2.0) + (2 \times 2.0) + (2 \times 2.0)}{4 + 4 + 4 + 2 + 2}$$

$$= \frac{16.0 + 12.0 + 8.0 + 4.0 + 4.0}{16}$$

$$= \frac{44}{16} = \mathbf{2.75}$$

All Course units that a student has registered for shall be taken into account in calculating the GPA for the award of the degree.

5.6 Attendance

The students are strongly advised to attend all lectures in all course units.

Attendance at all laboratory sessions and field visits is compulsory; unless a student has a valid reason (documentary evidence is required).
Minimum of 80% attendance is required to pass the laboratory course unit.

6. ELIGIBILITY FOR THE AWARD OF THE POSTGRADUATE DIPLOMA AND M.SC. DEGREE.

6.1 Eligibility for the Award of the Postgraduate Diploma in Applied Microbiology

To be eligible for the Postgraduate Diploma in Applied Microbiology a student must have

(i) obtained grades of C or better in all Level 5 course units aggregating to at least **30 credits**,

(ii) obtained a minimum cumulative **GPA of 2.3** from all course units),

(iii) obtained a grade C+ or better for the Course Unit MIBI 53122,

And

(iv) completed the relevant requirements within a period of **three academic years** from the date of first registration for the Postgraduate Diploma in Applied Microbiology.

6.2 Eligibility for the award of the M.Sc. Degree in Applied Microbiology

To be eligible for the M.Sc. degree in Applied Microbiology a student must have

(i) obtained totalling to a minimum of **60 credits** of which 30 credits should be earned each year,

(ii) obtained grades of C or better in each of Level 5 course units aggregating to at least 30 credits,

(iii) obtained a grade **B⁻** or better for the **Level 6 Research project**,

(iv) obtained a minimum cumulative **GPA of 2.7** from all course units (including the research project)

And

(iv) completed the relevant requirements within a period of **Four academic years** from the date of first registration.

7. OPTION OF UPGRADING TO THE M.SC. PROGRAMME IN APPLIED MICROBIOLOGY

A student who is admitted to the Postgraduate Diploma course could continue the studies further and will be allowed to transfer to the M.Sc. degree programme in Applied Microbiology, on the basis of his/her choice and academic performance at the end of the first academic year of study. The request should be made within 20 days after the release of the results of the Postgraduate Diploma course.

- To be eligible for the award of the M.Sc. Degree in Applied Microbiology, a student should complete all the requirements as given in section 6.1 of this document.
- The date of first registration for a transferred student will be the same date that he/she registered to follow the postgraduate diploma course and **not** the date that he/she transferred to the M.Sc. degree programme.

8. AWARD OF THE DEGREE/ DIPLOMA

A student should apply for the award of either degree or diploma after satisfying the requirements. On completion of either Postgraduate Diploma in Applied Microbiology or M.Sc. Degree in Applied Microbiology and after the confirmation of results by the University Senate, a student is entitled to an official transcript of results giving the grades obtained for each course unit.

Special Note:
A student registered for the said postgraduate programmes is only permitted to obtain *either* the Postgraduate Diploma in Applied Microbiology *or* the M.Sc. Degree in Applied Microbiology (only one of the qualifications to the exclusion of the other) and not both of the said qualifications.

9. ADMISSION CRITERIA:

9.1 Eligibility

Applicants should be graduates of a recognized Sri Lankan or foreign university with one of the following qualifications.

1. B. Sc. Special degree in Microbiology.
2. B. Sc Special degree in Biological Sciences.
3. B. Sc. General Degree in Biological Sciences.
4. Degree in Agricultural Sciences, Environmental Sciences, Medical, Dental or Veterinary Sciences.
5. Any other qualification acceptable to the Faculty of Graduate studies and approved by the Senate of the University of Kelaniya.

9.2. Application Procedure:

Each applicant should submit a duly completed application form together with the following documents to the **Assistant Registrar, Faculty of Graduate Studies, University of Kelaniya, Kelaniya.**

a. Copies of academic records
b. Recommendation letters from two referees, one of which from the applicant's academic supervisor.
c. List of scientific publications (if any).

9.3 Fees:

Selected candidates will have to pay the following fees before the commencement of the course.

Year 1

For First year	Local candidates	Foreign candidates	
		SAARC countries	Other Countries
Registration fee	Rs. 1,000.00	US $ 15.00	US $ 15.00
Tuition fee	Rs. 175,000.00	US $ 2625.00	US $ 4000.00
Science fee	Rs. 2,000.00	US $ 30.00	US $ 30.00
Library fee	Rs 1,500.00	US $ 20.00	US $ 20.00
Examination fee	Rs. 2,000.00	US $ 30.00	US $ 30.00

Tuition fee can be paid in two installments (Rs. 100,000/- at the registration and next Rs 75000/- at the beginning of the second semester).

Registration fee, Library fee and Science fee should be paid according to the procedure stipulated by the Faculty of Graduate studies, University of Kelaniya.

Year 2

	Local candidates	Foreign candidates
Registration fee	Rs. 1,000.00	US $ 15.00
Tuition fee	Rs. 75,000.00	US $ 1000.00
Examination fee	Rs. 2,000.00	US $ 30.00

If the cost of the research project exceeds Rs 75,000/-, (or US $ 1000/- for foreign students) the additional expenditure to complete the project should be borne by the respective student.

9.4 Payments for repeat or re-sit examinations:

Candidates should pay a fee of Rs. 350/- (or US$ 10 for foreign students) per question paper (not exceeding maximum amount of Rs. 2000/- or US$ 30.00).

