CURRICULUM FRAMEWORK AND SYLLABUS FOR OUTCOME BASED EDUCATION IN

MASTER OF SCIENCE IN MICROBIOLOGY DEGREE PROGRAM

FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2019 - 2020 AND ONWARDS

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICAS

HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)
(Affiliated to Bharathiar University and Accredited by NAAC)
COIMBATORE-641028
TAMILNADU, INDIA.
Phone: 0422-4440555
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HINDUSTHAN COLLEGE OF ARTS AND SCIENCE
DEPARTMENT OF MICROBIOLOGY

VISION

To provide world class education to the students to face global challenges and to inculcate the latest trends in technological advancement. To cater the needs of the environmental and ethical values in the mind of students to become good citizens and entrepreneurs.

MISSION

The Mission of the college is to pursue a philosophy of perpectual acquisition of knowledge. The important policy is to provide value based education and to bring out the hidden potentials in students that equip them to approach life with optimism.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

Post Graduates of MICROBIOLOGY program will

PEO1: Articulate the knowledge of Science to identify, apply modern tools, and analyse the societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the Profession.

PEO2: Apply ethical principles and commit to professional ethics, communicate effectively and recognize the need for life-long learning in the broadest context of technological change

PROGRAM OUTCOME (PO)

PO1: Summarize the intellectual skills to analyze the molecules using advance biophysical techniques such as HPLC, GC, Spectrophotometer, PCR etc.

PO2: Appraise the scientific literature effectively and use computational tools such as bio-statistical and bioinformatics

PO3: Substitute the knowledge in industry with regard to scale up, production, scale down and quality control of the various microbial products

PO4: Collaborate the basic research related to industry-environmental issues and use of agricultural sustainable products

PROGRAM SPECIFIC OUTCOME (PSO)

PSO1: To prepare students as skilled scientific manpower with an understanding of Research ethics (public policy, biosafety, and intellectual property rights)involving microorganisms to contribute to application, advancement and impartment of knowledge in the field of Microbiology.

PSO2: Production of substantial original research of significance and quality sufficient for publication.

PSO3:. Ability to present their work through written, oral, and visual presentations, including an original research proposal

HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)
COIMBATORE-641028
M.Sc., MICROBIOLOGY
SCHEME OF EXAMINATIONS – CBCS PATTERN
(For the students admitted from the Academic year 2019-2020 and onwards)

Course Code	Course Type	Course Title	LECTURE HRS /WEEK	EXAM DURATION HRS	MAXIMUM MARKS			Credit points
					IE	EE	Total	
Semester – I								
19MBP01	DSC	Bacteriology	5	3	30	70	100	5
19MBP02	DSC	Virology	5	3	30	70	100	5
19MBP03	DSC	Mycology,Phycology & Parasitology	5	3	30	70	100	5
19MBP04	DSC	Biochemistry	5	3	30	70	100	5
19MBP05	SEC	**Practical I** – Bacteriology, Virology, Mycology, Phycology, Parasitology.	5	9	40	60	100	2
19MBP06	SEC	**Practical II** – Biochemistry	5	6	40	60	100	2
Semester – II								
19MBP07	DSC	Applied Biotechniques	5	3	30	70	100	5
19MBP08	DSC	Immunobiology	5	3	30	70	100	5
19MBP09	DSC	Genetics and Molecular Biology	5	3	30	70	100	5
19MBP10	DSC	Medical Microbiology	5	3	30	70	100	5
19MBP11	SEC	**Practical III** - Immunobiology and Medical Microbiology	4	9	40	60	100	2
19MBP12	SEC	**Practical IV** - Microbial physiology and Molecular Genetics	4	9	40	60	100	2
19GSP01	AEE	**Skill Based** Cyber Security	2	-	100	-	100	2

Semester – III								
19MBP13	DSC	Environmental and Agricultural Microbiology	5	3	30	70	100	5
19MBP14	DSC	Food and Dairy Microbiology	5	3	30	70	100	5
19MBP15	DSC	Large Scale Manufacturing Practices	5	3	30	70	100	5
19MBP16 A	DSE	Pharmaceutical Microbiology (OR)	5	3	30	70	100	4
19MBP16 B		Microbial Genomics and Proteomics (OR)						
19MBP16 C		Microbial Production of Recombinant molecules						
19MBP17	SEC	**Practical V** – Food Microbiology and Fermentation technology	5	9	40	60	100	2
19MBP18	SEC	**Practical VI** - Recombinant DNA technology, Environmental and Pharmaceutical Microbiology	5	9	40	60	100	2
19MBP19	DSE	*Institutional/Industrial training	-	-	100	-	100	1
19MBP20	DSC	Self study Paper Bioethics, IPR and Biosafety	-	3	30	70	100	1
*Students should undergo an institutional training / Internship for a continuous period of 15 days before semester III and submit report along with attendance certificate.								
Semester – IV								
19MBP21	DSC	Biostatistics & Research Methodology	5	3	30	70	100	5
19MBP22 A	DSE	Bioinformatics and Nanotechnology (OR)	5	3	30	70	100	4
19MBP22 B		Commercial Microbiology (OR)						
19MBP22 C		Total quality management						
19MBP23	SEC	**Practical VII** - Biostatistics and Bioinformatics	4	3	40	60	100	2
19MBP24	DSE	Project work	16	-	50	150	200	6
						Total	**92**	
Students Should Complete Value Added Courses,Online Courses / Entrepreneurship/Startups/ Job Oriented Courses and Placement Training at the end of the Second Year								

No of papers	Course Type	Total Credit Points
1	Ability Enhancement Elective (AEE)	2
13	Discipline Specific course (DSC)	61
4	Discipline Specific Elective (DSE)	15
7	Skill Enhancement Course (SEC)	14
24	**TOTAL**	**92**

PG-REGULATIONS(2019-2020 and Onwards)

1. **Internal Marks for all PG**

Components	Marks
Test I	5
Model Exam	10
Assignment	5
Attendance*	5
Seminar	5(3+2)**
TOTAL	30

*Split-up of Attendance Marks for PG

- 75-79 - 1 marks
- 80-84 - 2 marks
- 85-89 - 3 marks
- 90-94 - 4 marks
- 95-100 - 5 marks

**3-For External paper presentation/ Mini Project
**2-Internal paper presentation/ Mini Project

QUESTION PAPER PATTERN FOR IE TEST I AND II

Duration: Two Hours **Maximum: 50 Marks**

Section-A (3 x 6=18 Marks)
Answer **ALL** Questions **Either or Type**
ALL questions carry EQUAL Marks
Section-B (4 x 8=32 Marks)
Answer **ALL** Questions
Either or Type
ALL questions carry EQUAL Marks

QUESTION PAPER PATTERN FOR IE MODEL EXAM

Duration: Three Hours **Maximum: 70 Marks**

SECTION – A (5x6=30 marks)
Answer **ALL** Questions
ALL Questions carry **EQUAL** Marks
Q.No 1 to 5: Either or type questions
(One question from each Unit)

SECTION – B (5x8=40 Marks)
Answer **ALL** Questions
ALL Questions carry **EQUAL** Marks
Q.No 6 to 10: Either or type questions
(One question from each Unit)

2 a) Components for Practical I. E.

Components	Marks
Test –I	20
Test - II	20
Total	**40**

2 b) Components for Practical E. E.

Components	Marks
Completion of Experiments	50
Record	5
Viva	5
Total	**60**

3. Institutional/ Industrial Training, Mini and Major Project Work

Institutional / Industrial Training		Mini Project	Project Work		
Components	**Marks**		**Components**		**Marks**
I.E Work Diary Report Viva –voce Examination	 25 50 25	 - 50 50	*I. E* a) Attendance Marks b) Review Marks	 20 30	50
Total	**100**	**100**			
			*E.E**[1] a) Final Report Marks b) Viva-voce Marks	 120 30	150
				Total	**200**

*[1]Evaluation of report and conduct of viva voce will be done jointly by Internal and External Examiners.

4. Components for Cyber Security Paper

Components	Marks
Two Tests (2 x 40)	80
Two assignments (2 x 10)	20
Total	------- **100** =====

The question paper pattern is as follows:

a) Test I – 2 hours [4 out of 7 essay type questions] 4 x 10 = 40Marks

b) Test II – 2 hours [4 out of 7 essay type questions] 4 x 10 = 40 Marks

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Total = 80 Marks

- The passing minimum for Cyber Security is 50
- In case the candidate fails to secure 50 marks which is the

passing minimum, he/she may have to reappear for the same in the subsequent semesters.

5. Question Paper Pattern for EE Theory

Duration: Three Hours **Maximum: 70 Marks**

SECTION – A (5x6=30 marks)

Answer **ALL** Questions
ALL Questions carry **EQUAL** Marks
Q.No 1 to 5: Either or type questions
(One question from each Unit)

SECTION – B (5x8=40 Marks)
Answer **ALL** Questions
ALL Questions carry **EQUAL** Marks
Q.No 6 to 10: Either or type questions
(One question from each Unit)

MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP01	Course Title	Batch:	2019-2021
		BACTERIOLOGY		I
Hrs/Week:	5		Credits:	5

Course Objective

1. To illustrate the structure and taxonomy of bacteria
2. To construct knowledge on bacterial physiology and metabolism

Course Outcomes (CO)

K1	CO1	Identify taxonomical classification of bacteria
K2	CO2	List out the nutritional requirements and growth of bacteria
K3	CO3	Connect microbial metabolic pathways
K4	CO4	Review the microbial biosynthetic pathways

Mapping of Outcomes

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	L	L
CO2	S	M	L	L
CO3	S	M	S	L
CO4	M	S	L	L

S - Strong; M-Medium; L-Low.

