PROGRAMME PROJECT REPORT FOR M.Sc. MICROBIOLOGY

DIRECTORATE OF DISTANCE EDUCATION
ALAGAPPA UNIVERSITY
(A State University Accredited with 'A^{+}' Grade by NAAC (CGPA: 3.64) in the Third cycle)
KARAIKUDI – 630 003

Open and Distance Learning (PPR)

Course: M.Sc., Microbiology

Credit Based System (CBS)

(With effective from June 2018 – 2019 onwards)

A. Programme's mission and objectives

Microbes are omnipresent and indispensable to human life. Interactions of microbes involved in soil, environment, food, fermentation, medical, or agriculture have been studied using modern techniques. Increased attention has been directed towards use of microorganisms for wastewater treatment (bioremediation) and management of industrial effluents including distillery waste, textile industries and paper industries. Genetic improvement of strains can be explored in future for the production of biofuels. Use of recombinant microorganisms for industrial production of useful compounds has reached at commercial levels.

M.Sc. Microbiology is a two year postgraduate program. Microbiology is introduced with Microbial Physiology, Biochemistry, virology, immunology, Industrial and Agricultural microbiology are mainly grown applied sciences.

This programme is designed to provide the theoretical knowledge, understanding and practical skills to ensure a solid grounding in core and applied microbiology, along with the transferable skills which are essential to enhance your employability options. This aims to prepare graduates for a broad range of careers within industrial, commercial, governmental, environmental settings and further postgraduate study.

B. Relevance of the program with HEI's Mission and Goals

Our University Mission is "Affording a High Quality Higher Education to the learners. So that they are transformed in to intellectually competent human resources that will help in the uplift of the nation to educational, social, technological, environmental and economic magnificence" regarding that we have paved way to a tremendous rise in job opportunities for microbiologists in various industrial sectors including pharmaceuticals, agrochemicals, fertilizers, food products, government setups for environment protection, hospitals, research institutes, pathology labs to mention a few. The curriculum and syllabus, of M.Sc., (Microbiology) course at Alagappa University, have been designed to encompass basic as well as applied knowledge of microbiology to produce industry ready and employable microbiologists capable of availing promising professional carrier in life.

C. Nature of prospective target group of learners

- Working Professionals
- Entrepreneurs
- Service Personnel
- Academic Faculty
- Government Officials
- Researchers
- Home Makers
- Unemployed Graduates

D. Appropriateness of programme

The M.Sc., Microbiology programme provides opportunities for students to develop, demonstrate, understanding, skills, qualities of knowledge and other attributes in the following areas:

- Be impressed on the milestones of Microbiology and present status
- Be able to understand in depth the techniques used in Microbiology
- How fundamental chemical principles and reactions are utilized in biochemical processes
- Be impressed on the special fermentation by specific microbes
- To know the value, production, application, crop response of biofertilizers and biopesticides
- The students will be able to know the Industrial production of various products
- The students will be able to understand the Rules and regulation of industrial microbiology
- The students are able to know the alternate energy sources and biomass energy

After completion, jobs are available with a wide range of organisations in the public, private and not-for-profit sectors. Typical employers include:

- Schools, colleges, science centres, libraries and museums
- Universities and research institutes
- Government agencies and research institutions
- Chemical, pharmaceutical and petroleum companies
- Food manufacturing and processing companies
- Medical research establishments and the National Health Service
- Milk and milk product related industries
- Water treatment plants

E. Instructional design

Curriculum Design

Sem	M.Sc Microbiology		Cr.	Marks		Total
	Course Code	Title of the course		Int.	Ext.	
FIRST YEAR						
I	**36411**	**General Microbiology**	4	25	75	100
	36412	**Microbial Biochemistry**	4	25	75	100
	36413	**Microbial Physiology**	4	25	75	100
	36414	**Lab I- General Microbiology, Microbial Physiology and Biochemistry**	4	25	75	100
			16	100	300	400
II	**36421**	**Microbial Genetics**	4	25	75	100
	36422	**Molecular Biology & r DNA Technology**	4	25	75	100
	36423	**Food & Dairy Microbiology**	4	25	75	100
	36424	**Lab II-, Microbial Genetics, Molecular Biology & r DNA Technology, Food & Dairy Microbiology**	4	25	75	100
			16	100	300	400
SECOND YEAR						
III	**36431**	**Immunology**	4	25	75	100
	36432	**Medical Microbiology**	4	25	75	100
	36433	**Environmental & Agricultural Microbiology**	4	25	75	100
	36434	**Lab III- Immunology, Medical Microbiology and Environmental & Agricultural Microbiology**	4	25	75	100
			16	100	300	400
IV	**36441**	**Bioprocess Technology**	4	25	75	100
	36442	**Microbial Biotechnology**	4	25	75	100
	36443	**Bioinformatics and Biostatistics**	4	25	75	100
	36444	**Lab IV- Industrial Microbiology & Microbial biotechnology**	4	25	75	100
			16	100	300	400
		Grand Total	**64**	**400**	**1200**	**1600**

Course Code Legend:

3	6	4	X	Y

364 - M. Sc., Microbiology Programme
X - Semester Number
Y - Course Number in the Semester

I semester = 16 credits

II Semester = 16credits

III semester = 16credits

IV semester = 16 credits

Total credits = 64

Total Marks = 1600

I YEAR – I SEMESTER
COURSE CODE: 36411
GENERAL MICROBIOLOGY

Objective

1. To inculcate knowledge on fundamentals of microorganisms.
2. To learn the structural organization, morphology and reproduction of microbes.
3. To know the principles of Microscopy and advancements in Microscopy.

Outcome

1. Knowledge on historical perspective of Microbiology.
2. Basic knowledge on different structure of microbes.
3. Ideas on different type of microscope.

BLOCK-1: History and Classification of Microorganisms

Unit I

Introduction to Microbiology, Haeckel's three–kingdom concept, Whittaker's Five-kingdom concept, Three-domain concept of Carl Woese.

Unit II

Classification of Bacteria according to Bergey's Manual.

Unit III

Fungi: Classification of fungi based on Alexopoulos system. - characteristics of Fungi, Industrial uses of yeast and moulds.

BLOCK-2: Microscopy, Staining techniques, Growth and Preservation methods

Unit IV
Simple, Compound, Dark-field, Phase contrast, Fluorescent and Electron microscopes. (SEM & TEM), Confocal microscopy – Principles and their applications.

Unit V
Stains and staining techniques: Simple, Differential, Structural staining methods and Imaging techniques.

Unit VI
Auxenic and synchronous, aerobic and anaerobic, Culture media and Nutritional types, Growth curve, Generation time and growth kinetics. Factors influencing microbial growth.

Unit VII
Preservation methods of microbes for storage, Sterilization and disinfection.

BLOCK-3: Prokaryotic and Eukaryotic cell structure

Unit VIII
Prokaryotic cell structure & Organization, Cell membrane, Plasma membrane, Cytoplasmic matrix, Inclusion bodies, Ribosome, Nucleiod, Prokaryotic cell wall, Capsule, Slime layers, S layers, Pili and Fimbriae, Flagella and Motility. Bacterial endospores. Archaeal cell structures.