10. RESOURCE PERSONNEL:

The teaching staff will be from the Department of Microbiology, Faculty of Science of the University of Kelaniya and visiting staff will be drawn from other faculties of the University, other universities, research organizations, public and private organizations, etc. as required.

From the Department of Microbiology

Professor S. Widanapathirana.
B.Sc.(Cey), M.Sc., PhD(H-W. Edin.), Dip. Microbiol. and Biotech.(Tokyo), FNAS (SL)
Emeritus Professor of Microbiology

Professor Mrs. C. P. Kodikara
B.V.Sc. (S'Lanka) Dip. Food Hyg. (Copenhegen), Ph.D (Copenhegen)

Dr. Mrs. S. I. Abeygunawardena
B.Sc., M.Phil. (Kel'ya), Ph.D.(Queensland)

Dr. D. L. Jayaratna
B.Sc.(C'bo), M.Sc. (Kel'ya), Ph.D.(London)

Mr. M. M. Gunawardane (Head of the Department)
B.Sc.(Sp)(Kel'ya), M.Phil. (Edinburgh)

Dr. Ms. D. Gunasena
B.Sc.(Sp)(Kel'ya), Ph.D.(Reading)

Dr. Mrs. I. V. N. Rathnayaka
B.Sc.(Sp)(Kel'ya), M.Sc. (S'Pore), Ph.D.(Uni.SA, Aus)

Mr. E. A. A. D. Edirisinghe
B.Sc.(Sp)(Kel'ya), M.Sc.(S'Japura)

Visiting Staff

Professor M J S Wijerathne
B.Sc.(Kel'ya), M.Sc. (Michigan), Ph.D.(Kel'ya), F.I.Biol (Sri Lanka), C. Biol (Sri Lanka), FNASSL
Senior Professor of Zoology
University of Kelaniya

Dr. Mrs. P. Thalgaswatta,
B. Sc, M.Sc. M.Sc. (Mgmt), Ph.D.
Deputy Director General,
Sri Lanka Standards Institute,
Colombo

Dr. P. B. Herath,
B. Sc.(USA), M.Sc. (USA), PhD
Operations Manager (Quality Assurance and Research)
Astron Pvt. Limited,
Ratmalana.

Mrs. P. M. G. Pathiraja
B. Sc.(Sp)(Kelaniya), M.Sc. (The Netherlands),
Research Scientist,
Energy and Environmental Management Centre,
National Engineering Research and Development (NERD) Centre,
(Ekala, Ja-Ela).

Dr R. R. D. P. Perera
B.V.Sc.(S'Lanka), Dip. Med. Micro.(C'bo), M.Phil.(C'bo),
Department of Medical Microbiology
University of Kelaniya
Faculty of Medicine
(Ragama)

Mr. D A M Arsekularatne
B.Sc.(Sp)(P'deniya), M.Sc.(Kel'ya)
Chartered Chemist,
Ceylon Cold Stores PLC,

11. COURSE UNITS AND PATHWAYS:

Year 1 - Semester 1			
Course Unit	**Code**	**PgDipAM**	**MScAM**
General Microbiology and Microbial Diversity	MIBI 51013	C	C
Microbial Metabolism	MIBI 51022	C	C
Microbial genetics and Applications of Gene Technology	MIBI 51033	C	C
Soil and Plant Microbiology	MIBI 51042	C	C
Environmental Biotechnology	MIBI 51052	C	C
Food Hygiene and Food Microbiology	MIBI 51062	C	C

Year 1 - Semester 2			
Course Unit	**Code**	**PgDipAM**	**MScAM**
Industrial Biotechnology	MIBI 52072	C	C
Food Technology	MIBI 52082	C	C
Medical and Pharmaceutical Microbiology	MIBI 52092	C	C
Immunology	MIBI 52102	C	C

Year 1 – Semesters 1 and 2			
Course Unit	**Code**	**PgDipAM**	**MScAM**
Microbiology Laboratory	MIBI 53112	C	C
Project / case study	MIBI 53122	C	C
Bioinformatics and Biostatistics	MIBI 53132	E	E
Food Quality and Food Service Management	MIBI 53142	E	E
Microbiology Laboratory management and Recent advances in Applied Microbiology	MIBI 53152	E	E

Year 2 – Semesters 1 and 2			
Course Unit	**Code**	**PgDipAM**	**MScAM**
M.Sc. Research Project (Throughout the year)	MIBI 6301X	-	C

C = compulsory
E = elective
X = 30 credits
PgDipAM = Postgraduate Diploma in Applied Microbiology
MScAM = M.Sc. in Applied Microbiology
Type/Status : Compulsory

Course code : **MIBI 51013**
Course title : **General Microbiology and Microbial Diversity**

Learning outcomes:
At the end of the course unit students should be able to

- appreciate the major developments in microbiology.
- describe molecular architecture of microbial cell
- discuss the factors affecting the microbial growth and growth kinetics
- analyze the major criteria used in microbial taxonomic divisions,
- illustrate important characteristics of some selected groups of bacteria and eukaryotic microorganisms, and their economic importance,
- classification of viruses and the growth cycles of different viruses

Course content:

Introduction and scope of microbiology.
Structure and function of bacterial cell: Basic cell shapes, arrangements, Structures external to the cell wall.
Structure and function of the bacterial cell wall
Structure and function of the bacterial cell- Plasma membrane and structures internal to the cell wall.
Microbial nutrition and growth- Cell division, Phases of growth Chemical requirements, Physical requirements
Culture media- Chemically defined media, Complex media, Enrichment isolation. Anaerobic growth media. Pure culture techniques, Preservation of bacterial cultures. Measurement of growth
Control of microorganisms- Physical methods, Chemical methods, Antimicrobial drugs, Evaluation of effectiveness
The diversity of microbial world- Classification of microorganisms, Three domains.
Methods of identification of bacteria- Morphological, Physiological and Biochemical methods Serological methods, phage typing and chemotaxonomic methods. Numerical methods.
Molecular methods of identification of bacteria.
Prokaryotic Diversity- The Bacteria- Study of selected groups of bacteria (According to Bergy's Manual), The *Archae*
Systematic study of yeasts and other fungi and their classification, Characteristics used in classifying yeast and other fungi, and methods of identification.
Systematic study of viruses and sub viral pathogens.
Classification, structure and chemical composition of viruses.

Method of teaching and learning: A combination of lectures, assignments and presentations. .

Assessment: Continuous assessment and end of course examination.

Recommended reading:

1. Atlas, R.M. (1996). *Microbiology Fundamentals and applications.* Wm. C. Brown Publishers
2. Dimmock, N J, and Primrose, S.B (1994) *Introduction to Modern Virology, 4th ed.* Blackwell Scientific Publications Ltd., Oxford, United Kingdom
3. Francki, R.I.B., Fauquet, C.M., Knudson, D. L. and.Brown, F. (1991). *Classification and Nomenclature of Viruses. Fifth Report of the international Committee on Taxonomy of Viruses.* Springer-Verlag, Wien, New York.
4. Mohan, S.; Dow, C. and Cole, J.A. (1992*). Prokaryotic Structure and function: a new perspective.* Cambridge University Press
5. Tortora, G.J., Funke, B.R., Case, C.L (2000) *Microbiology.* Benjamin Cummings Publishers, Addison Wesley Longman, Inc
6. Archives of Applied and Environmental Microbiology
7. Journal of General Virology

Type/ Status : **Compulsory**
Course code : **MIBI 51022**
Course title : **Microbial Metabolism**

Learning outcomes:

At the end of the course unit students should be able to

- describe the basic biochemical and physiological functions of a microbial cell that allow survival and growth.
- appreciate the industrial importance of some metabolic activities of microorganisms
- describe how the different biochemical and physiological functions are integrated, coordinately regulated, and expressed with in the cell.
- describe the metabolic diversity present in microorganisms contributes to their growth and survival and how it permits them to occupy diverse ecological niches.

Course content:

- Chemistry of life.
- Synthesis of energy: Strategies for generating cellular energy, Oxidation of chemicals and photophosporylation
- Chemotrophy: Chemoorganotrophy. Carbohydrate metabolism and its diversity, EMP, HMP and ED pathways. Krebs cycle and electron transport chain. Chemiosmotic theory of ATP synthesis.
- Catabolism of intermediate substrates Glyoxylate cycle, and other anaplerotic pathways. Gluconeogenesis.
- Microbial degradation of aromatics, alicyclics, aliphatics. alkenes, and aromatics
- Anaerobic respiration: Principle and examples.
- Fermentation: Principles of fermentation. Diversity and energy yields of fermentative microorganisms, oxidation and reduction balance.
- Chemolithotrophy: Oxidation of inorganic chemicals for energy synthesis.
- Phototrophy: Photolithotrophic and photoorganotropic methods of energy synthesis
- Synthesis of carbon compounds: Autotrophy and Heterotrophy.
- Biosynthesis of macromolecules in microorganisms.
- Structure and functions of cell membrane: transport systems and energy production.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended reading:

1. Atlas, R.M. (1996). *Microbiology Fundamentals and applications.* Wm. C. Brown Publishers
2. Gottschalk, G (1986*). Bacterial Metabolism*. Springer-Verlag, New York.
3. Mohan, S.; Dow, C. and Cole, J.A. (1992*). Prokaryotic Structure and function: a new perspective.* Cambridge University Press
4. Tortora, G.J., Funke, B.R., Case, C.L (2000) *Microbiology.* Benjamin Cummings Publishers, Addison Wesley Longman, Inc.
5. White. D. - 2000 - The Physiology and Biochemistry of Prokaryotes - Oxford Uni.Press.
6. Trends in Biotechnology,

Type/Status	**:**	**Compulsory**
Course code	**:**	**MIBI 51033**
Course title	**:**	**Microbial Genetics and Applications of Gene Technology**

Learning outcomes:

At the end of the course unit, the students should be able to

- describe the principles of the recombinant DNA technology and the bacterial transformation
- discuss how regulation of gene expression relates to structure and function at the cellular level
- explain how genome structure relates to general and specific functions in prokaryotes
- illustrate the application of recombinant DNA organisms and their usage in Agricultural, Medical and Industrial activities,

Course content:

Microbial Genetics:
Overview of Genetic Molecules, structure and behavior of DNA and RNA. DNA and RNA replication. DNA repair. DNA recombination, Gene expression.
Structure and organization of the eukaryotic chromosomes and bacterial chromosomes.
Bacterial plasmids. Transfer of genetic material among bacteria.
Gene expression in prokaryotes.
The process of protein synthesis; induction, repression and attenuation.
Molecular biological tools; Polymerases, Nucleases, Restriction endonucleases, Ligases.
Gene organization in bacteriophages and different mechanisms of transcription, regulation in prokaryotes.
Gene organization in eukaryotes. RNA synthesis and processing in eukaryotes; Transposable elements.