19MBP01	BACTERIOLOGY	I
Unit No.	**Topics**	**Hours**
I	**History and Cell structure** History and scope of microbiology. Morphology and Ultra structure of bacteria - Subcellular structures - Capsule, slime layer- cell wall- Gram positive and Gram negative, cytoplasmic membrane - pili- Fimbriae - flagella - storage granules- ribosomes - genetic material - Comparison of prokaryotic and eukaryotic organisms - Sporulation and germination – cell division.	12
II	**Taxonomy** Principle, classification - Phenetic, Phylogenetic, Genotypic; Modern approaches - Numerical, Molecular, Sero-taxonomy, Chemo-taxonomy. Taxonomic Ranks. Techniques to determine Microbial Taxonomy and Phylogeny - Characteristic – Classical and Molecular type (any type) - Phylogenetic tree. Bergey's manual of systematic bacteriology-II edition - general characteristics and organization - Archaea (Crenarchaeota); Euryarchaeota (Methonobacterium, Halobacterium); Proteobacteria – (Alpha- Caulobacter; Beta-Alcaligens; Gamma-Legionella; Delta- Myxococcus; Epsilon-Camphylobacter), Low G+C Gram positive bacteria - Eubacteria; High G+C Gram positive bacteria - Bifidobacterium; Fusobacterium Extremophiles	12
III	**Bacterial Nutrition** Nutritional requirements of Microorganisms –nutritional groups - transport mechanisms and types-simple diffusion – facilitated diffusion- active transport- group translocation-Ion transport. Growth curve – generation time - factors influencing microbial growth – growth kinetics-Batch and continuous cultivation -synchronous growth -diauxic growth.	12
IV	**Respiration and Fermentation** EMP – HMP – ED pathways – TCA cycle- Electron transport chain – Oxidative and Substrate level phosphorylation. Photosynthesis – Oxygenic and Anoxygenic, Carbon dioxide fixation. Sulphur, nitrogenous compounds and CO_2 as final electron acceptor - Fermentation – alcoholic, lactic acid, propionic, butanediol, acetate, amino acid and mixed acid fermentation.	12
V	**Biosynthesis and cell signaling** Biosynthesis of bacterial cell wall, biosynthesis of aminoacids (Pyruvate family) - bioluminescence. Cell signaling- types-mechanisms-G-protein linked receptors, hormone receptors and second messengers – Quorum sensing	12

Text Book: *Prescott, Hareley.P and Klein.A.,* "Microbiology", McGraw Hill Publishers, New Delhi. ***2017***

Reference Books

1. *Caldwell DR., "Microbial physiology and Metabolism", WMC Brown Publishers, New Delhi.* 1995
2. *R.C Dubey., "Textbook of Microbiology",* S. Chand and Company Ltd, New Delhi. 2013
3. *Geeta Sumbali and Mehrotra R.S., "Principles of Microbiology", Tata McGraw Hill Publishers.New Delhi. 2009.*
4. *Moat, A.G. and Foster, J.W., "Microbial Physiology", Springer, New York.* 2002
5. *Jacquelyn G. Black, Laura J. Black.*, "Microbiology: Principles and Explorations", Wileys Publishers, New Jersey. 2012

Course Designed by	Verified by HOD	Checked by	Approved by
Dr. LALI GROWTHER	Dr. LALI GROWTHER		CONTROLLER OF EXAMINATIONS HICAS CBE-28

MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP02	Course Title	Batch:	2019-2021
		VIROLOGY		I
Hrs/Week:	5		Credits:	5

Course Objective

1. To develop knowledge on the basics and fundamentals of Virology
2. To enumerate the integrated information in viral reproduction and host interaction

Course Outcomes (CO)

K1	CO1	Construct knowledge on the architecture of viruses
K2	CO2	Recall the interaction between the viruses and host
K3	CO3	Infer the methods of replication and strategies of representative viruses
K4	CO4	Relate the diagnostic methods in Virology

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	L	L	L
CO2	S	M	L	L
CO3	S	M	L	L
CO4	M	L	S	M

S - Strong; M-Medium; L-Low.

19MBP02	VIROLOGY	I
Unit No.	**Topics**	**Hours**
I	**General virology** Brief outline on discovery of viruses, nomenclature and classification of viruses; (Baltimore) distinctive properties of viruses; morphology and ultrastructure; capsid and their arrangement; types of envelope and their composition –viral genome, their types and structure; viruses related agents (viroids, prions, virusoids)-purification of viruses and antiviral agents - cultivation of viruses.	12
II	**Bacterial viruses** Bacteriophage structural organization; life cycle; one step growth curve; transcription ; DNA replication; eclipse phase; phage production; burst size; lysogenic cycle; bacteriophage typing; application in bacterial genetics; brief details on M_{13}, Mu,T_3, T_4 and lambda P_1, ϕx174, MS2, phage typing and application.	12
III	**Plant viruses** Classification and nomenclature; effects of viruses on plants; life cycle, type species of plant viruses like TMV, cauliflower mosaic viruses and potato viruses X, transmission of plant viruses with vectors (insects, nematodes, fungi) and without vectors (Contact , Seed and Pollen); viruses of cyanobacteria, algae, fungi. Viral disease of plants - paddy, cotton, tomato and sugarcane. Prevention of crop loss due to virus infection- virus free planting material – vector control.	12
IV	**Animal viruses** Classification and nomenclature of animal human viruses; epidemiology, life cycle, pathogenicity, diagnosis, prevention and treatment of RNA viruses – Picorna, orthomyxo, paramyxo, toga and other arthropod viruses, Rhabdo, Rota, HIV and oncogenic viruses; DNA viruses; pox, herpes, Adeno, SV 40, Zika, Ebola, Dengue; Hepatitis viruses. Viral vaccine (conventional vaccine, genetic recombinant vaccine used in national immunization programme with example-newer generation vaccine including DNA vaccine with example).	12
V	**General methods of Diagnosis and serology** Serological methods-haemagglutination and HAI; complement fixation; immunofluorescence methods, ELISA and RIA; assay of viruses-physical and chemical methods (protein, nucleic acid, radioactivity tracers)-infectivity assay (plaque method, end point method)-infectivity assay of plant viruses-diagnostic technique-seed, seed stocks and diseased plants.	12

Text Book *Luria S.E. Darnel, J.E Jr. Baltimore. D and Campbell A.," General Virology", Wiley and sons, France.1967*

Reference Books

1. *Dimmock NJ, Primrose SB Introduction to Modern Virology, IV Edition, BlackwellSceintific Publications Oxford. 1994*
2. *Nicholas H. Acheson., "Fundamentals of Molecular Virology", Wiley Publications, France.2007*
3. *Shubhrata.R.Mishra., "Virus and plant diseases", Discovery publishing house, New Delhi. 2004*
4. *Morag C and TiMBPry M.C medical virology-X edition .Churchill Livingstone , London. 1994*
5. *Conrat HF, Kimball PC and Levy JA virology-III edition prentice Hall, Englewood cliff, new Jersey. 1994*
6. *Mathews, RE., functional of plant virology, academic press, san DiagoTopley and Wilson's text book on principles of bacteriology,virology and immunology. Edward Arnold, London.1995*

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MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP03	Course Title	Batch:	2019-2021
		MYCOLOGY, PHYCOLOGY AND PARASITOLOGY		I
Hrs/Week:	5		Credits:	5

Course Objective

1. To impart knowledge on the distribution of algae, fungi and protozoa
2. To paraphrase the economic importance of algae, fungi and protozoa

Course Outcomes (CO)

K1	CO1	Demonstrate fungal, algal and protozoan structure
K2	CO2	Understand the ecology of algae, fungi and protozoa
K3	CO3	Explore the knowledge on classification of algae, fungi and protozoa
K4	CO4	List out the economic importance of algae, fungi and protozoa

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	M	L	L
CO2	S	L	M	L
CO3	S	L	M	M
CO4	S	L	L	M

S - Strong; M-Medium; L-Low.

19MBP03	MYCOLOGY, PHYCOLOGY AND PARASITOLOGY	I
Unit No.	**Topics**	**Hours**
I	**Fungal Structure and classification** Historical introduction to fungi – Morphology and Classification (Alexopoulos) Division Myxomycota Acrasiomycetes, Hydromyxomycetes, Myxomycetes, Plasmo-Diophoromycetes. Zoosporic fungi - Chytridiomyctes, Hypochytridiomycetes, Oomycetes. Zygomycotina – Zygomycetes, Tricomycetes- Ascomycotina, Basidiomycotina, Deuteromycotina. Evolutionary tendencies in lower fungi - Cell differentiation. Effect of environment on growth, preservation of fungi.	12
II	**Fungal ecosystem** Fungal ecosystem- saprophyte, substrate groups and nutritional strategies of fungi and physiological specialization – Lichens- Mycorrhizae- Fungi as an Insect symbiont.	12
III	**Phycology** Distribution of algae, classification of algae (Fritsch), algal nutrition, algal thallus, algal reproduction, green algae, diatoms, Euglenoid, brown Rhodophyta, Pyrrophyta, algal ecology.	12
IV	**Parasitology** General concepts and Protozoology; introduction, classification- host parasite relationship, pathogenic mechanism,transmission and life cycle protozoa-Entamoeba and human disease, Leishmania, Trypanosoma, Giardia, Trichomonas, Balantidium, Toxoplasma, Crytosporidium and other protozoan parasite causing human infection.	12
V	**Life Cycle and Economic Importance** Fungi – Aspergillus, Pencillium, Mucor *and* Yeasts: Algae - Chlamydomonas, Volvox, Chlorella and Diatoms. Protozoa – Entamoeba, Giardia. Helminthes – Ascaris, Taenia.	12

Text Book *Fundamentals of Mycology., J.H Burnett, publisher: Edward, Arnold Crane Russak.1968*

Reference Books

1. *Alexopoulos C.J and C.W Mims Mims 1979. Introduction to Mycology (3rd edition) ., Wiley Eastern Ltd, new delhi 1979*
2. *Mehrotra R.S and K.S Aneja., An introduction to Mycology, new age international publishers 1990*
3. *Fundamentals of the fungi., E.Moore-Landeekeer, Publisher: prentice Hall. 1972*
4. *Subash Chandra Parija., "Textbook of Medical Parasitology protozology and Helminthology", All India Publishers and Distributors, New Delhi. 2013*
5. *Sharma OP., Text book of Algae., TataMcGraw-Hill, New Delhi. 1986*

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MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP04	Course Title	Batch:	2019-2021
		BIOCHEMISTRY		I
Hrs/Week:	5		Credits:	5

Course Objective

1. To discover the knowledge on role of macromolecules
2. To develop knowledge on enzymes and their applications

Course Outcomes (CO)

K1	CO1	Relate the structure of macromolecules and their functions
K2	CO2	Analyze the structural properties and functions of various vitamins and minerals
K3	CO3	Integrate oxidative and reactive role of various enzymes in living matter
K4	CO4	Demonstrate the methods of purification of enzymes

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	S	L	L
CO2	M	L	S	M
CO3	S	L	M	L
CO4	L	L	S	M

S - Strong; M-Medium; L-Low.

