UNIVERSITY OF MYSORE

(Re-accredited by NAAC with 'A' Grade)
(NIRF-2023: Ranked 44 in University Category & 71 in Overall Category)
DEPARTMENT OF STUDIES IN MICROBIOLOGY

Proceedings of the BOS Meeting of Microbiology (CB)

As per the direction of the Registrar, University of Mysore, Mysuru, Board of Studies Meeting of Microbiology (CB) of University of Mysore was conducted on 10/06/2024 at Department of studies in Microbiology, Manasagangotri, University of Mysore, Mysuru. The information about the discussion carried out in the meeting is enclosed with this letter. The details of the BoS members who participated.

Sl.No	Name of the Bos Member	Designation	Signature
1.	Prof. M.Y. Sreenivasa	Chairman	
2.	Prof. Shubha Gopal	Member	10/6/24
3.	Prof. K. Ramachandrakini	Member	10/6/24
4.	Prof. V. Shyam Kumar	Member	10/6/24
5.	Prof. Virupakshaiah . DBM	Member	10/6/24
6.	Prof. Srinivas C	Member	Attended Online
7.	Dr G. S Siddegowda	Member	10/6/24
8.	Dr. H S. Jayanth	Member	10.6.24
9.	Dr. N.S. Devaki	Member	10/6/2024
10.	Dr. N.Anuroopa	Member	Absent
11.	Dr. P.K. Maheshwar	Member Special Invitee	

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Details of the Discussion & Decisions Taken at BoS Meeting of Microbiology (CB)

1. The Chairman BoS in Microbiology welcomed the BoS members and placed the BoS Meeting Agenda before the members.
2. Discussed and approved the changes in the course of B.Sc., Microbiology syllabi and Scheme of examination 2024-2025
3. Discussed and approved the course of M.Sc., Microbiology syllabi and Scheme of examination 2024-2025
4. Prepared and approved of Question paper pattern & scheme of Practical Examination 2024-2025
5. Prepared and approved the Panel of examiners for UG & PG examinations 2024-2025
6. Any other Matter:
   - Opinion regarding: Guide Recognition to Dr. Ragavendra M P, Professor, Maharani,s Science College, Mysuru (Ref.No.Dor/9.5/Ph.D/ROG-Mic/18/14/2024-25 Dtd:10-6-2024)
   - Decision: The member approved the Guide Recognition to Dr. Ragavendra M P.
7. The BoS meeting is concluded with the vote of thanks by the Chairman.

10/6/24 10/6/24 10/6/24 10/6/24 10/06/24 10/6/24 10/6/24 10/6/24

UNIVERSITY OF MYSORE, MYSURU

CHOICE BASED CREDIT SYSTEM (CBCS)

&

CONTINUOUS ASSESSMENT AND GRADING PATTERN (CGPA)

Based

M. Sc. MICROBIOLOGY SYLLABUS

For

2024-25 onwards

Board of Studies in Microbiology
Department of Studies in Microbiology
University of Mysore
Manasagangotri, Mysuru 570 006
Karnataka, India

Introduction

Microbiology is an important and wide-ranging discipline within the life sciences, covering a range ofsubjects relevant to human health, diseases, environmental studies and industrial and biotechnologicalapplication. Microbiology has vast scope in understanding the life through intervention of microorganism.There is an increase in demand for microbiologist globally. A microbiologist can innovate new diagnostickits, teach, research, discover new drugs etc., it encompasses many disciplines of science like medicine,diaryagriculture pharmacynanotechnologyetc.,

KnowledgeandskillsinMicrobiologythatwillempowerthestudents,throughawarenessofthesignificance of microorganisms in plant, animal and human health, environment, industry and generalhuman welfare by a problem based and skill-oriented curriculum. The syllabus is highly oriented towardsthe complete knowledge of the subject, which includes the basic as well as contemporary applied aspectsofMicrobiology includingmolecularbiologyand geneticengineering.