Recombinant DNA Technology :
Overview; Genetic engineering as a molecular biological techniques. Practical approaches of Genetic engineering, Bacterial transformation, transgenic plants, transgenic animals. DNA vectors, Plasmids, Cosmids, Bacteriophages, Yeast Artificial chromsomes (YAC), Host vector systems, prokaryotic and eukaryotic
Recombinant DNA construction and DNA cloning, Cloning vectors and expression vectors, cloning and expression of mammalian genes in bacteria.
Amplifying DNA, The polymerase chain Reaction (PCR) techniques. Analysis of cloned DNA and PCR amplified DNA. Using Agarose Gel

Electrophoresis, Pulsed-field gel electrophoresis, Southern blot hybridization, Dot blot hybridization, RFLP technique and DNA sequencing.
Other molecular biological techniques. Northern blot hybridization and Western blot hybridization, Practical application of molecular biological techniques.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended reading:

1. Anderson, P. and Ganetzky, B. (1997), *An electronic companion to genetics workbook.* Cogito Learning Media, Inc
2. Griffiths, A. J. F., Miller, J.H., Suzuki, D.T. and Gelbert, W. M. (1996), *An Introduction to Genetic analysis,* 6th edition, W.H. Freeman and Company.
3. Turner, P.C., McLennan, A. G., Bates, A. D. and White, M.R.S (2000), *Instant Notes in Molecular Biology*. Springer-Verlag New York
4. Sambrook, J., Frtsch, E. F. and Maniatis, T. (1989), *Molecular Cloning a Laboratory manual, 2nd Ed. Vol. 1, 2, and 3.* Cold Spring Harbor Laboratory Press.
5. Settow, J.K. (2000), *Genetic Engineering: Principles and methods.* Kluwer Academic Publisher.
6. Singer, M. and Berg, P. (1991), Genes and Genome. University Science Books CA94941
7. Archive of "Molecular and Cellular Biology".

Type/Status : Compulsory
Course code : MIBI 51042
Course title : Soil and Plant Microbiology

Learning outcomes
On successful completion of this course unit the students should be able to

- describe the ways in which microorganisms are involved in soil fertility demonstrate an awareness of the range of microorganisms that can cause diseases to plants.
- evaluate different microbial communities in the environment and their interactions with plants as diseases causing agents.
- evaluate plant defense response against microbial pathogens,
- describe the pathogencity determinants and their role

Course content:
Microbial diseases in plants:
Plant diseases caused by fungi, bacteria, mycoplasmas viruses and viroids; concepts and symptoms of plant diseases, structure and functions of pathogens, infections and colonization. Host pathogen interactions at whole plant, cellular and population levels.
Pathogenecity determinants and their role. Host-pathogens specificity.
Disease diagnosis and identification of pathogens.
Control of diseases. Bio-pesticides. Microbial control of insect-pests, microbial herbicides.

Soil Microbiology:
Introduction to Soil microbiology.
Methods of examination and estimation of soil microorganisms.
Soil microbial processes and soil fertility.
Soil Biotechnology: manipulation of soil micro-organisms and soil microbial processes for increase in crop productivity.
Biogeochemical cycling: reservoirs and transfer rates, nutrients transfer within habitats.
Interactions between microbes and plants: microorganisms involved in rhizosphere and phyllosphere, and their positive and negative interactions, mycorrhiza.
Decomposition of plant residues, including straw and composting, silage.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended reading:

1. Metting, F. B. (Jr) (1993), *Soil Microbial Ecology: Application in Agricultural and Environmental Management* . Published by Marcel Dekker Inc.
2.. Agrios, G.N (1997). *Plant Pathology*, Academic Press, NY
3. Dikinson and Lucas (1998). *Plant Pathology and Plant Pathogens.* Blackwell6Science, Inc. Oxford, UK.
4. Matthews, R.E.F (1992). *Plant Virology*. Published by Academic Press San Diego
5. European Journal of Plant Pathology, Kluwer Academic Publishers

Type/ Status : **Compulsory**
Course code : **MIBI 51052**
Course title : **Environmental Biotechnology**

Learning outcomes :

On successful completion of this course unit the students should be able to

- develop the and knowledge of the role and types of microorganism that are usefully applied by man and that are important in his environment.
- explain the ways in which manipulation of the microbial ecology can have effects that are beneficial to the macro-environment and/or are commercially useful.
- analyze how microorganisms in the environment involved in the breakdown and detoxification of natural and man-made compounds.
- describe the principles involved in water purification techniques and demonstrate the use of indicator microorganisms in evaluation of microbiological quality of water.
- discuss the basic principles of different operational units in conventional wastewater treatment facilities and industrial effluent treatment facilities

Course content:

- Introduction to Environmental biotechnology:
- Interactions among microbial populations. Microbial interactions with animals and plants
- Microbial loop, Microbial mat and Microbial biofilms. Physiology. morphology biochemistry of Microbial loop, Microbial mat and Microbial biofilms formed in natural environment.
- Xenobiotic compounds. Persistence and biomagnification of xenobiotic molecules Bioremediation of xenobiotic pollutants
- Microbial assimilation of metals and bioleaching
- Microbiology of water: Role of microorganisms in water quality, Transmission of infectious diseases, Microbiological evidence of water pollution
- Laboratory methods and microbiological standards for potable water
- Treatment of wastewater: Modern wastewater treatment techniques, Principles and aims of a wastewater treatment plants, Waste water characterization
- Suspended growth technologies: Activated sludge system, oxidation ditches,
- Fixed film technologies: Trickling filters, Rotating biological contactors, biofilters, fluidized bed etc.
- Anaerobic wastewater treatment units: Anaerobic digester, Anaerobic lagoon