19MBP04	BIOCHEMISTRY	I
Unit No.	**Topics**	**Hours**
I	**Composition of living matter** Composition of living matter-Structural features and chemistry of macromolecules; nucleic acids, proteins (Ramachandran plot, secondary Structure, Domains, motif & folds), carbohydrates, lipids and biomolecules such as antibiotics, pigments and other secondary metabolites. Stability of proteins and Nucleic acids.	12
II	**Bioenergetics** The role of ATP- laws of thermodynamics- high energy phosphates-redox potential-oxidoreductases-oxidases-dehydrogenases-peroxidases-oxygenases-superoxide dis mutase. Respiratory chain components-chemiosmatic theory – ATP synthase-structure and function. inhibitors and uncouplers.	12
III	**Vitamins and Minerals** Classification, properties and physiological functions of vitamins – fat soluble – (A,D,E and K) and water soluble (B and C) – deficiency – causes, manifestations and management – Macronutrients – Physiological importance of calcium , Phosphorus, Magnesium, Sodium and Potassium – Trace elements – Physiological functions of Iron, Copper and Iodine.	12
IV	**Enzymes** Enzyme as biocatalysts, classification of enzymes, specificity, active site, activity unit, isoenzyme. Enzyme kinetics: Menton equation for simple enzyme, determination of kinetic parameters, multistep reaction and rate limiting steps, enzyme inhibition, allosterism, kinetic analysis of allosteric enzyme, principle of allosteric regulation.	12
V	**Purification and Application of Microbial Enzymes** Importance of enzyme purification – Extra cellular and Intra cellular – Physical and chemical methods. Immobilization of enzymes – Microbial enzyme in textile, leather, wood industries and detergents. Enzyme in clinical diagnostics- Enzyme sensors for clinical processes and environmental analyses- Enzyme as therapeutic agents.	12

Text Book: *Deb A.C., "Fundamentals of biochemistry", New Central Book Agency, Calcutta. 2001*

Reference Books

1. *Ambika Shanmugam., "Fundamentals of Biochemistry for Medical students" WMC Brown Publishers, New Delhi.2016*
2. *Sathyanarayana U., "Biochemistry"., Books and Allied Pvt. Ltd., New Delhi.2017*
3. *Lehninger A.L., and Nelson D.l.," Principles of Biochemistry Cox- CBS Publishers, New delhi.2013*
4. *Lubert Stryer., "Biochemistry", Freeman and Company, New York.2002*
5. *Robert k Murray.Daryl k Granner,Peter A Mayes and victor W.Rodwell Harpers Illustrated Biochemistry 26th edition Lange Mc Graw Hill. 2009*

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MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP05	Course Title	Batch:	2019-2021
		PRACTICAL I – BACTERIOLOGY, VIROLOGY, MYCOLOGY, PHYCOLOGY, PARASITOLOGY		I
Hrs/Week:	5		Credits:	2

Course Objective

1. To impart practical skills on sterilization and pure culture techniques
2. To develop practical knowledge on Bacteriology, Virology, Mycology, Phycology and Protozology

Course Outcomes (CO)

K1	CO1	Interpret the sterility of lab equipments
K2	CO2	Demonstrate the microscopic observation of microorganisms and maintenance of microbial cultures
K3	CO3	Determine the isolation and enumeration of various microbes
K4	CO4	Illustrate the antagonistic effect of microbes

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	M	S	L	L
CO2	M	S	M	L
CO3	S	S	M	L
CO4	M	L	S	L

S - Strong; M-Medium; L-Low.

19MBP05	PRACTICAL I – BACTERIOLOGY, VIROLOGY, MYCOLOGY, PHYCOLOGY, PARASITOLOGY	I

LIST OF EXPERIMENTS

1. Sterility testing- Autoclave / Hot air oven.
2. Micrometry.
3. Isolation and enumeration of microorganism from soil – Bacteria, Fungi, Algae, Actinomycetes and Protozoa.
4. Staining – Bacteria (Gram, Acid fast, Spore, Capsule and Negative) / Fungi (LPCB).
5. Growth curve – Viable count, Turbidity and Neubauer counting chamber.
6. Effect of intrinsic factors on the growth of bacteria – pH, temperature, carbon and nitrogen.
7. Thermal death point / Thermal death time.
8. Biochemical Characteristization – IMViC, Catalase,Oxidase,TSI and Ureases
9. Polymer hydrolysis – Gelatin, Casein and Starch
10. Microbial degradation of organic dye by free and immobilized cells.
11. Extraction of Heterocyst from Algae.
12. Anaerobic culture technique- Mc'Intosh Fildes jar and Wrights Tube method.
13. Preparation of permanent slide.
14. Preservation of bacterial culture by various technique (Agar slant, Mineral oil, Gelatin disc, Soil).
15. Isolation of Coliphage/ cyanophage/ Actinophage.
16. Titration of Coliphage
17. Determination of one step growth curve of bacteriophage
18. Lysogeny and isolation of Rhizobium phage.
19. Determination of cross-infectivity of *E.coli* phages.
20. AMF colonization of plant.
21. Study of Algae –Microscopy and culture.
22. Antagonistic activity of soil Actinomycetes.
23. Pigment production from Fungi.
24. Observation of Protozoa - Hay Infusion broth.

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MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP06	Course Title	Batch:	2019-2021
		PRACTICAL II BIOCHEMISTRY		I
Hrs/Week:	5		Credits:	2

Course Objective

1. To develop practical knowledge on the estimation of macromolecules
2. To impart practical knowledge on production, separation and partial purification of enzymes

Course Outcomes (CO)

K1	CO1	Demonstrate the various methods to estimate macromolecules quantitatively
K2	CO2	Illustrate the separation of macromolecules
K3	CO3	Identify the methods of immobilization of microbial cells
K4	CO4	Differentiate the techniques for protein separation and purification

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	M	S	L	L
CO2	L	M	S	L
CO3	M	M	S	L
CO4	M	L	S	L

S - Strong; M-Medium; L-Low.

19MBP06	PRACTICAL II BIOCHEMISTRY	I

LIST OF EXPERIMENTS

1. Estimation of protein by Folin-Lowry / Biuret method
2. Quantitative estimation of Aminoacids by Rosen's method.
3. Quantitative estimation of sugars by DNSA method.
4. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
5. Separation of lipids/ amino acids / sugars / organic acids by TLC and Paper chromatography.
6. Microbial production of enzyme (Amylase).
7. Enzyme purification by salt precipitation and dialysis.
8. Determination of molecular weight by SDS-PAGE.
9. Column chromatography.
10. Immobilization of cells and enzyme using Sodium alginate.

Course Designed by	Verified by HOD	Checked by	Approved by
DR.R.MANJU	DR.LALI GROWTHER		CONTROLLER OF EXAMINATIONS HICAS CBE-28

MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP07	Course Title	Batch:	2019-2021
		APPLIED BIOTECHNIQUES		II
Hrs/Week:	5		Credits:	5

Course Objective

1. To Associate the principle and instrumentation of laboratory Instruments
2. To Apply bioanalytical techniques in Research

Course Outcomes (CO)

K1	CO1	Translate the principle and applications of Microscopy, Spectroscopy and centrifugation
K2	CO2	Speculate the types of Chromatography
K3	CO3	Distinguish the types of electrophoresis
K4	CO4	Evaluate the methods of gene transfer

Mapping of Outcome

PO / CO	PO1	PO2	PO3	PO4
CO1	M	S	L	M
CO2	M	S	M	L
CO3	L	S	M	L
CO4	S	M	S	S

S - Strong; M-Medium; L-Low.

19MBP07	APPLIED BIOTECHNIQUES	I
Unit No.	**Topics**	**Hours**
I	**Microscopy and Spectroscopy** Working principle and applications of light microscopes- Bright field, Dark field, Phase contrast, Fluorescence, Electron microscope- SEM and TEM. Principles, instrumentation and applications of Colorimetry - spectrophotometry - UV - Visible and IR spectroscopy. Principles and applications of spectroflurometry - Flame photometry – NMR - 3D structure by X-ray diffraction – ESR.	12
II	**Centrifugation techniques** Principle and instrumentation of centrifuges – design -preparative rotors- analytical samples containers - separation methods in preparative ultracentrifuges – density gradient separations – applications of preparative and analytical ultracentrifuges – safety aspects in the use of centrifuges.	12
III	**Chromatography** Principles - instrumentation– Paper – TLC – HPLC – GC – MS - LC-MS gel filtration - Ion –Exchange – Column - Hydroxy apatite - Immuno adsorption - Affinity chromatography - applications.	12
IV	**Electrophoresis and Radioisotopes** Principles and applications of Paper - starch gel – agarose - native and denaturing PAGE – 2D PAGE electrophoresis – isoelectrofocusing – Zymogram preparation, MALDI – TOF. Use of radio isotopes in life sciences- radioactive labeling - principles and applications of tracer techniques- detection and measurement of radioactivity using ionization chamber - Geiger Muller and scintillation counters - autoradiography and its applications – safety guidelines	12
V	**Recombinant DNA Techniques** Blotting Techniques – PCR – DNA sequencing methods. Methods of gene transfer- microinjection, protoplast fusion, macroinjection, microprojectile, electroporation, liposome, polyethylene glycol. Ti plasmid – insect, virus, herbicide resistant plants– microbial insecticides- transgenic mice – retroviral method – DNA Microinjection method – Embryonic stem cell method.	12

Text Book: *Keith Wilson and John Walker., "Practical Biochemistry", WMC Brown Publishers, New Delhi.1994*

Reference Books

1. *David Freifelder., "Physical Biochemistry", Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton. McGraw-Hill Higher Education New York.1994*
2. *Boyer., "Practical Biochemistry", Springer, New York. 1993*
3. *Kathleen Talaro and Arthur Talaro .," Foundation in Microbiology" WCB Publishers, London.2012*
4. *Lehninger A.L., and Nelson D.l.," Principles of Biochemistry Cox- CBS Publishers, New delhi.1970*

Course Designed by	Verified by HOD	Checked by	Approved by
Mrs.C.AJITHA	DR.LALI GROWTHER		CONTROLLER OF EXAMINATIONS HICAS CBE-28

MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP08	Course Title	Batch:	2019-2021
		IMMUNOBIOLOGY		II
Hrs/Week:	5		Credits:	5

Course Objective

1. To understand the overall organization of immune system
2. To articulate the salient features of antigen and antibody reactions

Course Outcomes (CO)

K1	CO1	Classify antigen and antibody structures and interactions
K2	CO2	Demonstrate knowledge on hypersensitivity and transplantation immunology
K3	CO3	Discriminate auto immune and immunodeficiency diseases
K4	CO4	Predict antigen and antibody reactions and its uses in diagnostics

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	L	M	S	M
CO2	L	M	L	S
CO3	M	L	S	M
CO4	M	S	M	L

S - Strong; M-Medium; L-Low.