Unit IX
General characters and classification of Blue green Algae (Cyanobacteria) Macroalgae - Biological and Economic importance of algae. Protozoa – structural characteristics, classification and reproduction.

Unit X
Eukaryotic cell structure and its organelles. Lichens and Microalgae- Structural organization and their properties.

BLOCK-4: Virology

Unit XI
Nomenclature and Classification of viruses.

Unit XII
Distinctive properties of viruses; morphology and ultrastructure. Capsids and their arrangements- types of envelopes and their composition

Unit XIII
Viral genome, their types and structures. Life cycle of virus.

Unit XIV
Virus related agents (viroids, prions).

References

1. Tortora, G.J., Funke B.R, and Case C.L. (2010). **Microbiology an Introduction** (10th Edition), Benjamin Cummins, USA.
2. Dubey, R.C. and Maheswari, D.K. (2013). **A Textbook of Microbiology** (Revised Edition), S.Chand and Company Ltd., New Delhi.
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I YEAR – I SEMESTER
COURSE CODE: 36412
MICROBIAL BIOCHEMISTRY

Objective

1. To know the structural organization of bio-molecules.
2. To learn the characteristics of nucleic acids and enzymes.
3. To acquire knowledge on secondary metabolites.

Outcome

1. Knowledge on metabolism of bio – molecules.
2. General Information about nucleic acids, enzymes and vitamins.
3. Clear idea on secondary metabolites.

BLOCK-1: Carbhohydrates and Proteins

Unit I

Carbohydrates- Classification, Structure, properties of monosaccharides and disaccharides. polysaccharides - starch, cellulose, agar- agar and peptidoglycan.

Unit II

Metabolism and its regulation- Gluconeogenesis, glycolysis, kreb's cycle, pentose phosphate pathway or hexose mono phospate shunt, glyoxylate cycle and Entner Doudroff pathway.

Unit III

Amino acid and proteins- Classification based on structure, polarity, biological importance and reactivity, physical properties and chemical reactions.

Unit IV
Biosynthesis of amino acids – an overall view. Protein - Classification, physical and chemical properties. Structure – primary, secondary, tertiary and quaternary structure of proteins.

BLOCK-2: Lipids and Nucleic acids

Unit V
Lipids and fatty acids- Classification and properties. Phospholipid and cholesterol synthesis in *E.coli*.

Unit VI
Lipids and fatty acids metabolism - α, β and γ oxidation of fatty acids and lipid peroxidation.

Unit VII
Nucleic acids- Structure, synthesis and degradation of purines and pyrimidines.

BLOCK-3: Enzymes

Unit VIII
Enzymes- Classification, chemical nature and properties of enzymes. Factors affecting enzyme activity and Active site of enzyme.

Unit IX
Enzyme inhibition- Reversible, irreversible, Allosteric inhibition, Enzyme specificity and co-enzymes.

Unit X
Mechanism of enzyme action- Michaelis - Menten hypothesis, Lock and key model, induced fit theory. Isozyme, ribozyme and abzyme.

BLOCK-4: Pigments, Secondary metabolites and Vitamins

Unit XI
Microbial pigments – chlorophyll, fluorescence, phosphorescence, bacteriochlorophyll, rhodopsin, carotenoids and phycobiliproteins.

Unit XII
Secondary Metabolites- Antibiotics – Classification based upon mode of action. Biosynthesis and regulation of penicillin and streptomycin.

Unit XIII
Microbial Toxins – *Salmonella* toxin, *Cholera* toxin, Botulism toxin and Aflatoxin.

Unit XIV
Vitamins – Classification, Properties and functions, Vitamins as Co – factors and Co – enzymes.

References

1. David, A. B. (2009). **Nutritional biochemistry of Vitamins**, Cambridge.
2. Deb, A.C. (2006). **Fundamentals of Biochemistry**, New Central Book Agency Pvt. Ltd., Kolkata.
3. Donald Voet and Judith Voet. G. (2011). **Biochemistry** (4th Edition), John Wiley and Sons, Inc. New York.
4. Stryer, L. (2010). **Biochemistry** (7th Edition), W.H. Freeman and Company, New York.
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8. Moat, A.G. and Foster, W. (2002). **Microbial Physiology** (4th Edition), John Wiley and Sons, New York.
9. Nelson, D.L. and Cox, M.M. (2012). **Lehingers's Principles of Biochemistry** (6th Edition), Mac Millan worth Publishers, New Delhi.
10. Srivastava, M.L. (2008). **Microbial Biochemistry**, Narosa Publishing House, New Delhi.

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I YEAR – I SEMESTER
COURSE CODE: 36413
MICROBIAL PHYSIOLOGY

Objective

1. To develop a sufficient background to students about the growth of Microbes.
2. To learn the microbial metabolism.
3. To acquire knowledge on microbial stress response.

Outcome

1. Knowledge on growth of Microbes.
2. General Information about microbial metabolism.
3. Clear idea on microbial communications.

BLOCK-1: Bacterial Growth and Nutrition

Unit I

Growth of Bacteria- Phases of growth. Growth kinetics - batch culture, continuous culture and synchronous culture. Factors affecting growth - nutrition, aeration, temperature and pH.

Unit II
Nutritional diversity in microorganisms, nutritional types - autotrophy, heterotrophy, chemotrophy, phototrophy, lithotophy and organotropy. Nutrition –essentiality of major and minor elements.

Unit III
Chemotrophism and their importance, reverse electron transport, CO_2 assimilation and reductive acetyl COA pathway.

Unit IV
Chemoheterotrophism - Acetogens, methanogens, methanogenenesis and its importance. Physiology and economic importance of methylotrophs.

BLOCK-2: Bacterial Photosynthesis, Nitrogen metabolism and Stress response

Unit V
Bacterial Photosynthesis- General types of microbial photosynthesis, oxygenic and anoxygenic. Structure of photosynthetic pigments – chlorophylls, bacteriochlorophyll, carotenoids and phycobilins.

Unit VI
Photosynthetic bacteria - green sulphur and purple. Mechanism of photosynthesis non-cyclic and cyclic electron transport. Photo phosphorylation.

Unit VII
Microbial stress responses- Osmotic stress and osmoregulation, Aerobic to anaerobic transitions, Oxidative stress, pH stress and acid tolerance, Thermal stress and heat shock response, Nutrient stress and starvation stress.

BLOCK-3: Microbial Metabolism

Unit VIII
Nitrogen metabolism- Nitrogen cycle - ammonification, nitrification, denitrification and nitrogen fixation. Nitrogenase enzyme, physiology of nitrogen fixation in symbiotic and free living bacteria.

Unit IX
Aerobic respiration- TCA cycle- intracellular location and reactions, amphibolic reactions. Glyoxalate cycle.

Unit X
Mechanisms of substrate – level phosphorylation. Respiratory electron transport in mitochondria and bacteria. Mechanism of oxidative phosphorylation.