- Ponds, lagoons: Oxidation ponds and lagoons, Anaerobic ponds and lagoons
- Sludge treatment and disposal: Sludge processing, Pathogen occurrence and fate of biosolids, Land disposal of biosolids
- Wastewater management and Microbial risk assessment: Assessing the efficiency of WTP, Concept of risk assessment, Elements of risk assessment, Process of risk assessment
- Bioremediation: Oil spills, metals and other hazardous wastes, In-situ and Ex-situ bioremediation of contaminated water and soil. Use of GMO in bioremediation

- Solid waste management: Composting, Landfill techniques, Utilization of wastes for food, fuel and fertilizers.
- Environmental Management Systems (EMS): Principles of Environmental Management. Environmental Impact Assessment (EIA), Life Cycle Assessment as EM Tool, EMS Standards: ISO 14000 (EMS). Application of GIS
- Aerobiology: Introduction to Aerobiology, Sampling and analysis of airborne microorganisms, Fate and transport of microorganisms in air

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended reading:

1. Atlas, R. A. (1996). *Microbiology Fundamentals and applications.* Wm. C. Brown Publishers
2. Hurst, C. J., Knudson, G. R. (1997). *Manual of Environmental Microbiology* Washington, ASM Press
3. Metcalf and Eddy, Inc (1991) *Wastewater Engineering: treatment Disposal and reuse* Revised by Tchobanoglous, G and Burton, F. L. 3rd edition Published by Tata McGraw-Hill Publishing Company ltd. India
4. Rittmann, B. E. and McCarty, P. L. (2001) Environmental Biotechnology – Principles and Applications
5. Asian Journal of Water Environment and Pollution, IOS Press
6. Archive of "Applied and Environmental Microbiology"

Type/Status	**:**	**Compulsory**
Course code	**:**	**MIBI 51062**
Course title	**:**	**Food Hygiene and Food Microbiology**

Learning outcomes

At the end of the course unit, the students should be able to

- demonstrate the knowledge and understanding of the principles involved in processing of food and application of hygienic principles.
- evaluate the microbial indicators of food spoilage and food-borne diseases.
- explain food safety regulations and microbiological criteria
- demonstrate the knowledge and understanding of the techniques used to critically evaluate commodities and products in terms of food safety and acceptability using the latest quality control procedures.

Course content:

- **Microorganisms important to food industry**: Scope, history and relevant microorganisms.
- **Microbial ecology of food**: Sources, incidence and types of microorganisms in food.
- **Growth of microorganism in food**: Intrinsic, extrinsic and implicit factors.
- **Microbial spoilage of food**: Principles, chemical changes during spoilage, Indicators of microbial spoilage, Methods of examination for specific spolage groups- psychrotrophs, proteolytic and lipolytic organisms.
- **Microbial spolage of different types of food**: Meat, fish, poultry, fruits and vegetables, canned foods and eggs.
- **Microbiological examination of food**: Statutory, recommended and supplementary tests, sampling, microscopy, physical and chemical methods.
- **Modern methods of microbiological analysis of food**: Facilitated culture such as Petrifilm, Immunoassays, Molecular techniques.
- **Food borne diseases**: Bacterial infections and intoxications, mycotoxins, viruses, prions.
- **Investigation of food borne outbreaks. Food Hygiene Legislation**.
- **Microbial indicators of food safety, Food plant sanitation, Cleaning and disinfection**.
- **Microbiology of milk**: Antimicrobial systems in milk, Milk borne diseases, Milk products. Microbiological quality and quality control of milk and milk products.
- **Fermented food**: Starter cultures, dairy products and vegetables.

- **Preservation techniques** and related groups of microorganisms- Thermophiles, thermodurics, psychrotrophs.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended Reading:

1. Banwart, G (1989) *Basic Food Microbiology*. Chapman and Hall
2. James, M.J.(1995) *Modern microbiology*. Plenum Press, NY
3. Rahman, M.S. (1999) *Handbook of food preservation*.
4. Harrigan, W.F (1998) *Laboratory methods in food and dairy microbiology*. Culinary and Hospitality Industry Publications Services.
5. International Journal of Food Microbiology

Type/Status	**:**	**Compulsory**
Course code	**:**	**MIBI 52072**
Course title	**:**	**Industrial Biotechnology**

Learning outcomes:

At the end of the course unit, the students should be able to

- develop an appreciation of the potential of microorganisms for developing new, and improving existing technologies.
- explain the bio-engineering principles of batch, continuous and fed-batch fermentation processes and solid state fermentation and microbial growth kinetics in relation to their product formations,
- apply engineering analysis to microbiological problems
- discuss the production of industrial chemicals, pharmaceuticals, food products etc.

Course content:

Bioprocess technology:

Introduction to Industrial biotechnology.
Microbial process development, selection of organisms and characterization, strain improvement and scale up Substrates for fermentation processes.
Different modes of fermentation
Development of microbial processes.
Microbial production of physiologically active substances, alcohol, organic acids, amino acids etc.
Enzyme production and immobilization, whole cell immobilization.
Metal leaching and other biotechnological applications.
Integrated biotechnological system and Socio-economic biotechnology.
Patents: introduction, composition of patent, background, patent practice and problems.
Elements of biochemical engineering: Microbial Stoichiometry, elemental analysis of bioprocesses. Bioprocess kinetics: Kinetics of growth and substrate utilization in batch, fed-batch and continuous system.
Basic principals of solid-state fermentation (SSF).