19MBP08	IMMUNOBIOLOGY	II
Unit No.	**Topics**	**Hours**
I	**Immune system and Immunity** History of Immunology; structure, composition and function of cells and organs involved in immune system; host parasite relationship; microbial infection; virulence and host resistance; immune response-innate immunity; acquired immunity; immunohaematology - blood groups, blood transfusion and Rh incompatibilities.	12
II	**Antigen , Antibodies and Complement system** Antigens – features of antigens – epitopes, cross reactivity, cell surface antigens and auto antigens- haptens- adjuvants and its significance. Immunoglobulin – structure, properties-types- Theories of antibody production - immunoglobulin variation, class switching - monoclonal antibody production - applications. Complement system - classical, alternate, lectine pathway, regulation of the complement system- regulation of Immune system – cytokines- lymphokines. Tolerance - T cell tolerance, B cell tolerance.	12
III	**Hypersensitivity and Transplantation** Hypersensitivity – MHC -HLA typing tumor antigens-immunity against cancer, gene regulation and Immuno Response (Ir) genes; Tissue typing- transplantation and tumour immunology – Tumor specific antigen, Immune response to tumor, Immuno diagnosis of tumor, Detection of tumor marker – α Foetal proteins, Carcino embryonic antigen. Therapy for cancer.	12
IV	**Autoimmune diseases and immunodeficiency diseases** Autoimmune diseases and immunodeficiency diseases – *In vivo* methods: skin test and immune complex tissue demonstration- application of these methods in diagnosis of microbial disease.	12
V	**Immunotechnology** Antigen-Antibody interaction – affinity- avidity -Principle and applications of agglutination, precipitation, complement fixation test, Immuno fluorescence, Radio immuno assay, Enzyme immunoassay, Western blotting. Immuno electron microscopy, flow cytometry and cell cytotoxicity assay-immunomic microarray-lymphochip. In Situ localization techniques - FISH & GISH	12

Text Books: *Tizard,R.I., "Immunology-An Introduction",Saunder's College publishers, Philadelphia.2012*

Reference Books

1) *Coleman, R.M.,Lourbard,M.F and Sicard,R.E.,."Fundamental immunology", W.H.Freeman and co., New York.1903*
2) *Roitt,I.M., "Essential of Immunology", Black Well Scientific Publishers, New York.2006*
3) *Ashim K. Chakravarthy., Immunology, TataMcGraw-Hill, New Delhi 2006*
4) *Kuby. J., "Immunology", W.H.Freeman and co., New York.1992*

Course Designed by	Verified by HOD	Checked by	Approved by
DR.N.HEMA SHENPAGAM	DR.LALI GROWTHER		CONTROLLER OF EXAMINATIONS HICAS CBE-28

MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP09	Course Title	Batch:	2019-2021
		GENETICS AND MOLECULAR BIOLOGY		II
Hrs/Week:	5		Credits:	5

Course Objective

1. To impart knowledge on the fundamental principles like replication, transcription and translation
2. To categorize gene transfer mechanisms

Course Outcomes (CO)

K1	CO1	Recognize the importance of the central dogma of Molecular biology
K2	CO2	Analyze the types of mutations and repair mechanisms
K3	CO3	Describe concepts of genetic recombination
K4	CO4	Explore the enzymes and vectors in genetic engineering

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	M	M	L
CO2	S	M	L	L
CO3	L	L	S	M
CO4	M	M	S	L

S - Strong; M-Medium; L-Low.

19MBP09	GENETICS AND MOLECULAR BIOLOGY	II
Unit No.	**Topics**	**Hours**
I	**Genetic material and Replication** Genetics - Mendelian principles, Segregation, Independent Assortment, Dominance –Identification of genetic material (Griffith, Hershey & Chase, Avery's Experiments), RNA as a genetic material, Watson and Crick model of DNA. DNA replication – Meselson & Stahl experiment- Bidirectional and Rolling circle replication. Differences in Prokaryotes and Eukaryotic replication.	12
II	**Transcription and Translation** Transcription – Initiation, Elongation and Termination- synthesis of mRNA in Prokaryotes and Eukaryotes. Structure of rRNA, mRNA and tRNA – RNA processing-Capping and Polyadenylation. Genetic code – Translation - Initiation, Elongation and Termination – antisense RNA - signal sequences and Protein transport.	12
III	**DNA damage, repair and Gene Regulation** Mutation – Spontaneous and Induced mutations- Physical and chemical mutagens- Site specific mutagenesis-Mutagenicity testing (Ames test) - DNA repair, Direct repair, Mechanism of excision repair, Nucleotide excision repair and SOS repair. Regulation of gene expression – Operon concept (lac, trp and ara)	12
IV	**Gene transfer Mechanisms and Transposons** Genetic Recombination – Homologous recombination, Site specific recombination. Conjugation F^+ v/s F^-, Hfr + v/s F^-, F' v/s F^-, Transformation – Transduction (Generalized & Specialized)-Phage genetics - Genetic mapping of T_4 Phage, Transposable elements- Insertion sequence, complex, compound.	12
V	**Enzymology of Genetic Engineering & Vector** Introduction to genetic engineering- Restriction enzymes, alkaline phosphatases, modifying enzymes. Joining of DNA fragments to vectors, homo polymer tailing, cohesive and blunt end ligation, adaptors and linkers. Construction of pBR 322 and pUC 18. Viral vectors-λ Phage- M13 -cosmid, phagemid, yeast artificial chromosome. Expression vector: Origin of replication- promoter- ribosome binding site- reporter gene- selectable marker gene - terminator. cassettes and fusion vectors.	12

Text Book: *David Freifelder., "Molecular biology", Narosa publishing house, New Delhi.1983*

Reference Books

1. *Gardner, E. J,Simmons, M J& D P Snustard., "Principles of Genetics", John Wiley & Sons, New York.2006*
2. *Robert H .Tamarin., "Principles of Genetics", WmC Brown Publishers, New York.1981*
3. *Lewin.B., Genes XII", Oxford University Press, New York 2017*
4. *Klug .W.S. & Cummings, MR.,"Essentials of Genetics", Mentics Hail, NewJersey.2016*

Course Designed by	Verified by HOD	Checked by	Approved by
Ms.K.SUKIRTHA	DR.LALI GROWTHER		CONTROLLER OF EXAMINATIONS HICAS CBE-28

MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP10	Course Title	Batch:	2019-2021
		MEDICAL MICROBIOLOGY		II
Hrs/Week:	5		Credits:	5

Course Objective

1. To list the basic principles, etiological agents and pathology of infectious diseases
2. To demonstrate the laboratory control of antimicrobial therapy

Course Outcomes (CO)

K1	CO1	Classify the types, sources and methods of transmission of infection
K2	CO2	Interpret and identify the microbes from clinical specimens
K3	CO3	Describe the pathogenecity and lab diagnosis of Gram positive and Gram negative organisms
K4	CO4	Summarize the types of fungal infections

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	M	S	M	L
CO2	M	S	L	M
CO3	L	M	S	M
CO4	L	M	S	L

S - Strong; M-Medium; L-Low.

19MBP10	MEDICAL MICROBIOLOGY	II
Unit No.	**Topics**	**Hours**
I	**Infection** Infection- types - sources and methods of transmission – normal microbial fluora of human body-Infectious disease cycle – sample collection, transport and examination of clinical specimens-blood, Sputum, CSF, urine, stool, serological and molecular methods for diagnosis - Mechanism of bacterial adhesion and colonization.	12
II	**Gram positive organisms** Bacteriology: Gram positive organisms - morphology, pathogenicity, laboratory diagnosis, prophylaxis and treatment of *Staphylococcus aureus, Streptococccus pyogenes, Bacillus anthracis, Corynebacterium diphtheriae, Clostridium tetani, Mycobacterium tuberculosis, Mycobacterium leprae. Spirochaetes – Treponema pallidum,* and *Leptospira icterohaemorrhagiae.*	12
III	**Gram negative organisms** Bacteriology: Gram negative organisms - Morphology, pathogenicity, laboratory diagnosis, prophylaxis and treatment of *E. coli, Klebsiella pneumoniae, Salmonella typhi, Shigella dysentriae, Pseudomonas aeruginosa, Vibrio cholerae, Bordetella pertussis, Yersinia pestis, Neiserria gonorrhoeae* and *Neiserria meningitidis.*	12
IV	**Mycology** Mycoses – superficial, subcutaneous and systemic infections – *Dermatophytoses, Madura mycosis, Cryptococcosis, Histoplasmosis, Blastomycosis. Candidiasis* and *Aspergillosis*	12
V	**Sensitivity testing** Drug susceptibility testing, antibiotic assay in body fluids. Immunization schedule. Nosocomial infection, common types of hospital infection – antibiotic resistance.	12

Text Book: *Ananthanarayan and Jayaram Paniker., "Textbook of Microbiology", University Press India Pvt ltd. New Delhi.*

Reference Books

1. *Jawetz E Melnic JL and Adelberg EA , review of Medical Microbiology Lange Medical Publications, USA.1963*
2. *Mackie and Mc catney, , Medical Microbiology No I and II. Churchill Livingston, USA. 1996*
3. *Bailey and Scotts "Diagnostic Microbiology", 9th edition. Baron and Finegold CV Mosby Publications. USA. 1970*
4. *David Greenwood "Medical Microbiology", Churchill Livingstone,2012*

Course Designed by	Verified by HOD	Checked by	Approved by
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MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP11	Course Title	Batch:	2019-2021
		PRACTICAL III IMMUNOBIOLOGY AND MEDICAL MICROBIOLOGY		II
Hrs/Week:	4		Credits:	2

Course Objective

1. To develop practical knowledge on isolation and identification of pathogenic microorganisms
2. To demonstrate the various immuno diagnostic procedures

Course Outcomes (CO)

K1	CO1	Identify pathogens from clinical specimens
K2	CO2	Demonstrate antibiotic sensitivity testing and interpretation
K3	CO3	Illustrate the antigen, antibody reactions by various tests
K4	CO4	Correlate the efficiency of disinfectants

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	L	S	M	L
CO2	M	M	S	L
CO3	L	S	M	M
CO4	M	L	S	M

S - Strong; M-Medium; L-Low.

19MBP11	PRACTICAL III IMMUNOBIOLOGY AND MEDICAL MICROBIOLOGY	II

LIST OF EXPERIMENTS

1) Diagnostic Microbiology: Isolation and identification of pathogens from clinical specimens
   a) Throat swab
   b) Urine
   c) Pus
   d) Faeces
   e) Blood.
2. Isolation and identification of clinically important fungi
   a) *Candida albicans*
   b) Aspergillus niger
   c) Cryptococcus neoformans
3. Antibiotic susceptibility test - Kirby Bauer technique
4. Examination of blood smear study for *Plasmodium* sp.,
5. Agglutination reaction - Blood grouping & Rh Typing.
6. Immunodiffusion – ODD Test.
7. Diagnostic Tests – WIDAL (Slide & Tube Test), RA, ASO, CRP, RPR.
8. Identification and enumeration of Leucocytes
9. Immunoelectrophoresis – Counter Current & Rocket Immunoelectrophoresis.
10. ELISA.
11. Phenol co-efficient test.