Unit XI
Anaerobic respirations- sulphate, nitrate, carbonate respirations and their ecological significance.

BLOCK-4: Bacterial Transport and Quorum sensing

Unit XII

Bioenergetics- Entropy, enthalpy, electron carriers, artificial electron donars, inhibitors, uncouplers, energy bond and phosphorylation.

Unit XIII

Transport across membrane - diffusion, osmosis, active transport and group translocation.

Unit XIV

Quorum sensing- Mechanism and Signaling molecules.

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1. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). **Biology Microorganisms** (12th Edition), Prentice Hall, New Jerry.
2. Moat, A.G. and Foster, W. (2002). **Microbial Physiology** (4th Edition), John Wiley and Sons, New York.
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I YEAR – I SEMESTER
COURSE CODE: 36414
LAB I- GENERAL MICROBIOLOGY, MICROBIAL PHYSIOLOGY& BIOCHEMISTRY

Suggested Laboratory Exercises:

GENERAL MICROBIOLOGY

1. Principle and methods of sterilization.
2. Preparation of media: nutrient broth, nutrient agar plate, and soft agar.

3. Pure culture techniques: streak plate, spread plate and pour plate.
4. Motility determination – Hanging drop method.
5. Isolation and enumeration of bacteria from different environmental samples.
6. Enumeration of bacteria - viable count (plate count) and total count (Haemocytometer count).
7. Direct microscopic observation of fungal spores and mycelium.
8. Fungal slide culture.
9. Staining method: simple, negative, Gram's staining and spore staining.

BIOCHEMISTRY

10. Measurement of growth rate and generation time by turbidometry method.
11. pH metry -Preparation of buffer.
12. Spectrophotometry- Wavelength scan.
13. Chromatography - Paper and Thin layer chromatography - separation of amino acid.

MICROBIAL PHYSIOLOGY

14. Carbohydrates: Quantitative estimation of glucose, glycogen from bacterial and yeast cell.
15. Protein- Quantitative estimation of protein from bacterial yeast cell.
16. Enzyme- Estimation of alkaline phosphatase activity.
17. Environmental factor- Effect of temperature and pH on bacterial growth.
18. Physiological groupings of bacteria- Isolation of saccharophilic microorganisms (starch hydrolysis)- Proteolytic activity of microorganisms (casein and gelatin hydrolysis)- Lipolytic activity of microorganisms.
19. Utilization of Unusual compounds- Microbial degradation of azodyes.
20. Bioenergetics- Cytochrome oxidase assay - Catalase assay.
21. Nitrogen metabolism- Nitrate reduction test.

References

1. Aneja, K.R. (2003). **Experiments in Microbiology: Plant Pathology and Tissue Culture**, Wishwa Prakashan, New Delhi.
2. Cappuccino, J.H. and Sherman, N. (2014). **Microbiology – A Lab Manual** (10^{th} Edition), The Benjamin Publishing Company, Singapore.
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4. Gunasekaran, P. (1995). **Laboratory Manual in Microbiology**, New Age International (P) Ltd. Publishers, New Delhi.
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8. Reddy, S.W. and Reddy, R.S. (2000), Microbiology: A Laboratory Manual, BSC Publishers &. Distributors.

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10. Wilson, K. and Walker, J. (1986). (Low Price Edition 1995) **Principles and Techniques of Practical Biochemistry**, CUP, Cambridge.

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I YEAR – II SEMESTER
COURSE CODE: 36421
MICROBIAL GENETICS

Objective

1. To extend the knowledge on molecular basis of mutation at microbial level.
2. To focus on gene regulation and expression mechanisms.
3. To understand the principles role of plasmids and gene transfer methods.

Outcome

1. Receive elaborate knowledge on mutation.
2. Better understanding about gene regulation.
3. Get thorough knowledge on gene transfer mechanisms in microbes.

BLOCK-1: Mutation, DNA damage and repair

Unit I

Mutation and its types, Mutation rate and its determination and Mutagenesis.

Unit II

Mutagens-Types, Physical mutagens, DNA reactive chemicals, base analogs, intercalating agents, metals and biological agents.

Unit III

DNA damages- Deamination of bases, alkylation, damage due to reactive oxygen, UV induced damage.

Unit IV

Repair pathways (Methyl-directed mismatch repair, Nucleotide excision repair, Base excision repair, recombinational repair, SOS inducible repair, specific repair for oxidative DNA damage, pyrimidine dimers and alkylation induced damage and adaptive response).

BLOCK-2: Bacterial Recombination

Unit V

Recombination- Types of recombinations, Models for Homologous recombination, Molecular mechanism of homologous recombination, Homologous recombination in eukaryotes, Mating type switching. Molecular mechanism for site-specific recombination. Biological roles of site specific recombination.

Unit VI

Conjugation- Conjugation by *E. coli* F factor, Structure of F-factor, Regulation of F-factor fertility, establishment of cell contact, DNA mobilization, transfer and separation of mating

pair, Hfr conjugation and chromosomal transfer, Interrupted mating and conjugational mapping.

Unit VII
Transformation- Mechanism of Natural competence and transformation in *Bacillus subtilis* and *Streptococcus pneumoniae*. Transformation by inducing artificial competence, Gene linkage and mapping by transformation.

Unit VIII
Transduction- Generalized and specialized transduction.

BLOCK-3: Operon concept and Extra Chromosomal Materials

Unit IX
Gene concept- regulation of bacterial gene expression. Lactose system - coordinate regulation, Lac components, positive, negative regulation and catabolite repression.

Unit X
Tryptophan operon - attenuation. Arabinose operon and its regulation.

Unit XI
Plasmids- Types of plasmids - F, R & Col plasmids. Properties of plasmids – sex factors, drug resistant, colicinogenic. Agrobacterium Ti and broad host range plasmid.

BLOCK-4: Transposable Elements and Epigenetics

Unit XII
Detection and purification of plasmid DNA. Transfer of plasmid DNA. Replication of plasmid. Control of copy number, plasmid amplification, curing and incompatability.

Unit XIII
Transposable elements- Types of transposable elements, Structure, genetic organization and mechanism of transposition of Tn5, Tn3 and related transposons, Bacteriophage Mu, Tn7 and IS911, Integrons, Retrotransposons.

Unit XIV
Epigenetics- Definition, Molecular basis, Mechanisms, Functions and Epigenetics in bacteria.

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1. Benjamin Lewin,(2000). **Genes VIII**, Oxford University Press, New York.
2. David Freifelder. D. (2008). **Microbial Genetics**, (18th Edition), Narosa Publishing House, NewDelhi.
3. Freifelder, D. (2000). **Molecular Biology, (**2nd Edition), Narosa Publishing house. NewDelhi.
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COURSE CODE: 36422
MOLECULAR BIOLOGY & rDNA TECHNOLOGY

BLOCK-1: DNA and its replication, RNA and its types

Unit I
Discovery of DNA- Molecular basis of DNA as genetic material. Structure of DNA – A, B and Z form. Forms of DNA – DNA heteroduplex, circular, superhelical DNA, twisted circle. Properties of DNA - denaturation, renaturation, melting curve and hyperchromicity.