Fermentation Technology:

Basic functions of a fermenter.
Properties of Fermentation broths.
Different types of fermenters, Sterilization of fermentation equipment, air, media, mechanical seals etc.
Inoculum development and aseptic inoculation and sampling.
Control of process parameters.
Instrumentation for monitoring bioreactor and fermentation processes, microprocessor based control systems.
Good Manufacturing Practices (CGMP).
Downstream processing: Cell separation and product purification.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended Reading:

1. Cruger, W. and Cruger, A. (1990) *Biotechnology A text book of industrial microbiology.* Science Tech. Inc. Madison.
2. Greenwood, D., Slack, R. C. B., Peutherer, J. F. (1997) *Medical microbiology*(15th Ed): Churchill Livingstone, UK.
3. Prave, P., Faust, U., Sttigg, W. and Sukatsch, D. A. (1982) *Biotechnology – A student's guide.* VCH Vergasgesllschaft, Germany.
4. Trends in Biotechnology

Type/Status : **Compulsory**
Course code : **MIBI 52082**
Course title : **Food Technology**

Learning outcomes

On successful completion of this course unit the students should be able to

- describe principles of food engineering and food processing
- apply the basic knowledge of heat transfer and pshycometry to pasteurization, canning dehydration , concentration and extrusion processes.
- provide an appreciation of the variety of packaging materials available and to relate barrier properties to product requirements

Course content:

Basic Food engineering and Food processing.
Introduction to Food processing techniques.
Basic fluid flow dynamics. Centrifugation and homogenization. Mixing and emulsification. Size reduction and evaporation.
Conservation of mass and energy in relation to Food Industry.
Food preservation with chemicals, cold storage and freezing: underlying principles, storage equipment and applications.
Osmotic control as preservation technique.
Principles of food preservation by heat: introduction to heat transfer mechanisms and equations. Pasteurization and Sterilization as food preservation techniques. Principles of other food preservation techniques: canning -aseptic and high pressure process, dehydration and evaporation and extrusion.
Packaging of Foods.
Losses of food and nutrition in Food processing.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended Reading:

1. Banwart, G (1989) *Basic Food Microbiology*. Chapman and Hall
2. Poter, N.N.H (1999) *Food Science*. Chapman and Hall.
3. Rahman, M.S. (1999) *Handbook of food preservation*.
4. European Journal of Nutrition,
5. International Journal of Food Microbiology

Type/Status : Compulsory
Course code : MIBI 52092
Course title : Medical and Pharmaceutical Microbiology

Learning outcome :

At the end of the course unit, the students should be able to

- describe the common microbial disease agents, transmission, control and diagnosis.
- explain the principles of antimicrobial agents
- demonstrate the knowledge and understanding of the processing of pharmaceutical products and its good manufacturing practices.

Course content:

Medical Microbiology :
Microbial interactions with host, pathology, infections and diseases, Relationships between normal flora and host, opportunistic organisms.
Mechanisms of pathogenicity, entry of microorganisms into the host, Virulence: Entry, establishment, spread of microorganism in body, tissue damage and Antiphagocytic factors.
Mechanism of bacterial adhesion; colonization and invasion of mucous membranes of respiratory, enteric and urinogental tracts.
Measurement of virulence, bacterial resistance to humoral defense; coagulase reacting factor; lysozyme; lactoferrin; transferrin,
Microbial toxins. Antigenic variation and bacterial virulence.
Microbial diseases: morphological, cultural, biochemical, antigenic characters,
pathogenesis, transmission, laboratory diagnosis, prevention and control of some selected pathogenic bacteria.
Oral microbiology, Dental Caries and periodontal diseases and their infectious nature.
Rapid methods of identification of pathogenic microorganisms – API, ELISA, FAT, RIA and Western Blot.
Pathogenic properties of nonbacterial microorganisms;
Clinically important bacterial, virus, and fungal diseases of man.

Pharmaceutical Microbiology:
Antimicrobial agents: Types of antibiotics and synthetic antimicrobial agents. Principles of methods of assaying antibiotics: Tests for microbial susceptibility, effectiveness of chemotherapeutic agents.
Mechanisms of action of antimicrobial agents .
Bacterial resistance to antimicrobial agents
Chemical disinfectants and antiseptics.

Microbiological aspects of pharmaceutical product processing : microbial spoilage and preservation of pharmaceutical products.
Factory and hospital hygiene and good manufacturing practices.
Sterilization control and sterility testing.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended reading :

1. Atlas, R M (1996). Microbiology Fundamentals and applications. Publishers
Wm. C. Brown
2. Barnum S. (1998), *Biotechnology. A Brief Introduction*. Published by Thompson Learning.
3. Tortora, G.J.; Funke, B.R.; Case, C.L (1998) *Microbiology.* Published by Benjamin Cummings, Addison Wesley Longman, Inc.
4. European Journal of Clinical Microbiology and Infectious Diseases, Springer Verlag KG

Type/Status : **Compulsory**
Course code : **MIBI 52102**
Course title : **Immunology**

Learning outcomes

At the end of the course unit, the students should be able to

- explain the main features of the non-specific Immune system which present barriers to infection.
- demonstrate the knowledge and understanding of the general functions of specific and non-specific Immune systems.
- Discuss the different types of immunoassay and to be able to propose suitable immunoassay strategies for specified types of compounds.