Course Designed by	Verified by HOD	Checked by	Approved by
DR.N.HEMA SHENPAGAM	DR.LALI GROWTHER		CONTROLLER OF EXAMINATIONS HICAS CBE-28

MASTER OF SCIENCE IN MICROBIOLOGY

Programme Code:	MBP	Programme Title: Master of Science in Microbiology		
Course Code:	19MBP12	Course Title	Batch:	2019-2021
		PRACTICAL IV APPLIED BIOTECHNIQUES AND MOLECULAR GENETICS		II
Hrs/Week:	4		Credits:	2

Course Objective

1. To develop practical knowledge on growth and biochemical characterization of bacteria
2. To impart practical knowledge on microbial genetics

Course Outcomes (CO)

K1	CO1	Express the different growth characteristics of bacteria
K2	CO2	Demonstrate the biochemical characterization of microorganisms
K3	CO3	Isolate and quantify chromosomal DNA, Plasmid and RNA
K4	CO4	Elucidate the gene transfer methods

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	M	L	S	S
CO2	L	S	M	S
CO3	S	L	M	M
CO4	S	M	L	M

S - Strong; M-Medium; L-Low.

19MBP12	PRACTICAL IV APPLIED BIOTECHNIQUES AND MOLECULAR GENETICS	II
Unit No.	Topics	Hours

LIST OF EXPERIMENTS

1) Separation of serum protein by horizontal submerged gel electrophoresis.
2) Isolation of chromosomal DNA
3) Isolation of plasmid DNA.
4) Quantification of DNA by diphenylamine test.
5) Isolation of auxotrophic mutants by chemical agents (replica plate method).
6) Isolation of antibiotic resistant mutants by gradient plate technique.
7) Study of conjugation in *Escherichia coli*.
8) Transformation in *Escherichia coli*.
9) Detection of carcinogens- AMES test.
10) Isolation of RNA using orcinol reagent
11) Extraction of RNA from *Saccharomyces cerevisiae*.

Course Designed by	Verified by HOD	Checked by	Approved by
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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP13	Course Title	Batch:	2019-2020 only
		ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	Semester:	III
Hrs/Week:	5		Credits:	5

Course Objective

1. To associate the knowledge on soil Microflora and its implication in Agriculture
2. To interpret various biogeochemical cycle and microbes involved for their interaction

Course Outcomes (CO)

K1	CO1	Outline the knowledge on microbiology of air, water and soil
K2	CO2	Describe techniques to treat soil and liquid waste
K3	CO3	Illustrate the role of microbes in environment
K4	CO4	Formulate the various methods in determine the quality of wastewater treatment

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	M	S	M
CO2	S	S	M	M
CO3	M	S	M	M
CO4	S	M	S	M

S - Strong; M-Medium; L-Low.

19MBP13	ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY	III
Unit No.	**Topics**	**Hours**
I	**Aerobiology** Microbiology of air – source of air microflora- Biological indicators of air pollution - assessment of air quality – significance of air Microflora –solid –liquid- impingement methods -airborne diseases(Bacterial - Whooping cough, Diphtheria, Pneumonia; Fungal - Aspergillosis, Cryptococcosis; Viral – Chickenpox, Influenza, Measles) and control measures – air sanitation- air curtains-filters-International standards for air quality in operation theatres.	12
II	**Aquatic Microbiology** Water ecosystem – types – microbial flora of freshwater (Ponds, Lakes, Streams) - Marine habitats (estuaries, mangroves, deep sea, hydrothermal vents, saltpans, coral reefs)- Zonations of water ecosystem-upwelling-eutrophication- Extremophiles-food chain. Potability of water – Indicator organisms - Bacteriological assessment of water quality- water purification - water borne diseases and their control measures.	12
III	**Soil & Agricultural Microbiology** Classification of soils - physical and chemical characteristic, Microflora - Rhizosphere – Phyllosphere - microbial interaction -symbiosis-mutualism-commensalism-competition-amensalism-synergism-parasitism-predation; biogeochemical cycles -carbon, nitrogen, phosphorus and sulphur, nitrogen fixation- symbiotic nitrogen fixation – *nod* genes - nitrogenase enzyme - *nif* genes; -(Rhizobium, Frankia) - nonsymbiotic microbes-Azotobacter- Azospirillium – production and application of Biofertilizers -Microbial inoculums.	12
IV	**Waste treatment** Wastes-types-solid and liquid waste characterization – Liquid waste treatment - Waste water treatment –primary-secondary-tertiary; BOD – COD - solid waste treatment – Saccharification and gasification, composting – Vermi composting. Utilization of waste - Food (SCP, mushroom, yeast); fuel (ethanol, methane-Biogas) - radioactive product waste disposal.	12
V	**Bioremediation** Biodegradation of recalcitrant compound –lignin- bioaccumulation of metals and detoxification - bioremediation - pesticide; biodeterioration of paper - leather, wood textile - metals corrosion - mode of deterioration-organism involved- disadvantage- GMO and their impact, Bioleaching, Application of GIS and RS technique, bioaugmentation, biostimulation and Xenobiotics. Bio control agents-Bacillus, Trichoderma, Baculovirus	12

Text book: *Michel R, Introduction to Environmental Microbiology., 1974 Prentice-hall, Englewood cliffs, NJ.*

Reference Books

1. *Alexander M., (1971) Microbial ecology, John Wiley and sons, Inc., New York*
2. *Norris J.R and Petipher G.L (1987) Essay in agricultural and food microbiology. John Wiley and sons Singapore.*
3. *Harry buckman and Nyle C.brady (1960). The nature and properties of soil. Eurasis Pub.House(Pvt) Ltd., New Delhi*
4. *Brock T D, Madigan MT, (1994) Biology of microorganisms. Prentice Hall Int.Inc.*
5. *K.C Marshall, (1985) Advance in Microbial Ecology, Vol 8 , Plenum Press.*

Course Designed by	Verified by HOD	Checked by	Approved by
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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP14	Course Title	Batch:	2019-2020 only
		FOOD AND DAIRY MICROBIOLOGY	Semester:	III
Hrs/Week:	5		Credits:	5

Course Objective

1. To distinguish the food and dairy Microflora, preservation and spoilage
2. To categorize quality assurance and standards

Course Outcomes (CO)

K1	CO1	Describe food microflora and food preservation
K2	CO2	Summarize the fermented food products
K3	CO3	Illustrate the contamination and spoilage of vegetables, meat and fruits
K4	CO4	Outline on food borne diseases and quality assurance in food industry.

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	M	S	S	S
CO2	S	M	S	M
CO3	S	S	M	M
CO4	S	M	S	M

S - Strong; M-Medium; L-Low.

19MBP14	FOOD AND DAIRY MICROBIOLOGY	III
Unit No.	**Topics**	**Hours**
I	**Food Microflora and Preservation of Foods** Introduction- Importance of food microbiology – types of microorganisms in food – source of contamination (Primary sources) – factors influencing microbial growth of food (extrinsic and intrinsic) **Food preservation**: Principles of food preservation – methods of food preservation Asepsis – high temperature – low temperature – drying – radiation – chemical additives (permitted preservatives).	12
II	**Fermented products** Fermented food – pickled cucumber , soysauce, bread, idli, butter, Soy sauce, Miso, Sufu, Natto, Idli, fermented fish products. Fermented vegetables: Sauerkraut, pickles, Olives. Fermented sausages. Probiotics- Health benefits, types of microorganisms used, probiotic foods available in market –Prebiotics and nutrition	12
III	**Dairy Microbiology** Production of starter cultures; Cheese - principles of cheese making. Cheddar Cheese, Swiss Cheese, Surface ripened Cheeses; Mold ripened Cheeses. General principles of manufacture of Yogurt, acidophilus milk, Kefir, Koumiss- dry milk, ice cream , Utilization and disposal of dairy by-product – whey – microbial spoilage of milk. Applications of microbial enzymes in dairy industry [Protease, Lipases].	12
IV	**Spoilage of food products** Contamination and spoilage – cereals, sugar products, vegetables and fruits, meat, fish and seafood – poultry, spoilage of canned foods –Food borne infections - *Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia*, Nematodes, protozoa, algae, fungi, and viruses. Food borne outbreaks-laboratory testing procedure. Food intoxications- Mycotoxins, mushroom poisoning	12
V	**Quality assurance and validation** Principles and use of HACCP in food Industry - Food laws and regulations - National – PFA Essential Commodités Act (FPO, MPO etc.) – Codex Alimentarius, ISO – 9000 series , ISO 22000 & BS 5750 - Regulatory Agencies – WTO - Consumer Protection Act - Relevance of Microbiological standards & criteria for food safety – Sampling plans – Microbiological guidelines - Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in dairy industry. Genetically modified foods, Nutraceuticals, Biosensors in food.	12

Text Books: *Adams M.R. and M.O. Moss., "Food Microbiology", The royal Society of Chemistry, Cambridge, New York 1995*

Reference Books

1. *Fraizer W.C. and Westhoff D.C., "Food Microbiology", TATA McGraW Hill Publishing Company Ltd. New Delhi.1995*
2. *Robinson R., "Dairy Microbiology, Elseiver Applied Science Pub, New York.1990*
3. *Yadav J.S. Sunitha G. and V.K. Batish., "Comprehensive dairy Microbiology", Metropolitan Book Co., New Delhi.1993*
4. *Patel A H., "Industrial Microbiology", MacMillan Publisher, New Delhi.2005*

Course Designed by	Verified by HOD	Checked by	Approved by
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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP15	Course Title	Batch:	2019-2020 only
		LARGE SCALE MANUFACTURING PRACTICES	Semester:	III
Hrs/Week:	5		Credits:	5

Course Objective

1. To acquire knowledge on fermentation process and bioreactor design.

2. To analyze the process of fermented microbial products.

Course Outcomes (CO)

K1	CO1	Describe about fermentation and fermenter types
K2	CO2	Distinguish upstream and downstream processes
K3	CO3	Demonstrate fermented products in large scale
K4	CO4	Categorize commercial products and its uses

Mapping of Outcomes

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	M
CO2	M	L	S	M
CO3	S	S	L	M
CO4	M	L	S	M

S - Strong; M-Medium; L-Low.