Unit II
Replication of DNA- semi conservative mode, Meselson - Stahl experiment. Enzymology of DNA replication - DNA polymerase I, II &III, topoisomerase I & II, helicase, primase, gyrase. Molecular basis of DNA replication - replication fork, origin, okazaki fragments. Types of replication - circular and theta.

Unit III
Structure of RNA - types of RNA - tRNA, mRNA and rRNA

BLOCK-2: Protein Synthesis & Cloning vectors

Unit IV
Transcription process in Prokaryotes- Initiation - promotors, upstream and downstream sequences, transcription factors. Elongation - RNA polymerase, sub units. Termination - Rho dependent and Rho independent, nus A protein. antitermination.

Unit V
RNA processing (post transcriptional modifications), inhibitors of transcription. Reverse transcription.

Unit VI
Cloning vectors – plasmids, cosmids, phasmids ,phagemids, expression vectors, plasmid vectors – $p^{BR}322$ and $p^{UC}18$, integrating shuttle vector –YAC vectors, viral vector – SV 40 and adeno virus.

BLOCK-3: Gene Cloning

Unit VII
Cloning of human insulin, interferon in *E.coli.* Recombinant vaccine development – HBs Ag in yeast.

Unit VIII
Cloning for commercial production of antibiotics (Penicillin).

Unit IX
Cloning methodologies- α complementation, sticky and blunt end cloning. Cloning from mRNA – synthesis of cDNA, cloning cDNA– cDNA library. Cloning from genomic DNA – genomic library. Shot gun cloning.

Unit X
Screening of recombinant – phenotypic expression of characters. Blotting techniques – western, northern and southern. Mapping of human genes – Human genome project.

BLOCK-4: Molecular Techniques

Unit XI
PCR- gene amplification, primer designing, optimization, variation in the PCR (RAPD and RFLP)

Unit XII
DNA sequencing – Sanger – Coulsen's method, Maxam Gilbert's method, automated sequencing and micro array.

Unit XIII
Gene silencing and antisense technology- Types and mechanism of gene silencing. Genetic factors of silencing, formation of antisense mRNA, inhibition of gene expression by antisense RNA.

Unit XIV
Plant genetic engineering- Ti plasmid, CaMV vector, Direct DNA delivery methods – micro projectile bombardment, microinjection and electroporation.

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1. Benjamin Lewin. (2000). **Genes VIII,** Oxford University Press, New York.
2. David Freifelder. D. (2008). **Microbial Genetics**, (18th Edition), Narosa Publishing House, NewDelhi.
3. Freifelder, D. (2000). **Molecular Biology**, (2nd Edition), Narosa Publishing house. NewDelhi.
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I YEAR – II SEMESTER
COURSE CODE: 36423
FOOD & DAIRY MICROBIOLOGY

BLOCK-1 Introduction to food microbiology

Unit I
General introduction of foods and related microorganisms.

Unit II
Intrinsic factors- Nutrient Content, pH and Buffering Capacity, Redox Potential, Antimicrobial Barriers and Constituents and Water Activity.

Unit III
Extrinsic factors- - Relative Humidity, Temperature and Gaseous Atmosphere.

BLOCK-2: Food contamination, Spoilage and Preservation

Unit IV
Contamination and spoilage of cereals, cereal products, fruits, vegetables, meats, meat products, fish, sea foods, eggs, poultry and canned foods.

Unit V
Food poisoning and food borne infections (bacterial, viral, fungal and protozoa), bacterial and fungal toxins.

Unit VI
General principles of food preservation- Physical and Chemical methods.

BLOCK-3: Dairy Microbiology, Microbial Products

Unit VII
Dairy microbiology- Normal flora of milk and milk products, Spoilage of milk and milk products.

Unit VIII
Fermented milk products- acidophilus milk, bifidus milk ,yoghurt manufacture of cheese and evolution of quality milk.

Unit IX
Microbial food fermentation- Fermentation in food processing, role of microorganisms in food fermentation.

Unit X
Microbial products of food; SCP, mushrooms, oriental foods Fermented beverages (fruit and cereal based).

BLOCK-4: Microbial enzymes, Quality control and Quality Assurance

Unit XI

Industrial production of enzymes- cellulases, amylases, proteases, phytases, pectinases, lipases and glucose isomerases.

Unit XII

Food borne disease outbreaks - Objectives of investigation, Field investigation, lab testing and preventive measures.

Unit XIII

Food sanitation – Microbiology of food plant sanitation, water and milk testing.

Unit XIV

Food laws and quality control – HACCP, Codex alimentarius, PFA, FPO, MFPO, BIS and AGMARK.

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COURSE CODE: 36424
MICROBIAL GENETICS, MOLECULAR BIOLOGY & r DNA TECHNOLOGY and FOOD & DAIRY MICROBIOLOGY

MOLECULAR BIOLOGY& r DNA TECHNOLOGY

1. Single colony isolation and checking for genetic markers.
2. Measurement of growth-one step growth curve using a T even phage.
3. Titration of phages (T4).
4. Induction of Lambda Phage.
5. Induced mutagenesis – UV.
6. Isolation of antibiotic resistant mutants.
7. Isolation of auxotrophic mutants.

MICROBIAL GENETICS

8. Isolation of specialized transducing phage.
9. Bacterial conjugation – transfer of drug resistant factor (Plasmid).
10. Transposon mutagenesis of chromosomal and plasmid DNA.
11. Isolation of plasmid and chromosomal (bacterial) DNA.
12. Quality and quantity checking of DNA by UV Spectrophotometer and Submarine agarose gel electrophoresis.
13. Gene cloning – Preparation of vector and passenger – Ligation – Preparation of competent cells – Transformation of *E.coli* with recombinant plasmids.
14. Selection of recombinants by blue white selection.
15. PCR amplification – Demo.

FOOD & DAIRY MICROBIOLOGY

16. Resazurin dye reduction test.
17. Phosphatase test.
18. Litmus milk reactions.
19. Potability analysis of drinking water.
20. Bacterial examination of water (qualitative and quantitative).
21. Membrane filtration technique.

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II YEAR – III SEMESTER
COURSE CODE: 36431
IMMUNOLOGY

Objective

1. To provide knowledge on human immunity system.
2. To understand the mechanism of antigen antibody reaction.
3. To inculcate the principles of vaccine development.

Outcome

1. Students acquire the information about immunity development.
2. Become an eminent in immunotechnology.
3. Able to understand the immunological reactions.

BLOCK-1: Immune system and Immune cells

Unit I
Basic concepts and terminologies in immunology. Haematopoiesis.

Unit II
Immune system- primary and secondary lymphoid organs: structure and functions and cells of immune system.

Unit III
Innate and acquired immune system- cells and molecules involves. Cell mediated and humoral mediated response. Role of Toll like receptors in innate immunity.

Unit IV
Maturation and Differentiation of T-cell and B-cell. T-cell and B-cell receptors.

BLOCK-2: cytokines, Antigen Antibody interactions

Unit V
Characteristics and functions of cytokines, haemokines.