ProgramPedagogy:

The seminar presentation will improve the oration skills of students and group discussion will kindle theirlogical ability to analyze the problems**.** Assignments improvise students in gathering the information andenhancing their writing ability. In practical laboratory they will be enhancing their skills towards varioustechniques used in the laboratory. As a part of curriculum, students work on project, which will give ahands-on experience on different techniques and will be a platform for the students to work and interactwith different scientists and research institutions. This will pave the way for the students to know aboutrecentresearchworksgoing oninthefieldandhelpthestudent in workingindifferentamenities.

Programoutcome:

- Thestudentsgettoknowaboutdifferentbeneficialandharmfulmicroorganisms,whichmightbeuseful /pathogenictohumans,animalsandplants.
- Microbiologyisconcernedwithdiversifiedformsofmicroorganism,classification,structure,reproduction,physiology,metabolismandmostimportantlytheir economicimportance.
- Industrial productions of organic acids, enzymes and pest control using microbes and improving soilqualityandagriculturaloutputandcleaningthe environment throughsustainablemicrobiologicalapplications.
- Toenablethemtoemploytheacquiredtheoreticalknowledgeinthesectorof Diseasediagnosis,treatment and prevention.
- To enrich the post graduate students with fundamentals of microbiology and advanced technologies,which enables them use this knowledge in industry, hospitals, community and institutes or any otherprofessionthey wouldliketopursue.

Programspecificoutcome:

Understand the basic knowledge and concepts of microbiology and other related areas. Hands on skills inIndustry and/or Institutes, for better placement in drug manufacturing companies, public health entities,bloodservice,industriallaboratories,cancerresearchinstitutes,R&D,educationalinstitutes,environmental pollution control, agriculture and fisheries, food and dairy industry, forensic science,hospitals, public health laboratories, etc. There is requirement for microbiologist in quality control andsafetysections of food, pharmaceuticals, health andbeautycare, etc.

SCHEME OF THE STUDY

For M.Sc. in Microbiology

Credits to be earned	40 credits
Core papers	28 credits
Open elective paper	04 credits
Total credits	**72 credits**

Honors in Microbiology

Credit Based Choice Based Continuous Evaluation Pattern System Proposed Semester-wise distribution of the course structure for the year 2024-2025

Semester-I Credits: 18

No	Paper Code	Title of The Course Paper	Credit Pattern in L:T:P	Credits
1	**MB 1.1 Hard core**	Virology	3:1:0	4
2	**MB 1.2 Hard core**	Bacteriology	3:1:0	4
3	**MB 1.3 Hard core**	Mycology	3:1:0	4
		Select 3 among 4 papers		
4	**MB 1.4 Soft core**	Microbial Genetics	3:0:0	2
5	**MB 1.5 Soft core**	Microbial Ecology & Diversity	3:0:0	2
6	**MB 1.6 Soft core**	Practical I (Virology & Bacteriology)	0:0:2	2
7	**MB 1.7 Soft core**	Practical II (Mycology & Microbial Genetics)	0:0:2	2
		Total credits to be earned		**18**

HC=03; SC=03; O.E=0.

Semester-II Credits: 18

No	Paper Code	Title of The Course Paper	Credit Pattern in L:T:P	Credits
1	**MB 2.1 Hard core**	Microbial Physiology	3:1:0	4
2	**MB 2.2 Hard core**	Immunology	3:1:0	4
		Select 3 among 4 papers		
3	**MB 2.3 Soft core**	Food Microbiology	3:0:0	2
4	**MB 2.4 Soft core**	Soil Microbiology	3:0:0	2
5	**MB 2.5 Soft core**	Practical III (Microbial Physiology & Immunology)	0:0:2	2
6	**MB 2.6 Soft core**	Practical IV (Food Microbiology)	0:0:2	2
7	**MB 2.7 OE**	Techniques in Microbiology	4:0:0	4
		Total credits to be earned		**18**

HC=02; SC=03; O.E=1.