Course content:

Organs and Cells of Immune System: Organization of lymphoid system, primary and secondary lymphoid organs, Lymphocytes – subpopulations, properties and functions, membrane bound receptors of lymph cells, T and B Cells.
Regulation of immune response – helper and suppressor cells, lymphokines and their functions, T and B cell interactions,
Immunoglobulins : Basic structure and types, light and heavy chain types and subtypes, allotypes,
Generation of antibody diversity, assembly, synthesis and secretion of antibody, control of antibody synthesis.
Immunomodulation (activation and suppression) Complement system – complement components, methods of detection and quantification of components, classical and alternate pathways, regulation of complement pathways.
Nonspecific defense mechanisms.
Specific defense mechanisms; Types of acquired immunity: antigen and antibodies; B cells and humoral immunity; T cells and cell mediate immunity.
Practical applications: vaccines, diagnostic immunology.
Disorder associated with the immune system, hypersensitivity, autoimmunity, natural Immune deficiencies, AIDS.
Interaction of antibody with antigen and applications in laboratory investigations. Immunochemistry, Immunofluorescence test, Immunodiffusion test ELISA, Molecular biological tools for disease diagnosis.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended reading :

1. Turgeon, M.L (1995) *Immunology and serology in laboratory***.**2nd ed. Published by Plenum. Press, NY
2. Atlas, R M (1996). *Microbiology Fundamentals and applications.* Publishers
   Wm. C. Brown
3. Tortora, G.J.; Funke, B.R.; Case, C.L (1998) *Microbiology.* Published by Benjamin Cummings, Addison Wesley Longman, Inc.
4. European Journal of Clinical Microbiology and Infectious Diseases, Springer Verlag KG

Type/Status : **Compulsory**
Course Code : **MIBI 53112**
Title : **Microbiology Laboratory**

Learning outcomes:
At the end of the course unit students should be able to

- demonstrate the basic techniques of handling, culturing, examination and identification of selected groups of microorganisms.
- build upon and develop the diverse range of laboratory skills and techniques required in the practical use and manipulation of microorganisms in the laboratory, industrial, and field situations
- explain the genomic variability for identification and characterization of microorganisms
- practice the identification of bacteria and fungi
- demonstrate the knowledge and understanding of the manipulation of biological molecules in bacteria for detection, identification and genome transformation
- demonstrate the knowledge and understanding of the techniques used to critically evaluate commodities and products in terms of food safety and acceptability using the latest quality control procedures.

Course content:
Laboratory exercises to illustrate the contents and special features emphasized in lecture series.

Examination of living micro-organisms in natural environment, Microscopic examination of bacteria using different staining procedures, examination of endospores and capsules. General techniques of isolation and enumeration of bacteria. Identification of unknown bacteria using taxonomic keys. Isolation, enumeration and identification of soil fungi. Identification of bacterial enzymes. Identification of some important biochemical characters in selected microorganisms. Preparation of bacterial Genomic and plasmid DNA, Digestion of DNA and analysis of the digestions by Gel electrophoresis: Restricted Fragment Length Polymorphism (RFLP) analysis, Bacterial transformation and cloning of DNA, Polymerase Chain Reaction (PCR) for the detection of important Bacterial species and some viruses. Enzyme linked Immunosorbent Assay (ELISA) test for the identification of the viruses. Isolation of plant pathogenic microorganisms. (Fungi and Bacteria), Plant disease diagnosis (Fungal, Bacterial, Virus diseases), Identification of plant pathogens using Cultural, Biochemical and Molecular biological techniques. Confirmation of pathogenicity. Qualitative and quantitative analysis of soil microorganisms.

Microbial Quality of water: Coliform Test, Membrane filter techniques, MPN counts Physico–Chemical characteristics of polluted water. Isolation of bacteria capable of degrading aromatic compounds and synthetic organic compounds. Microbiological quality of milk and milk products. The Microbiological examination of specific foods, determination of commercial sterility canned foods, detection of *Salmonella* in foods. Determination of different types of bacteria present in various condiments. Chemical methods of control: Disinfectants and Antiseptics, Action of Antibiotics and dyes. Immunological techniques used in disease diagnosis-Blood Test, Agglutination Reaction, Tube Agglutination, Compliment fixation, ELISA

Method of teaching and learning: laboratory exercises, group work and presentations.Field visits

Assessment: Continuous assessment and end of course examination.

Type/Status : **Compulsory**
Course Code : **MIBI 53122**
Title : **Project / Case study**

Learning outcomes:
At the end of the course unit, the students will be able to

- carry out documentation survey
- apply microbiological techniques,
- analyze data,
- interpret and present the findings in the form of a report.

Method of teaching and learning:

An individual or group project / case study will be assigned to the student under the supervision of a Senior staff member at the beginning of the second semester . A detail report should be submitted to the Department of microbiology

Assessment: Continuous assessment

Recommended Reading: Materials relevant to the research project

Type/Status	**:**	**Elective**
Course code	**:**	**MIBI 53132**
Course title	**:**	**Bioinformatics and Biostatistics**

Leaning outcomes

At the end of the course unit, the students should be able to

- practice the application of genetic manipulation in basic research
- Explain techniques used to make biological inferences from protein and nucleic acid sequences.
- Demonstrate basic skills in programming, design and management of bioinformatics databases.
- apply regression, classical methods of analysis of categorical data, logistic regression, and other appropriate statistical approaches to analyze the data obtained from various disciplines in Applied Microbiology

- Apply statistical methods of estimation and hypothesis testing and explain the basics of correlation and regression for the purpose of analyzing the research findings

Course content:
Introduction to bioinformatics. Databases, applications
Biostatitics: Introduction to biostatistics, Principles and application of biostatistics
Assessment: Continuous assessment and end of course examination.