Unit VI
Immunoglobulins- class, subclass, structure and fuction, Immunoglobulins genes- Organization and expression. Generation of antibody diversity.

Unit VII
Immunogenicity- Immunogens, adjuvants, epitopes, haptens and carriers.

Unit VIII
T dependent and T independent antigens. Strength of antigen-antibody interactions- affinity, avidity, valency, agglutination and precipitation.

BLOCK-3: Complement system and Major Histocompatibility Complex

Unit IX
Complement systems- mode of activation, classical and alternate pathway.

Unit X
Mechanisms of antigen processing and presentation-cytosolic and endocytic pathways. Antibody engineering.

Unit XI
Major histocompatibility complex (MHC)- structure and its interaction with peptide.

BLOCK-4: Hypersensitivity, Transplantation and Vaccines

Unit XII
Hypersensitivity reactions- Type I, II, III and IV. Autoimmune disorders.

Unit XIII
Organ transplantation and HLA tissue typing. Oncogenes and antioncogenes.

Unit XIV
Hybridoma and monoclonals. Vaccine – Introduction- types- live or attenuated, killed and DNA vaccines. Stem Cells and its clinical application- Human pluripotent stem cells (bone marrow, nerve cells, heart muscle cells and pancreatic islet cells).

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II YEAR – IV SEMESTER
COURSE CODE: 36432
MEDICAL MICROBIOLOGY

Objective

1. To inculcate on the role of normal flora and pathogenic microbes.
2. To understand the pathogenesis of various diseases.
3. To understand the various clinical microbiological techniques.

Outcome

1. Get information about various mechanisms of infection.
2. Knowledge on clinical lab techniques.
3. Acquire knowledge on control measures of diseases.

BLOCK-1: Introduction to Medical Microbiology

Unit I

Laboratory management – Safety in containment laboratory. Collection and transport of clinical samples.

Unit II

Microbiological examination of urine, blood, faeces, cerebrospinal fluid, throat swabs, sputum, pus and wound exudates.

Unit III

Normal flora of human systems – skin, respiratory tract, gastrointestinal tract and genitourinary tract. Nosocomial infections.

BLOCK-2: Bacterial diseases

Unit IV

General characters, pathogenesis, laboratory diagnosis and control measures of- Gram positive cocci disease – pharyngitis, pneumonia. Gram negative cocci– gonorrhea.

Unit V

Gram positive non spore forming bacilli – nocardiosis, diphtheria. Gram positive spore forming bacilli- aerobic- anthrax and anaerobic- Tetanus (Lockjaw).

Unit VI

General characters, pathogenesis, laboratory diagnosis and control measures of- Gram negative nonspore forming bacilli- Aerobic- pertussis. Small gram negative facultative anaerobic bacteria – Yersiniosis.

Unit VII
Enteric Gram negative bacilli – Vibriosis, *S*almonellosis. Acid fast bacteria – tuberculosis and leprosy. Cell wall less bacteria – pneumonia and Leptospirosis.

BLOCK-3: Viral and Fungal Diseases

Unit VIII
Influenza, Measles, Mumps, Chicken pox, Hepatitis A, B, C, D & E , Poliomyelitis, AIDS, Human Papilloma virus, Rabies and Yellow fever.

Unit IX
Dengue, Japanese Encephalitis, SARS and Swine Flu.

Unit X
Mechanism of pathogenesis and lab diagnosis of fungal diseases: Superficial Mycoses, Cutaneous Mycoses and Subcutaneous Mycoses.

Unit XI
Systemic mycosis, Opportunistic Mycoses and Mycotoxicosis.

BLOCK-4: Parasites, Newly Emerged Diseases and Control Mechanism

Unit XII
Mechanism of pathogenesis and lab diagnosis of Protozoology- Amoebiasis amd Malaria.

Unit XIII
Classification of antibiotics based on mode of action- antibacterial (Penicillin), antiviral (Amantidine), antifungal (Amphotericin) and antiparasitic drugs (Quinine and Metraindazole).

Unit XIV
Emerging and re-emerging infections (Chickungunya, Zika virus, H1N1 and Ebola). National programmes in prevention of infectious diseases.

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II YEAR – III SEMESTER
COURSE CODE: 36433
ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Objective

1. To create awareness on Environmental Microbiology.
2. To give knowledge on plant pathogen interaction and its control.
3. To inculcate on biofertilizer and biopesticides.

Outcome

1. Acquire knowledge on agriculture microbiology.
2. Understand the biogeochemical cycles prevail in environment.
3. Able to know about global environmental problems.

BLOCK-1: Ecosystem

Unit I

Environment and Ecosystems- Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of environment. Conservation and Management.

Unit II

Concept of biosphere, communities and ecosystems. Ecosystem characteristics, structure and function. Food chains, food webs and trophic structures. Ecological pyramids.

Unit III

Eutrophication- Definition, causes of eutrophication, and microbial changes in eutrophic bodies of water induced by various inorganic and organic pollutants.

BLOCK-2: Waste water treatment, Xenobiotic degradation, Environmental problems

Unit IV

Types of solid Waste, Treatment of solid wastes -composting, vermiform composting, saccharification and gasification.

Unit V

Types of liquid Waste, Treatment of liquid wastes –primary, secondary and tertiary treatment- anaerobic (methanogenesis), aerobic, trickling, activated sludge and oxidation pond.

Unit VI
Microbiology of degradation of xenobiotics (heavy metals) in the environment- ecological considerations, decay behaviour, biomagnifications, degradative plasmids and substituted hydrocarbons.

Unit VII
Global environmental problems- Ozone depletion, UV-B, green house effect and acid rain, their impact and biotechnological approaches for management. Containment of acid mine drainage applying biomining [with reference to copper extraction from low grade ores].

BLOCK-3: Soil Microbiology and Biogeochemical cycle

Unit VIII
Soil as an environment for microorganisms- Classification of soil, physical and chemical properties of soil and structure of soil.

Unit IX
Microbial interactions between plants– phyllosphere, mycorrhizae, rhizosphere and symbiotic association in root nodules.

Unit X
Biogeochemical cycles - carbon, phosphorus and sulfur.

BLOCK-4: Plant Disease Control and Management

Unit XI
Plant pathogens and classification of plant diseases- Host-pathogen recognition and specificity. Principles of plant infection - entry of pathogen in to host, colonization of host, role of enzymes, toxins and growth regulatory substances.

Unit XII
Defense mechanisms in plants - Structural and biochemical - Molecular aspects of host defense reactions - Lipoxygenase and other enzymes in the expression of disease resistance**.**

Unit XIII
Symptoms, Etiology, Epidemiology and management of the following plant diseases- Mosaic disease of tobacco, Bunchy top of banana, Bacterial blight of paddy and Grassy shoot of sugar cane.

Unit XIV
Plant disease management – exclusion, evasion, eradication and crop rotation. Sanitation - physical, chemical and biological control. Plant disease forecasting. Biotechnological approaches to disease management.