M.Sc. Microbiology

Credit Based Choice Based Continuous Evaluation Pattern System Proposed Semester wise distribution of the course structure

Semester-III Credits: 18

No	Paper Code	Title of The Course Paper	Credit Pattern in L:T:P	Credits
1	**MB 3.1 Hard core**	Molecular Biology	3:1:0	4
2	**MB 3.2 Hard core**	Genetic Engineering	3:1:0	4
3	**MB 3.3 Hard core**	Industrial Microbiology	3:1:0	4
		Select 3 among 6 papers		
4	**MB 3.4 Soft core**	Medical Microbiology	3:0:0	2
5	**MB 3.5 Soft core**	Clinical & Diagnostic	3:0:0	2
6	**MB 3.6 Soft core**	Practical V (Molecular Biology & Genetic Engineering)	0:0:2	2
7	**MB 3.7 Soft core**	Practical VI (Industrial Microbiology & Medical Microbiology)	0:0:2	2
8	**MB 3.8 Soft core**	MOOCS/ SWAYAM	2:0:0	2
9	**MB 3.9 OE**	Microbial Diversity	3:0:0	2
		Total credits to be earned		**18**

HC=03; SC=03; O.E=01.

Semester-IV Credits: 18

No	Paper Code	Title of The Course Paper	Credit Pattern in L:T:P	Credits
1	**MB 4.1 Hard core**	Agricultural Microbiology	3:1:0	4
2	**MB 4.2 Hard core**	Environmental Microbiology	3:1:0	4
		Select 3 among 7 papers		
3	**MB 4.3 Soft core**	Microbial Nanotechnology	4:0:0	4
4	**MB 4.4 Soft core**	Genomics & Proteomics	4:0:0	4
5	**MB 4.5 Soft core**	Practical VII (Agricultural Microbiology)	0:0:2	2
6	**MB 4.6 Soft core**	Practical VIII (Environmental Microbiology)	0:0:2	2
7	**MB 4.7 Soft core**	Practical IX (Microbial Nanotechnology)	0:0:2	2
8	**MB 4.8 Soft core**	Project Work	0:0:6	6
9	**MB 4.9 Soft core**	MOOCS/ SWAYAM	2:0:0	2
		Total credits to be earned		**18**

HC= 02; SC=03

Grand Total Credits: 72

SEMESTERI

MB1.1Hardcore: VIROLOGY

CoursePedagogy:

- Knowledgeonhistory,generalcharactersofvirusesandviralclassification
- Understandingthereplicationstrategiesofviruses;Cultivationanddetectionofviruses.
- Comprehendevolutionaryimportanceofviruses.
- Knowledgeonsomecommonplantandanimaldiseasescausedbydifferentviruses,viraltransmissionandcontrol.

CourseOutcome:

Afterthe completion ofthe coursestudentswould beable

- Tostudy thenatureofviruses.
- Techniquesemployedforculturinganddetectionofplantandanimalviruses
- Togainknowledgeabout neweremergingviral
- Tounravelthemechanismsby whichviruses infectcells andcausedisease.
- Virusesusedas cloningvectorsforgenetransfer,therapeuticagents.

THEORY **48 hours**

UNIT I **12 hours**

Viral Diversity: Classification – LHT, Baltimore & ICTV; and nomenclature of viruses. Replication patterns of the following groups; Group I – T2 Bacteriophage, Group II – Banana bunchy top virus, Group III – Reovirus, Group IV-TMV, Group V – Rhabdovirus, Group VI – HIV and Group VII – Hepatitis B virus. Microbial viruses: General account on algal, fungal, protozoan viruses, Giant viruses and Bacteriophages.