19MBP15	LARGE SCALE MANUFACTURING PRACTICES	III
Unit No.	**Topics**	**Hours**
I	**Fermentation** Scope of industrial microbiology- Historical development of fermentation technology - Types of fermentation-solid state, submerged, types of culture system - batch, continuous, fed batch- Screening: primary, secondary- preservation of culture- strain development -fermentation economics- metabolic pathway and control mechanism.	12
II	**Bioreactor Design** Characteristics of an ideal Fermenter, Construction material used, surface treatment of material, Design of a typical Batch Fermenter, fed batch, Continuous fermenter-Aerator and Agitator - types, Baffles, Seals and valves used, steam traps- Different designs of bioreactors- Mechanically agitated and non-mechanically agitated, Bubble column, Bubble Cap, Air Lift (internal and external loop), Packed Bed reactor, Fluidized bed reactor, Pressure cycle Animal and Plant cell Bioreactors- use of computers in fermentation technology. Kinetics of batch, fed – batch and continuous fermentation.	12
III	**Upstream process** Upstream processing- media formulation, substrates used for industrial fermentation, inoculum preparation, sterilization- Batch and continuous -process control in fermentation. Fermenter pre-culture and production-Aeration and agitation, power requirement oxygen transfer kinetics, concepts of Newtonian and Non-Newtonian fluids, plastic fluids apparent viscosity, foam and antifoam.	12
IV	**Downstream Process** Product recovery-intracellular and extracellular - cell disruption- flocculation – floatation- filtration –centrifugation- chromatography, dialysis and electro dialysis, distillation, crystallization- precipitation and drying.	12
V	**Biomass based Products** Baker's Yeast, Single cell Protein; Enzymes - amylase, protease; Antibiotics - Penicillin, Streptomycin Vitamins - B12, Riboflavin; Amino acids - Glutamic acid, Lysine; Vaccines - DPT, Polio; Biotransformation Products - Steroids, Ascorbic acid; Alcohol and Wine.	12

Text book: *P.F. Stanbury, A.Whitaker, S.J.Hall., "Principles of Fermentation Technology", Aditya Books Private Limited, New Delhi 2016*

Reference Books

1. *A H Patel., "Industrial Microbiology", MacMillan Publisher, New Delhi.2005*
2. *L. E Casida, JR., "Industrial Microbiology", New Age Interanational Publisher, New Delhi.1986*
3. *Wulfcrueger and AnnelieseCrueger., "Biotechnology A text book of Industrial Microbiology", Panima Publishing Corporation, New Delhi.1990*
4. *Michael J. Waites, Neil L. Morgan, John S. rockey and Gary Higton., "Industrial Microbiology An Introduction", Blackwell Science Publisher, New Delhi.2001*
5. *McNeil B. and Harvey L. M. Fermentation A. Practical Approach . IRL.1990*

Course Designed by	Verified by HOD	Checked by	Approved by
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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP16A	Course Title	Batch:	2019-2020 only
		PHARMACEUTICAL MICROBIOLOGY	Semester:	III
Hrs/Week:	5		Credits:	4

Course Objective

1. To develop the knowledge on microbial production of pharmaceutical products
2. To discuss about the regulatory practices in pharmaceuticals

Course Outcomes (CO)

K1	CO1	Describe about antibiotics and synthetic antimicrobial agents
K2	CO2	Classify drug development strategies
K3	CO3	Illustrate the production of few biopharmaceuticals
K4	CO4	Categorize the regulatory aspects in pharmaceutical industry

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	M	S	S	M
CO2	S	M	S	M
CO3	M	S	M	S
CO4	S	M	S	S

S - Strong; M-Medium; L-Low.

19MBP16A	PHARMACEUTICAL MICROBIOLOGY	III
Unit No.	**Topics**	**Hours**
I	**Antibiotics and synthetic antimicrobial agents** Antibiotics and synthetic antimicrobial agents (Aminoglycosides, β lactams, tetracyclines, ansamycins, macrolide antibiotics) - Antifungal antibiotics, antiviral agents- antitumor substances. Peptide antibiotics- Synthetic antibiotics: Sulphonamides, Chloramphenicol; Quinolone - Bacterial resistance to antibiotics- antimicrobial agents, chemical disinfectants and antiseptics.	12
II	**Drug development strategies** Need for developing new drugs: Substances derived from bacteria, plants, insects, and animals; Sources of active principles; Combinatorial Synthesis: Chemistry, Microbiology, and Biotechnology. Molecular principles of Drug delivery and targeting-cellular and synthetic drug carriers - Drug delivery system in gene therapy- Biosensors in pharmaceuticals.	12
III	**Pharmaceutical products** Microbial products - Antibiotics (tetracycline, gentamycin), vitamins, probiotics. Animal vaccines-Subunit vaccines, peptide vaccines, attenuated and vector vaccines. Clinical trials. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures-Application of cell cultures in pharmaceutical industry and research.	12
IV	**Therapeutic proteins:** Insulin, human growth hormone, clotting factors, interferons, interleukins, tissue plasminogen activators, erythropoietin, Streptokinase, DNAsel, alginate lyase, muteins; Production, advantages, limitations and applications of monoclonal antibody.	12
V	**Regulatory practices and Quality Assurance** Government regulatory practices and policies - FDA perspective- Rational drug design - Good Laboratory Practices (GLP) Good Manufacturing Practices (GMP) in pharmaceutical industry - GMP regulations - US-FDA, Europe, Japan, ICH, PICS/S, WHO- ISO.	12

Text Book: *Golan D., Tashjian A., Armstrong E., Galanter J., Armstrong A.W., Arnaout R. and Rose H.., "Principles of Pharmacology", Lippincott Williams and Wilkins, New York,2009*

Reference Books

1. *Hardman J., Lee Limbird and Gilman., A.G. "Goodman and Gilman's The Pharmacological Basis of Therapeutics". Lippincott Williams and Wilkins, New York. 2016*
2. *Hugo, W.B. and Russel*, "Pharmaceutical Microbiology",. AD.Blackwell Scientific, Oxford 2004
3. *Lancini, G. and Parenti, F.* "Antibiotics", Springer-Verlag.1995
4. *Block, S.S.* "Disinfection, sterilization and preservation", Lea and Febigor, Baltimore 2005

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP16B	Course Title	Batch:	2019-2020 only
		MICROBIAL GENOMICS AND PROTEOMICS	Semester:	III
Hrs/Week:	5		Credits:	4

Course Objective

1. To develop knowledge in the field of genomics and proteomics
2. To impart knowledge on databases and computational methods

Course Outcomes (CO)

K1	CO1	Describe the components of prokaryotic and eukaryotic genomes
K2	CO2	Classify the tools used in genome sequencing and genome analysis
K3	CO3	Discover the databases for proteins and nucleic acids
K4	CO4	Analyze the tools used in recombinant DNA technology

Mapping of Outcomes

CO \ PO	PO1	PO2	PO3	PO4
CO1	M	S	S	M
CO2	S	M	S	M
CO3	M	S	M	S
CO4	S	M	S	S

S - Strong; M-Medium; L-Low.

19MBP16B	MICROBIAL GENOMICS AND PROTEOMICS	III
Unit No.	**Topics**	**Hours**
I	**Structural Genomics** Sequencing genomes – Preparation of libraries (Genomic and cDNA) - conventional sequencing (Sanger, Maxam and Gilbert Methods), Automated Sequencing - Whole genome shotgun sequencing - Bacterial genome - Eukaryotic genome - Insights from genome analysis - Genome Sizes and Gene Densities.	12
II	**Functional Genomics** Identifying Genes in DNA sequences – Sequence similarity searches to assign Gene function – Assigning gene function experimentally –Patterns of gene Expression-1000 genome browser-JGI-Genbanks	12
III	**Databases** Use of Internet, public domain database for nucleic acid and protein sequences (EMBL, GenBank and PDB). Computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotation of genes, conserved protein motifs related structure/ function (PROSITE, PFAM, Profile scan). DNA analysis for repeats (direct and inverted). Palindromes, folding programs.	12
IV	**Transcriptomics** Overview of past and current technology – connecting traits to genes and genes to functions – Protein – protein interactions , protein networks , system biology, synthetic biology; KEGG pathways.	12
V	**Genome and Proteome analysis** DNA Microarray-principle-methods-applications; RT-PCR; validation tools-Analysis of single nucleotide Polymorphism using DNA chips. 2D separation of total cellular proteins, isolation and sequence analysis of individual proteins spots by Mass spectroscopy. Microarray - Advantages and Disadvantages of DNA and Protein Microarray.	12

Text Book: *T.A Brown.., "An introduction to Gene Cloning" ,Champman and Hall, New York. 2006*

Reference Books

1. *Old. RW and Primbrose., "Principle of Gene Manipulation,", Blackwell Scientific Publication ,Boston.1981*
2. *Winnecker, E.D., "From gene to clones, Introduction to Gene Technology", VCH Publication, FRG. 1983*
3. *Bernard. R Glick and Jack J Pasternak., "Molecular biotechnology", Panima Publishing Corporation, India. 2010*
4. *U.Sathyanarayana., Biotechnology Books and Allied(P) Ltd., India.2002*

Course Designed by	Verified by HOD	Checked by	Approved by
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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP16C	Course Title	Batch:	2019-2020 only
		MICROBIAL PRODUCTION OF RECOMBINANT MOLECULES	Semester:	III
Hrs/Week:	5		Credits:	4

Course Objective

1. To develop the knowledge of gene expression and microbial production of recombinant molecules

2. To describe the cloning strategies, expression patterns and various recombinant techniques

Course Outcomes (CO)

K1	CO1	Describe the vector construction and the requirement of recombinant molecule
K2	CO2	Distinguish the gene expression and promoters and integration of DNA in host
K3	CO3	Demonstrate the process of mutagenesis and engineered proteins
K4	CO4	Illustrate on molecular markers and mapping of genome

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	M	M	S	M
CO2	M	S	M	M
CO3	M	M	S	M
CO4	S	M	M	M

S - Strong; M-Medium; L-Low.

19MBP16C	MICROBIAL PRODUCTION OF RECOMBINANT MOLECULES	III
Unit No.	**Topics**	**Hours**
I	**Recombinant Molecules** Requirement of recombinant molecules in pharmaceutical, health, agricultural, industrial sectors and research laboratories. Criteria for purity. Expression vectors, promoter probe vectors, vectors for library construction	12
II	**Gene Expression** Gene expression from strong and Regulatable promoters - Fusion proteins - Translational Expression vectors- protein folding – DNA Integration into the host chromosome.	12
III	**Mutagenesis and Protein Engineering** Direct Mutagenesis procedures – Oligonucleotide with M13 DNA – Plasmid DNA- PCR amplified – Random mutagenesis – Error prone PCR – DNA shuffling – Protein engineering – Enzymatic activity – modifying protein specificity – altering multiple properties.	12
IV	**Genome Mapping** Genetic and physical maps, physical mapping and map based cloning, choice of mapping population, simple sequence repeat Loci, Chromosome micro dissection and micro cloning, molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, molecular markers linked to disease resistance genes.	12
V	**Commercial Products** Microbial synthesis of commercial products - proteins-insulin-pharmaceuticals – interferons - human growth hormone - somatostatin-antibiotics – cephalosporin – biopolymers- PHB. Vaccines – subunit vaccines – monoclonal antibody- gene therapy - regulating the use of genetically modified organisms.	12

Text Books:

Bernard. R Glick and Jack J Pasternak., "Molecular biotechnology", Panima Publishing Corporation, India.2010

Reference Books

1. *Brown T.A.., "An introduction to Gene Cloning" ,Champman and Hall, New York.2006*
2. *Old. RW and Primbrose., "Principle of Gene Manipulation,", Blackwell Scientific Publication ,Boston.1981*
3. *Winnecker, E.D., "From gene to clones, Introduction to Gene Technology", VCH Publication, FRG. 1983*
4. *Sambrose and Russell "Molecular cloning Volume 3 2000.,* CSH *Press.*

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP17	Course Title	Batch:	2019-2020 only
		PRACTICAL V FOOD MICROBIOLOGY AND FERMENTATION TECHNOLOGY	Semester:	III
Hrs/Week:	5		Credits:	2

Course Objective

1. To develop practical knowledge on the quality control parameters of food products.
2. To experiment the fermentation process for the microbial production of enzymes and organic acids

Course Outcomes (CO)

K1	CO1	Explain the production of organic acid and antibiotics
K2	CO2	Differentiate the estimation of various enzymes and wine
K3	CO3	Demonstrate the sterility of food products
K4	CO4	Analyze the presence of toxins in food

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	M	M	M	S
CO2	S	S	M	M
CO3	M	M	S	S
CO4	S	S	M	S

S - Strong; M-Medium; L-Low.