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II YEAR – III SEMESTER
COURSE CODE: 36434
IMMUNOLOGY, MEDICAL MICROBIOLOGY, ENVIRONMENTAL & AGRICULTURE MICROBIOLOGY

Suggested Laboratory Exercises:

IMMUNOLOGY

1. Collection of venous blood from human, separation and preservation of serum/plasma.
2. Blood Grouping.
3. Precipitation method- Immunodiffusion and Immunoelectrophoresis.
4. Latex Agglutination test.
5. Widal test (Tube and Slide Test).
6. ELISA.
7. Western Blotting.

MEDICAL MICROBIOLOGY

8. Isolation and identification of - Respiratory tract infections- *Pseudomonas aeruginosa*, Urinary tract infection- *Ecoli/ K. pneumonia.*
9. Fungal skin pathogens- *Dermatophytes* and *Candida*.

ENVIRONMENTAL & AGRICULTURE MICROBIOLOGY

10. Enumeration of microorganism from air.
11. Settle plate technique.
12. Air sampling technique.

13. Estimation of dissolved oxygen (DO), BOD and COD.
14. Isolation of free living nitrogen fixing bacteria from soil – *Azotobacter*.
15. Isolation of Symbiotic nitrogen fixing bacteria from root nodule – *Rhizobium.*
16. Examination of Plant Bacterial diseases- Sheath blight of rice and Wilt of potato
17. Fungal diseases – Late blight of potato and Wilt of cotton.
18. Viral diseases- Banana bunchy top virus and Tobacco Mosaic Virus.

References

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II YEAR – IV SEMESTER
COURSE CODE: 36441
BIOPROCESS TECHNOLOGY

Objective

1. To give knowledge on strain improvement methods.

2. To learn about upstream fermentation process.
3. To understand about downstream fermentation process.

Outcome

1. Students will get knowledge on strain improvement.
2. Enable them to work in fermentation industry.
3. Students will get idea on upstream and downstream fermentation process.

BLOCK-1: Introduction to Fermentation Technology

Unit I

An overview of fermentation technology, range of fermentation processes, primary and secondary metabolites and components of fermentation process.

Unit II

Industrial microorganisms- isolation, preservation, screening, strain improvement and maintenance.

Unit III

Formulation of industrial media- Medium requirements for fermentation processes, carbon, nitrogen, mineral sources, buffers, antifoam agents and medium optimization.

Unit IV

Stoichiometry of cell growth and product formation, Sterilization of media and fementers, scale – up process and starter culture technology.

BLOCK-2: Fermentor and fermentations

Unit V

Basic design of a microbial fermentor, types of fermentation vessels. Aseptic operation and containment.

Unit VI

Body construction (stirrer glands, bearing, valves, steam traps) baffles, spargers and impellors.

Unit VII

Types of fermentations- batch, continuous, fed-batch, solid state and submerged.

Unit VIII

Aerobic and anaerobic, dual and multiple fermentations, their advantages and disadvantages.

BLOCK-3: Downstream processing

Unit IX

Importance of downstream processing in industrial fermentation processes. Problems and requirements of bio product recovery and purification.

Unit X
Downstream Processing- Recovery and purification of fermentation products- Removal of microbial cells and other solid materials, Foam separation, Precipitation, Filtration and Centrifugation.

Unit XI
Cell Disruption- Physical, Chemical methods, extractors, chromatography, membrane process, drying, crystallization and whole broth processing.

BLOCK-4: Fermentation Products and marketing

Unit XIII
A brief out lines of processes for the production of the following commercially important products – Organic acids- Citric acid, lactic acid. Amino acids- Glutamic acid, L – lysine. Solvents- Acetone, ethyl alcohol.

Unit XIV
Antibiotics- Streptomycin, penicillin and Vitamins- B12, Riboflavin.

Unit XII
Fermentation economics - Market potential, some effects of maintenance legislation on production of antibiotics and recombinant proteins.

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II YEAR – IV SEMESTER
COURSE CODE: 36442
MICROBIAL BIOTECHNOLOGY

Objective

1. To provide knowledge on application of microorganisms using technologies.
2. To understand the production and mechanism of microbial products.

Outcome

1. Students acquire the information about various uses of microorganisms.
2. Become an eminent in production of biofertilizers and pesticides.
3. Able to understand the remediation process through microbes.

BLOCK-1: Introduction to Microbial and Algal Biotechnology

Unit I

Introduction to microbial biotechnology- Scope and applications in human therapeutics, agriculture, food technology, SCP and environment.

Unit II

Algal Biotechnology- Application of cell fusion, tissue culture and hybridization techniques in algae. Algae genomics. Genetic engineering of algae- construction of transformation and expression vectors, methods of gene introduction.

Unit III

Biotechnological applications of Algae in agriculture and environment.

BLOCK-2: Biological Control

Unit IV

Microbial Pesticides- Basic principle- Antagonism, Amensalism- Siderophores, Parasitsm and Nematophagy.

Unit V

Microbial Herbicides – Formulation and their applications.

Unit VI

Microbial Insecticides- bacterial insecticide- *Pseudomaonas, Bacillus* sp., *Bacillus thuriengenesis*- toxins, BT cotton-viral insecticide- entamopathogenic fungi.

Unit VII

Pathogens- Antagonists, VAM fungi and modification of culture practices.

BLOCK-3: Commercially Important Products

Unit VIII

Cytokines, Human growth hormones, Tissue plasminogen activator and Factor VII.

Unit IX

Microbial polysaccharides and polyesters.

Unit X

Production, application of biocompost and biogas. Microbial fuel cells (Biodiesel and H_2 production).

Unit XI
Biosensor- Advantages of using microorganisms as biosensing elements, Immobilization of microorganisms, Electrochemical microbial biosensors, Optical microbial biosensor and other types.

BLOCK-4: GMO

Unit XII
Genetically Modified Microorganisms- Molecular Tools for Genetic Engineering of Microorganisms.

Unit XIII
Applications of GMM- Derived Products- Human Health, Agriculture and environment.

Unit XIV
Ethical issues raised by genetically modified microorganisms.

References

1. Lodish, H., Berk A., Kaiser, C.A., Krieger, M., Scott, M. P., Brtscher A.,Ploegh, H., and Matsudaria, P. (2008). **Molecular Cell Biology** (6th Edition), W. H. Freeman, USA.
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II YEAR – IV SEMESTER
COURSE CODE: 36443
BIOINFORMATICS & BIOSTATISTICS

Objective

1. To create awareness on usage of computer aided biology.
2. To learn about individual nucleotide and protein sequence analysis.
3. To understand the concepts of data collection.

Outcome

1. Better understanding of evolutionary relationship of various species.
2. Get more knowledge on structure of proteins and nucleotides.

3. Able to understand the role of biostatistics in research.

BLOCK 1: Introduction to Bioinformatics

Unit I
Biology in the Computer age- Computational approaches to Biological questions, Basics of computers- servers and workstations.

Unit II
Operating systems- UNIX, Linux, World Wide Web. Search engines, finding scientific articles- Pubmed- Public biological databases.