Recommended reading:

1. Anderson, P. and Ganetzky, B. (1997), *An electronic companion to genetics workbook.* Cogito Learning Media, Inc
2. Griffiths, A. J. F., Miller, J.H., Suzuki, D.T. and Gelbert, W. M. (1996), *An Introduction to Genetic analysis,* 6th edition, W.H. Freeman and Company.
3. Harrigan, W.F (1998) *Laboratory methods in food and dairy microbiology*. Culinary and Hospitality Industry Publications Services.
4. Archive of "Molecular and Cellular Biology"
5. Current Genomics, Bentham Science Publishers Ltd

Type/Status	**:**	**Elective**
Course code	**:**	**MIBI 53142**
Course title	**:**	**Food Quality and Food Services Management**

Learning outcomes

At the end of the course unit, the students should be able to

- explain food safety regulations and microbiological criteria
- demonstrate the knowledge and understanding of the techniques used to critically evaluate commodities and products in terms of food safety and acceptability using the latest quality control procedures.
- apply sampling plans and sampling methodologies
- interpret of food quality and food safety test results
- apply microbiological criteria to GMP and HACCP
- discuss current and future trends in food service industry
- discuss legal regulations relate to food service industry.

Course content:

- **Food Safety Regulations and agencies involved-** national and international
- **Sampling of food**: Objectives, Sampling plans, Factors influencing sampling plans, Sampling methods, Interpretation of results.
- **Analytical methods for evaluation of food safety** (official methods, validated methods, and other), interpretation of data on food quality and safety tests and actions taken.
- **Microbiological standards of food. –**National and international (ISO, Codex Alimentarius).
- **Quality and safety assuarance systems in the food industry**-
  - Prerequisite programmes- GAP, SSOP and GMP
  - Principles and application of Hazard Analysis and Critical Control Points (HACCP) systems in food industries.
  - ISO 9001, 22000

- **Introduction to food service management** : commercial and on-site food service operations.
- **Purchasing for food services**; specifications and quality standards, grading of food products on the basis of nutritive values and storage, cost control.
- **Regulations of food service industry and ethical aspects**.
- **Principles of food service management**.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended Reading:

1. Banwart, G (1989) *Basic Food Microbiology*. Chapman and Hall
2. Forsyth, S.J (1995) *Food Hygiene, Microbiology and HACCP.* Culinary and Hospitality Industry Publications Services
3. Harrigan, W.F (1998) *Laboratory methods in food and dairy microbiology*. Culinary and Hospitality Industry Publications Services.
4. Ronald S. Kirk and Ronald Sawyer (1997) *Pearson's Composition and Analysis of Foods*.
5. Spears, M. and Gregorie, M. (2007) *Food service organization: A managerial and Systems approach (6th edition)*, Published by Prentice Hall, USA.
6. European Journal of Nutrition, Springer Verlag KG

Type/Status : **Elective**
Course Code : **MIBI 53152**
Title : **Microbiology Laboratory management and Recent Advances in Applied Microbiology**

Learning outcomes:

At the end of the course unit, the students will be able to

- perform standard laboratory procedures employed in academic, industry, and government laboratories
- develop comprehensive laboratory management strategies
- demonstrate skills in critical thinking, problem solving, project management, and team building
- selectively extract information from published sources and use this to present critical reviews of the current status of knowledge in this area
- identify and describe new trends in Applied Microbiology

Course content:

Microbiology Laboratory management: Safety and occupational health in a microbiology laboratory
Principles of safety and safety cabinets, risk groups in bacteria.
Quality assurance in laboratory testing programmes. National and International standards (ISO 17025).
Internal and external audits in a laboratory. Proficiency testing. Design and evaluation of a SOP system.
Method of preparing a laboratory for accreditation to ISO 17025.
Recent Advances in Applied Microbiology: Current topics in different areas in Applied Microbiology.

Method of teaching and learning: A combination of lectures, assignments and presentations.

Assessment: Continuous assessment and end of course examination.

Recommended reading:

1. Gartifield, F. M., Hiresh, G. H. and Klesta (Jr) E. J. (1999) *Quality Assurance Principles for Analytical Laboratories, 3rd Edition* the AOAC publication.
2. Archives of Microbiology, Springer Verlag KG.
3. Current Microbiology, Springer Verlag KG
4. Recent text books and latest research papers relevant to the respective study area.

Type/Status : **Compulsory**
Course Code : **MIBI 6301X**
Title : **Research Project**

Learning outcomes:
At the end of the course unit, the students will be able to

- critically assess and summaries the literature in the area of the research project.
- Plan and organize the methodologies to achieve the objectives of the research project
- apply appropriate microbiological techniques to obtain data relevant to the project
- analyze and interpret data.
- organize and present the findings in the form of a dissertation.

Content:

Research methodology; Purpose of doing research, how to identify a research problem, literature review, factors to be considered in selecting a research topic, writing research objectives and research hypothesis, research methodology and research design, recording observations, data analysis, writing discussion, making conclusions and recommendations, list of references.

Method of teaching and Learning:

An individual project is assigned to each student under the supervision of a Senior staff member at the beginning of the second year.

Assessment:

Formative assessment: Oral presentations and draft reports

Summative assessment: A detail project report should be submitted as a dissertation before the end of the academic year.

Recommended Reading: Latest research papers relevant to the respective research project.