19MBP17	PRACTICAL V FOOD MICROBIOLOGY AND FERMENTATION TECHNOLOGY	III

LIST OF EXPERIMENTS

1. Methylene Blue reduction test
2. Alkaline phosphatase test to check efficiency of pasteurization
3. Litmus Milk reaction
4. Direct microscopic examination of curd- Observation of Lactobacillus sp.
5. Enumeration of bacteria, yeast and molds in vegetables
6. Isolation of bacteria from contaminated foods-Salmonella / Dairy products- *S.aureus*.
7. Determination of sterility of canned foods- fermentation test.
8. Wine production- estimation of sugar, acid, alcohol.
9. FAO-WHO guidelines for canned food of HACCP – Regulatory assessment (Sauerkraut/Yogurt)
10. Analysis of mycotoxin in fungal contaminated food material.
11. Organic acid production- Glutamic acid / Citric acid-solid state and submerged fermentation.
12. Production and estimation of extracellular enzyme- Amylase, Protease, lipase, Cellulase.
13. Production and estimation of Lactic acid by *Lactobacillus* sp.,

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP18	Course Title	Batch:	2019-2020 only
		PRACTICAL VI RECOMBINANT DNA TECHNOLOGY, ENVIRONMENTAL AND PHARMACEUTICAL MICROBIOLOGY	Semester:	III
Hrs/Week:	5		Credits:	2

Course Objective

1. To impart practical knowledge on recombinant techniques
2. To describe various techniques for isolation of specific microorganisms from the environment

Course Outcomes (CO)

K1	CO1	Identify restriction digestion pattern and preparation of competent cells
K2	CO2	Distinguish blotting techniques
K3	CO3	Demonstrate the parameters for water quality
K4	CO4	Categorize spoilage of pharmaceutical products and bioassay methods

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	M	M	M
CO2	S	M	M	S
CO3	S	M	M	M
CO4	M	M	S	M

S - Strong; M-Medium; L-Low.

19MBP18	PRACTICAL VI RECOMINANT DNA TECHNOLOGY, ENVIRONMENTAL AND PHARMACEUTICAL MICROBIOLOGY	III

LIST OF EXPERIMENTS

Genetics (pr iv)

1. Restriction digestion of λ DNA.
2. Enzyme Induction (ONPG)
3. Competent cell production and transformation of competent cells
4. Southern Blotting (Demo)
5. Western Blotting (Demo)
6. Biological Oxygen demand
7. Chemical Oxygen demand
8. MPN Technique – Detection of potability of water.
9. Isolation of free living and symbiotic nitrogen fixers, phosphate solubilizers.
10. Isolation of Ammonifers, nitrifiers and denitrifies.
11. Sterility testing of Pharmaceuticals for microbial contamination-Antibiotics.
12. Phenol coefficient test.
13. To determine MIC of tetracycline.
14. Bio-assay of chloramphenicol by plate assay method.

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP20	Course Title	Batch:	2019-2020 only
		BIOETHICS, IPR AND BIOSAFETY	Semester:	III
Hrs/Week:	SS		Credits:	1

Course Objective

1. To compare the ethical, social, legal aspects in biology and the biocontainment

2. To describe about the IPR and biosafety

Course Outcomes (CO)

K1	CO1	Describe the ethical values in Microbiological Research
K2	CO2	Discuss about Patenting in Biological research
K3	CO3	Apply and use of animal and human specimens for Research
K4	CO4	Illustrate biosafety in applying genetically modified organisms

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	M	M	S
CO2	S	M	M	S
CO3	S	M	S	S
CO4	M	M	S	S

S - Strong; M-Medium; L-Low.

19MBP20	BIOETHICS, IPR AND BIOSAFETY (SS)	III
Unit No.	**Topics**	**Hours**
I	**Ethics** Introduction to ethics and bioethics Perspective of Ethics, Personal vs professional ethics: Moral Reasoning – Ethical theories Deontological, Utilitarianism – Ethical leadership (integrity and ingenuity) - framework for ethical decision making- Michael Macdonald model & Storch model.	12
II	**Bioethics** Biotechnology ethics in agriculture and environment: GM crops and GMO"s - benefits and risks – ethical aspects of genetic testing – ethical aspects relating to use of genetic information and bio-warfare. Ethical implications of cloning -Reproductive cloning, therapeutic cloning; Ethical, legal and socio-economic aspects of gene therapy, germline, somatic, embryonic and adult stem cell research. Biotechnology and biopiracy – ELSI of human genome project. Animal ethics-Norms in India-Licensing of animal house-ethical clearance norms for conducting studies on human subjects-IAEC-Organizational structure and regulations in India.	12
III	**IPR** Introduction to intellectual property and intellectual property rights Types, patents, copyrights, trademarks, design rights, geographical indications – importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO) – Open source and IPR.	12
IV	**Biosafety** Introduction - Biosafety issues in microbiology – risk assessment and risk management – safety protocols: risk groups – biosafety levels – Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3. Discarding biohazardous waste - Methodology of Disinfection, Autoclaving & Incineration- types of biosafety containment.	12
V	**Biosafety Guidelines** Biosafety regulations (National and International) –Biosafety Committee (IBSC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC) - Biosafety guidelines for research -Good laboratory practices, Good microbiological practices.	12

Text Books : *Raj mohan Joshi., "Biosafety And Bioethics", Gyan books pvt.lmt., Bangalore.2006*

Reference Books

1. Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. NewDelhi. 1985
2. Sasson A, Biotechnologies and Development, UNESCO Publications. 1992
3. Singh K, Intellectual Property rights on Biotechnology, BCIL, New Delhi. 1993
4. Regulatory Framework for GMOs in India (2006) Ministry of Environment and Forest, Government of India, New Delhi
5. Cartagena Protocol on Biosafety (2006) Ministry of Environment and Forest, Government of India, New Delhi

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP21	Course Title	Batch:	2019-2020 only
		BIOSTATISTICS AND RESEARCH METHODOLOGY	Semester:	IV
Hrs/Week:	5		Credits:	5

Course Objective

1. To develop knowledge about statistics to biologist and its application in research

2. To impart knowledge on bioinformatics tools

Course Outcomes (CO)

K1	CO1	Define the statistical theory and their probabilistic foundation
K2	CO2	Explain the basic framework of research process
K3	CO3	Apply the various research design and techniques
K4	CO4	Relate and organize data and literature

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	L	M	M
CO2	S	S	M	M
CO3	S	S	M	M
CO4	L	M	S	M

S - Strong; M-Medium; L-Low.

19MBP21	BIOSTATISTICS AND RESEARCH METHODOLOGY	IV
Unit No.	**Topics**	**Hours**
I	**Introduction to statistics** Statistics for biologist- application in project design. Probability analysis, collection, classification, & tabulation of data, data presentation methods. Histogram- Ogive curves.	12
II	**Measures of location** Calculation of mean, median, mode, standard deviation, Range, standard error for discrete and continuous series in reference to biological standards (MPN, Sterility testing of medicines, Animal Toxicity, Therapeutic trial of drugs and vaccine, infection and Immunization studies).	12
III	**Analysis of Variance** Introduction, procedure and tests, Multiple comparisons. Simple correlation coefficient, correlation regression-simple and linear ANOVA.	12
IV	**Analysis of Significance** Basic ideas of significant test-hypothesis testing, level of significant test, test based on studies-t-test, chi-square and goodness of fit. Optimization tools – classical – one-factor-at-a-time – response surface methodology.	12
V	**Project designing** Selection of research problem. Designing a project-objective, executing the research-thesis writing-review of literature, methods-data collection for bioscience research-preparation of thesis. Presenting the research findings-Plagiarism and research ethics. Citation index - H index- cumulative factor.	12

Text Books: *Guptha S.P.., "Statistical methods", Sultan chand and Sons, New Delhi.2012*

Reference Books

1) *Palanisamy & Manoharan., "Statistical Methods of Biology", Paramount Publications, New Delhi.1994*
2) *Khan and Khan.,"Fundamentals of Biostatistics", Atiya Khanum Ukaaz publications Hyderabad.2004*
3) *GR Kothari., "Research Methodology- Methods and techniques", urley eastern limited, New Delhi 1990*
4) *Ignacimuthu S., "Basic Bioinformatics", Alpha Science International, New Delhi. 2009*

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP22A	Course Title	Batch:	2019-2020 only
		BIOINFORMATICS AND NANOTECHNOLOGY	Semester:	IV
Hrs/Week:	5		Credits:	4

Course Objective

1. To develop basic idea about application of computers and nanomaterials in biology
2. To analyze the software techniques for sequencing and interpreting protein structures

Course Outcomes (CO)

K1	CO1	Identify the basic concepts in Bioinformatics
K2	CO2	Describe databases and to construct phylogenetic trees
K3	CO3	Demonstrate the alignment methods.
K4	CO4	Analyze the Synthesis of Nanoparticles

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	L	M	M
CO2	S	M	M	S
CO3	S	M	L	M
CO4	L	M	S	M

S - Strong; M-Medium; L-Low.