Unit III
Genomics- Sequence analysis- Sequencing genomes- sequence assembly- pairwise sequence comparision- genome of the web- annotating and analyzing genome sequences.

BLOCK 2: Database

Unit IV
Genbank-sequence queries against biological databases- BLAST and FASTA- multifunctional tools for sequence analysis.

Unit V
Multiple sequence alignments, Phylogenetic alignment- profiles and motifs.

Unit VI
Proteomics- Protein data Bank, Swiss prot- biochemical pathway databases, Predicting protein structure and function from sequence-Determination of structure- feature detection- secondary structure prediction- predicting 3D structure- protein modeling.

BLOCK 3: Introduction to Biostatistics

Unit VII
Biostatistics- definition, scope, applications in biology, terminology, sampling techniques- random and non-random methods.

Unit VIII
Measures of central tendencies - Mean, mode, median, standard errors and standard deviations.

Unit IX
Probability - concepts, terminology, kinds of probabilities, theorems of probability, normal, binomial and poisson distribution. Skewness and kurtosis.

Unit X
Chi Square test- characteristics, degrees of freedom, test of goodness of fit and null hypothesis.

BLOCK 4: Statistical Analysis

Unit XI
Analysis of variance (ANOVA)- Methods of ANOVA, one way and two way classifications, F-test, steps involved in ANOVA and its importance.

Unit XII
Correlation- Definition, methods of studying the correlation, scatter diagram, Karl Pearson's efficient of correlation and rank correlation methods and types of correlations.

Unit XIII
Regression- Definition, types of regression analysis, regression equation, methods of studying regression, graphic and algebraic methods and importance of regression.

Unit XIV
Importance of statistical software in data analysis.

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1. Ewans, W.J. and Gregory, G. (2005). **Statistical methods in Bioinformatics: An Introduction** (Statistics for Biology and Health) Springer.
2. Stanton, A and Clantz, S. (2005). **Primer of Biostatistics**, The McGraw Hill Inc., New York.
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II YEAR – IV SEMESTER
COURSE CODE: 36444
INDUSTRIAL MICROBIOLOGY& MICROBIAL BIOTECHNOLOGY

Suggested Laboratory Exercises:

INDUSTRIAL MICROBIOLOGY

1. Inoculum preparation for fermentation.
2. Screening of antibiotic producing microorganisms from soil.
3. Production of extracellular metabolites from actinomycetes.
4. Production of industrially important enzymes by Submerged fermentation (Any one enzyme).

5. Production of industrially important enzymes by Solid state fermentation (Any one enzyme).
6. Assay of extracellular enzymes produced by bacteria : a) Amylase, b) Protease and c) Lipase.
7. Purification of enzymes by Filtration method / Chemical method by ammonium sulphate.
8. Wine production.
9. Microbial Production of citric acid by using *Aspergillus niger.*
10. Separation of biomass – Wet and Dry mass.
11. Immobilization of cells and enzymes.

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12. Isolation of dye degrading microorganism.
13. Antibiotic sensitivity test - a) Kirby Bauer's method and b) MIC determination by filter paper assay and broth dilution assay.
14. Separation of proteins - a) Paper chromatography, b) Column chromatography.

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Duration of the Course

The course for the degree of Master of Science in Microbiology shall consist of two academic years with four semester pattern.

Faculty and Support Staff requirements

The programme for the degree of Master of Science in Microbiology requires following faculty and supporting staff:

Staff Category	Required
Faculty for Core Microbiology Subjects #	3
Faculty for Specialty Subject viz., Biochemistry, Bioinformatics, etc., #	2
Laboratory Assistant	1
Clerical Assistant	1

Faculty may be belongs to at least Assistant Professor level either permanent or part time.

Instructional Delivery Mechanisms

Each semester there will be one contact programme of 168 hours duration in total comprising of both theory and practical (120 hours practical and 48 hours theory).

Number of Assignment/Semester	Contact Sessions - Practical	Contact Sessions - Theory
4	120 hours guided experiments with support of Internal supervisor for 4 credits	48 Hours for four Assignments

The class room teaching would be through conventional lecture, use of OHP, power point presentation and novel innovative teaching ideas like television and computer aided instruction. Student seminars would be arranged to improve their awareness and communicative skill. In the laboratory, instruction would be given for the safe handling of chemicals and instruments. The practical experiments shall be conducted with special efforts to inculcate scientific knowledge among students. The students shall be trained to handle advanced instrumental facilities and shall be allowed to do experiments individually.

Identification of Media

1. Online – uses the Internet to deliver content; courses may be synchronous or asynchronous; generally widely available to learners.
    a. Web-conferencing – connecting learners through the Internet; access is often through a host established link; may use phone or computer for audio connection
    b. Digital media – includes podcasts to portable electronic devices or computers with audio, video, and documents; often involves downloading content and/or materials.
    c. Social media – connecting learners who are part of a social network; may offer text, audio and video connectivity.
2. Offline – uses physical media (e.g., DVD, USB Drive, memory card) to deliver content; asynchronous; hosted locally rather than using the Internet; generally on a single computer; uses recorded and stored text, audio, and video content
3. Teaching Mode: Applying mode of teaching such as SLM, MOOC, Virtual lab and face to face for understanding of education easily.

Student Support Service Systems

Faculty are often among the first to notice when students are experiencing problems and sometimes those are problems we are not able, nor qualified, to help them with. To find out more about your role in helping students in need, we've provided links to a number of resources the university provides:

1. Counseling
2. Academic support for student
    a. note-taking
    b. time-management
    c. exam preparation

F) Procedure for admission, curriculum transaction and evaluation

Eligibility

A candidate who has passed Bachelor's Degree in Biological Sciences (Microbiology, Biochemistry, Biotechnology, Botany, Zoology, Bioinformatics, agricultural/ Veterinary/ Fisheries Sciences/ Pharmacy) degree with at least 50% of marks and 45% marks for SC/ST

candidates eligible for applying this programme. Preference in admission will be given to candidates working as teacher or scientific assistants.

Curriculum Transactions

The classroom teaching would be through chalk and talk method, use of OHP, Power Point presentations, web-based lessons, animated videos, etc. The face to face contact sessions would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

For practical courses exclusive study materials containing the requirements, procedure for the experiments will be issued to the learners. In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

The face to face contact sessions will be conducted in following durations;

Course Type	**Face to Face Contact Session per Semester (in Hours)**
Theory Courses (3 courses with 4 credits each)	48
Practical Courses (1 course with 4 credits)	120
Total	**168**

Evaluation

The examinations shall be conducted separately for theory and practical's to assess the knowledge acquired during the study. There shall be two systems of examinations viz., internal and external examinations. In the case of theory courses, the internal evaluation shall be conducted as Continuous Internal Assessment via. Student assignments preparation and seminar, etc. The internal assessment shall comprise of maximum 25 marks for each course. The end semester examination shall be of three hours duration to each course at the end of each semester. In the case of Practical courses, the internal will be done through continuous assessment of skill in demonstrating the experiments and record or report preparation. The external evaluation consists of an end semester practical examinations which comprise of 75 marks for each course.

Scheme of External examination

The duration of examinations for theory and practical's shall be three hours.

Question paper pattern (Theory)

- The question paper carries a maximum of 75 marks.
- The question paper consists of three sections namely Part-A, Part-B and Part-C.
- Part-A consists of 10 questions of 2 marks each (10 x 2 = 20 marks) with no choice. Candidate should answer all questions.
- Part-B consists of 5 either or choice questions. Each question carries 5 marks (5 x 5=25 marks).
- Part-C consists of 5 questions. Each question carries 10 marks. The candidate should answer any three questions (10 x 3 = 30 marks).
- All blocks should be given equally importance for question setting.

Question paper pattern (Practical) (Maximum 75 marks)

Major practical	20 marks
Minor practical	10 marks
Spotters	25 marks
Viva voce	10 marks
Practical record note	10 marks
Total	**75 marks**

Distribution of Marks in Continuous Internal Assessments

The following procedure shall be followed for awarding internal marks for theory courses

Component	**Marks**
Student's Assignments	25
Total	**25**

The following procedure shall be followed for awarding internal marks for theory courses

Internal –Practical	**Marks**
Continuous Assessment (demonstration and observation of experiments)	10
Record Note Book	10

Viva	5
Total	**25**

Passing Minimum

- For internal Examination, the passing minimum shall be 40% (Forty Percentage) of the maximum marks (25) prescribed for UG and PG Courses.
- For External Examination, the passing minimum shall be 40% (Forty Percentage) of the maximum marks (75) prescribed for UG and PG Courses.
- In the aggregate (External + Internal), the passing minimum shall be 40% for UG and 50% for PG courses.

Marks and Grades

The following table gives the marks, grade points, letter, grades and classification to indicate the performance of the candidate.

Range of Marks	Grade Points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D^+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A^+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

For a semester;

Grade Point Average [GPA] = $\sum_i C_i G_i / \sum_i C_i$

Grade Point Average = $\frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$

For the entire programme;

Cumulative Grade Point Average [CGPA] = $\sum_n \sum_i C_{ni} G_{ni} / \sum_n \sum_i C_{ni}$

CGPA = $\frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses for the entire programme.}}$

C_i = Credits earned for the course i in any semester.

G_i = Grade Point obtained for course i in any semester.

n refers to the semester in which such courses were credit.

CGPA	Grade	Classification of Final Result
9.5-10.0	O^+	First Class- Exemplary*
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D^{++}	First Class with Distinction*
8.0 and above but below 8.5	D^+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A^{++}	First Class
6.5 and above but below 7.0	A^+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B^+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

*The candidates who have passed in the first appearance and within the prescribed semester of the PG Programme are eligible.

Maximum duration for the completion of the course

The maximum duration for completion of M.Sc., Degree in Microbiology programme shall not exceed ten semesters from their fourth semester.

Commencement of this Regulation

These regulations shall take effect from the academic year 2018-2019 (June session) i.e., for students who are to be admitted to the first year of the course during the academic year 2018-2019 (June session) and thereafter.

Fee Structure

The programme has the following Fee Structure:

Sl. No.	Fees Detail	Amount in Rs.		Nature of Fees
		First Year	Second Year	
1	Admission Processing Fees	**300.00**	**-**	Non- Refundable
2	Course Fees	**20000.00**	**20000.00**	Non- Refundable
5	ICT Fees	**150.00**	**150.00**	Non- Refundable
	TOTAL	**20450.00**	**20150.00**	Non- Refundable

The above mentioned fee structure is exclusive of exam fees

G. Laboratory Support

The postgraduate curriculum of Alagappa University has strived to offer both theory courses as well as laboratory and design practice in the field of Microbiology. Instruments, chemicals and glasswares are needed for conducting practicals to the better understanding of microbes.

Each semester there will be one contact programme of 168 hours duration in total comprising of both theory and practical (120 hours practical and 48 hours theory). Attendance for contact programmes is compulsory. The personal contact programme will be conducted only at Alagappa University campus, Karaikudi.

The practical books (manual) will be supplied to the students at the time admission. Hands on experience on the techniques of biological sciences will be given to the students individually during the contact sessions. The practical's will also be conducted and performed by applying virtual reality methods wherever necessary.

Library Resources

The Central Library is one of the important central facilities of Alagappa University. It has text book, reference books, conference proceedings, back volumes, standards, and non-book material such as CD-ROMs and audios. The central Library procured several e-books in different areas. The library also subscribes to about 250 current periodicals.

All routine functions of the library are automated with the help of an integrated library software package, SOUL, developed and distributed by UGC INFLIBNET. The database for the entire collection has been created and available through online Public Access Catalogue (OPAC) to the users via campus network. Now this facility is also available through Institute's Intranet as a web enabled OPAC.

H. Cost Estimate of the Programme and Provisions

Nature of Expenditure	Amount Required (Rs.)	Provision
Programme Development	**20,00,000**	University funds
Delivery	**24,00,000**	Fee collected from the students and university funds
Maintenance	**5,00,000**	Laboratory fee collected from the students

Provisions	Number
Class room + Smart class room	2
Laboratory	1
Staff room	1
Office	1

I. Quality assurance mechanism

1. Student's feedback about staffs, teaching methods and methodologies.
2. Teachers review about students.
3. Continuous assessment (Model practical).
4. The students give feedback on teaching every semester. Feedback is also taken on their campus experience through suggestion boxes.

Expected programme outcomes

1. This programme will provide higher education for rural people in this surrounding.
2. This programme will provide opportunity to study after breakup in their studies due to family circumstances especially women.

3. Gaining knowledge which helps job opportunities, research innovation, competitive exams and upgradation of their position.

Review Mechanism

We will get feedback from the students, alumni and employers from various sectors and analyze for further improvement of the quality curriculum transaction.

Minutes of the Meeting of the Board of Studies in Microbiology (For M.Sc. Microbiology Programme to be offered through ODL Mode) held at The Directorate of Distance Education, Alagappa University, Karaikudi – 630 003, on 05.09.2017, (11.00 A.M).

Members Present

1.	Dr. A. Arun	-	Chairman
2.	Dr. H. Shakila	-	Member
3.	Dr. E. Kannapiran	-	Member
4.	Dr. G. Muralitharan	-	Member
5.	Dr. P. Rameshthangam	-	Member
6.	Dr. M. JothiBasu	-	Member
7.	Dr. G. Selvakumar	-	Member

After the deliberation and discussion the board resolved the following:

1. The board considered the curriculum design and detailed syllabi of M.Sc., Microbiology programme, prepared as per the norms by the Chairman and the Board Members, scrutinized and suitably modified the same.

2. The board resolved to approve curriculum design, detailed syllabi and other regulations for the M.Sc., Microbiology programme to be offered by the Directorate of Distance Education of Alagappa University are given in Annexure I.

Dr. A. Arun Dr. H. Shakila Dr. E. Kannapiran Dr. G. Muralitharan

Dr. P. Rameshthangam Dr. M. Jothi Basu Dr. G. Selvakumar