19MBP22A	BIOINFORMATICS AND NANOTECHNOLOGY	IV
Unit No.	**Topics**	**Hours**
I	**Introduction to Computer Fundamentals & Biological Databases** RDBMS – Definition of relational database – Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer; Biological Databases – nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage – File formats – FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.	12
II	**Sequence Alignments, Phylogeny and Phylogenetic trees** Local and Globa Sequence alignment - pairwise and multiple sequence alignment – Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices – Types of phylogenetic trees, Different approaches of phylogenetic tree construction – UPGMA, Neighbor joining, Maximum Parsimony, Maximum likelihood.	12
III	**Protein Structure Predictions** Hierarchy of protein structure – primary, secondary and tertiary structures, modeling – structural classes, Motifs, Folds and Domains; Protein structure prediction in presence and absence of structure template – Energy minimizations and evaluation by Ramachandran plot – Protein structure and rational drug design	12
IV	**Nanoscience** Introduction-Definition- Nanomaterial- Nanocomposites, History of nanotechnology; Classification of Nanostructures- Top down & Bottom-up approach- Quantum dots- Bio inspired nanomaterials; Nanomaterial synthesis, Physical methods (Plasma, Laser), Chemical method (Sol-gel, Co-precipitation) & Biological method (Microbes, plant).	12
V	**Nanomaterial characterization:** Electron microscopy – TEM, SEM & AFM – For particle imaging, XRD and FTIR for analysis of size, shape, structure, chemistry and crystallography. Applications- nanomedicines- Drug delivery - liposomes as drug carriers - nanoparticles in cancer therapy- lab on chip concept- biosensors- military application of nanotechnology.	12

Text Book: *S. Ignacimuthu., "Basic Bioinformatics", Alpha Science International, Tamil Nadu 2009*

Reference Books

1. *K.K.Jain., "Nano Biotechnology", Horizions Biosciences, Tamil Nadu.2002*
2. *Dan Gusfield., "Algorithms on Strings Trees and Sequences", Cambridge University Press, London.1997*
3. *Lesk., " Introduction to Bioinformatics", Cambridge University Press, London.2002*
4. *Baxevenis, "Bioinformatics", John Wiley & Sons, New York 2001*

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP22B	Course Title	Batch:	2019-2020 only
		COMMERCIAL MICROBIOLOGY	Semester:	IV
Hrs/Week:	5		Credits:	4

Course Objective

1. To develop and strengthen the entrepreneurial quality in Microbiology

2. To demonstrate the characteristics of patent and open source soft wares

Course Outcomes (CO)

K1	CO1	Select the ability to establish a mushroom cultivation unit
K2	CO2	Classify the parameters to the production of Biofertilisers and composting
K3	CO3	Develop the skills for commercial production
K4	CO4	Design and formulate the principles of entrepreneurship

Mapping of Outcomes

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	L	M	M
CO2	S	M	M	S
CO3	S	M	L	M
CO4	L	M	S	M

S - Strong; M-Medium; L-Low.

19MBP22B	COMMERCIAL MICROBIOLOGY	IV
Unit No.	**Topics**	**Hours**
I	**Mushroom cultivation** Cultivation of *Agaricus campestris Calocybe indica*, *Pleurotus Florida.*, *Agaricus bisporous, Valvarellia volvaciae*, - Exotic mushrooms – *Ganoderma lucidem.*, - *Ophiocordyceps sinensis* - Nutritional value, cultivation method- Preparation of compost, filling tray beds, spawning, maintain optimal temperature, casing, watering, harvesting, storage, control of pathogen and pest, Medicinal value of Mushroom, Advantages of mushroom.	12
II	**Biofertilizer production** Biofertilizer – chemical fertilizer versus biofertilizer, organic farming, Mass cultivation and field application of *Rhizobium*, *Azospirillium*, *Azotobacter* and phosphate solubilizer as biofertilizer - Bacterial insecticides *(Bacillus thuringiensis)* and Viral insecticides (NPV)and *T.viride*. Mass cultivation and field application of *Bacillus thuringiensis*. Composting – Microbiology of composting, preparation of compost, types of composting, advantages of composting, vermicomposting.	12
III	**Production of Diagnostic kits and Probiotics** Production of kits- serum electrophoresis and diagnostic kits -WIDAL, ABO blood grouping, RPR, VDRL, ASO - Probiotics- supplements for nutrition	12
IV	**Commercial product production** Commercial product production - Beer, Wine, Antibiotics- Penicillin, enzymes- amylase and protease. Aminoacids - lysine, glutamic acid. Organic acids – citric acid, acetic acid. Ergot alkaloid.	12
V	**Entrepreneurship** Entrepreneurial development – activity, institute involved -process of entrepreneurship -socio-economic gain, schemes and program for entrepreneurship- Department of Science and Technology schemes, Nationalized banks – SIDBI, NSIC, NABARD and IDBI. Structure of a biobased technology company, Start-up of biobased technology company – Incubation centres – innovation cell – BIRAC – ABLE (Association of Biotechnology Lead Enterprises) - IPR and Patents- characteristics of patent- drafting- patents in India and other Countries.	12

Text book: *Dubey., R.C "Textbook of Biotechnology" New age Publishers, New Delhi.2007*

Reference Books

1. *Ronald M Atlas and Richard Bartha., "Microbial Ecology", Pearson publication, Germany.1981*
2. *Greene., "Entrepreneurship ideas inaction", Thomson learning, New York.2010*
3. *Anil kumar S.," Entrepreneurship Development", New Age International, India.2011*
4. *Satyanarayana U., "Biotechnology", Books and Allied P Ltd, Kolkata, India.2002*

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP22C	Course Title	Batch:	2019-2020 only
		TOTAL QUALITY MANAGEMENT (TQM)	Semester:	IV
Hrs/Week:	5		Credits:	4

Course Objective

1. To provide information about the concepts of total quality management.
2. To demonstrate quality assurance and audits in laboratories.

Course Outcomes (CO)

K1	CO1	Identify, understand the design and applications of Microbiology lab.
K2	CO2	Describe the maintenance of lab equipments and quality control records
K3	CO3	Compute biological references and standards
K4	CO4	Outline good lab practices and first aid procedures

Mapping of Outcomes

PO / CO	PO1	PO2	PO3	PO4
CO1	S	L	M	S
CO2	S	M	M	S
CO3	S	M	S	M
CO4	M	L	S	S

S - Strong; M-Medium; L-Low.

19MBP22C	TOTAL QUALITY MANAGEMENT (TQM)	IV
Unit No.	**Topics**	**Hours**
I	**Basic concepts** Concepts in TQM- Tools & techniques of TQM – Requirements for implementing TQM – Steps for implementing TQM – Questionnaire, Assessment through questionnaire – Mission statement – Benefits of TQM – Checklist for implementing TQM – Case study.	12
II	**Quality assurance** Introduction and overview – Definition. Designing of microbiology laboratory – Control of quality – Applications. Quality assessment of Equipments, chemicals, glass wares and laboratory environments – Variance – Quality control calculations – Quality management – Maintenance of records and reports. Quality assurance in sterilization and disinfection - Preservation of stock cultures, media and diagnostic kits – Quality control of media and stains	12
III	**Quality standards** General requirements for laboratories- ISO standards applicable to laboratories-competence of testing and calibration-structure and items from ISO 9001- ISO/IEC-17025 –similarities and differences between certification and accreditation-Accreditation bodies- NABL-International Accreditation systems-The American Association for Laboratory Accreditation	12
IV	**Quality assurance in disposal** Quality assessment of disposal – decontaminated matters and other biological effluents – Quality management in transportations of cultures. National control of biologicals – Biological references and standards	12
V	**Quality Control Department and Audits** Good laboratory practices – Management of laboratory hazards and knowledge in First aid procedures- Establishing a QC department - Investigating product quality. Audits-Records -Maintaining accurate, clear, and precise documents - Identifying individuals responsible for maintaining documents. Validation - Qualification, Process validation, Cleaning validation and Computer validation	12

Text Books : *Compendium of Good Practices in Biotechnology, BIOTOL series, Butterworth-Heinemann Ltd, 1994.*

Reference Books

1. Twelve Management skills for success – Ram Narain , Viva books private limited – Chennai 2006.

2. A cross functional perspective Total Quality Management – Rao, Carr, Dambolena and Kopp- John Wiley & Sons, New York .1997Delhi

3. A WHO guide to good manufacturing practice (GMP) requirements: Volume 1,2,3,4,5. Part 2-Validation, by Gillian Chaloner-Larsson, Ph.D, GCL Bioconsult, Ottawa

4. Good Manufacturing Practices for Pharmaceuticals, Sixth Edition by: Graham Bunn Publisher: Informa Healthcare; 6 edition | 424 pages (2007)

5. A Primer – Good Laboratory Prcatices and current manufacturing practice, by Ludwig Huber, Published by Agilent Technologies, Germany (2002)

Course Designed by	Verified by HOD	Checked by	Approved by
DR.LALI GROWTHER	DR.LALI GROWTHER		

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MASTER OF SCIENCE IN MICROBIOLOGY

Program Code:	MBP	Program Title: Master of Science in Microbiology		
Course Code:	19MBP23	Course Title	Batch:	2019-2020 only
		PRACTICAL VII BIOSTATISTICS AND BIOINFORMATICS	Semester:	IV
Hrs/Week:	4		Credits:	2

Course Objective

1. To develop knowledge on statistical tool for Microbiology
2. To explain the various tools and databases of Bioinformatics

Course Outcomes (CO)

K1	CO1	Identify bioinformatics databases and retrieve sequences
K2	CO2	Discuss statistical methods for biological data
K3	CO3	Demonstrate primer design and setup PCR cycles
K4	CO4	Compare prediction results from nucleotide and protein databases

Mapping of Outcomes

CO \ PO	PO1	PO2	PO3	PO4
CO1	S	S	M	M
CO2	S	M	M	S
CO3	S	M	L	M
CO4	M	M	S	M

S - Strong; M-Medium; L-Low.

19MBP23	PRACTICAL VII BIOSTATISTICS AND BIOINFORMATICS	IV

LIST OF EXPERIMENTS

1. Visit NCBI, EMBL, DDBJ, and TIGR.org. Explore them. List out the salient features.
2. Retrieve protein sequence for tyrosinase and find out if this protein is present in *APgaricus bisporus, Colletotrichum lagenarium and Fusarium oxysporum* using BLAST P and 'limit by entrez' query option
3. Retrieve nucleotide sequence for *Streptococcus* M protein, β - lactamase, Trypsin, Cytochrome oxidase
4. Dissect trypsin (code 1TRY) protein and colour residues (Asp102, His 57, Ser195) that constitute the catalytic triad show only helix in the molecule, show only sheets, show only backbone. And catalytic triad in space fill
5. Compare the gene prediction results from Genscan, genmark, framed and glimmer. Interpret the sensitivity and specificity of them.
6. Similarity search- Get any two sequence in FASTA format
7. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN)
8. Use MOTIF search and PROTPARM tools
9. Design a primer for cloning and set the PCR cycles
10. Protein structure prediction: primary structure analysis, secondary structure prediction using psi-pred. Molecular visualization using jmol
11. Graphical representation a. Histogram b. Ogives C. scatter diagram
12. Diagrammatic representation a. line diagram b. bar diagram c. pie diagram
13. Analysis of variance one way and two way.
14. Measures of Location- Mean, Median, Mode
15. Measures of Dispersion- Range, S.D, Variance
16. Correlation- Karl Pearson's coefficient, Spearman's rank correlation

Course Designed by	Verified by HOD	Checked by	Approved by
For MS.K.SUKIRTHA	DR.LALI GROWTHER		Co-ordinator Curriculum Development Cell Hindusthan College of Arts & Science, Coimbatore-641 028.