UNIT II **12 hours**

Plant viruses: Propagation, Cultivation, Isolation and purification using centrifugation, chromatography and electrophoresis techniques. Detection and diagnosis of Plant Viruses **Cultivation and detection of animal viruses**: Animal Inoculation, Inoculation into embryonated egg and CellCulture. Direct methods of detection- light microscopy (inclusion bodies), electron microscopy (SEM, TEM, AFM and Cryo EM) and fluorescence microscopy. Immunodiagnosis: hemagglutination and hemagglutination inhibition test, compliment fixation, neutralization, western blot, flow cytometry. Nucleic acid based diagnosis: nucleic acid hybridization, PCR, qRT, Microarray and nucleotide sequencing. **Infectivity assay for animal and bacterial viruses:** Plaque assay, Transformation assay, Fluorescent focus assay, Infectious centre assay, end point dilution methods, LD50, ID50, EID50, TCID50.

UNIT III **12 hours**

Sub-viral particles: Discovery, Structure, Classification, replication and diseases caused by Satellite virus, Virusoids, Viroids and Prions. Anti-viral strategies-prevention and control of viral diseases: Host specific and nonspecific defense mechanisms. Role of interferon in viral infections.

Viral Chemotherapy: Nucleoside analogs, reverse transcriptase inhibitors, protease inhibitors. **Conventional viral vaccines**: killed and attenuated vaccines, Modern vaccines: peptide vaccines, edible vaccines, immune-modulators (cytokines),anti-idiotype, DNA and m-RNAvaccines.

UNIT IV **12 hours**

Viral transformation and oncogenesis: Oncogenic viruses and viral transformation mechanism by EBV, HPV, and HTLV-1. **Viruses and the future**: Promises and problems. Evolutionary importance of viruses: Antigenic shift, antigenic drift. Emerging and life threatening diseases – COVID-19 and variants, KFD virus, and ZIKA. Sources and causes of emerging viral diseases. Viruses as threat of bioterrorism, as therapeutic agents, as gene delivery system, viruses to destroy other viruses.**Virus and nano-technology.**

References:

1. AlanJ.Cann (2011)Principles ofMolecular Virology,5th edition, Elsevier
2. Clokie,MarthaR.J., Kropinski,Andrew(2009)Bacteriophages,Methodsand Protocols,Volume1:Isolation,Characterization, andInteractions, HumanaPress
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4. Hunter-Fujita,FrancesR.,PhilipF.Entwistle,HughF.Evans,and Norman E.Crook.Insectviruses andpestmanagement. JohnWiley & Sons Ltd1998.
5. Jane S. Flint , Lynn W Enquist, Anna Marie Shalka (2004) Principles of Virology: Molecular Biology,Pathogenesis,and Control of AnimalViruses, American SocietyforMicrobiology
6. John Carter, Venetia A. Saunders,(2007),Virology: Principles and Applications, John Wiley & Sons,westSusscex,England.
7. Lobocka,Malgorzata, andWaclawT.Szybalski,eds.(2012)Bacteriophages.Part2,AcademicPress
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9. Matthews,RichardEllisFord,andRogerHull.(2002)Matthews'plantvirology.4thedition,GulfProfessional Publishing.
10. Moulay Mustapha Ennaji (2020), Emerging and Reemerging Viral Pathogens: Volume 1: FundamentalandBasicVirologyAspects ofHuman, Animaland Plant Pathogens1st Edition.AcademicPress.
11. Nigel Dimmock, Andrew Easton, Keith Leppard, (2009), Introduction to Modern Virology, 6thEdition,Wiley-Blackwell.

MB1.2Hardcore: BACTERIOLOGY

CoursePedagogy:

- Tostudythescope,history,economicimportance,cellstructure,growth,cultivationandcontrolofbacteria.
- Workingprinciples ofmicroscopy and staining.

CourseOutcome:

Afterthe completion ofthe coursestudentswould beable:

- Toknowbacterialclassification,nutrition,cultivation,preservationofmicrobialculture.
- Todescribethemorphologicalfeatures,cellarrangementandstructuralcomponentsofbacterialcell.
- To enlist thecharacteristicsof Achaea.
- Tousedifferentmicroscopes forstudying bacterialmorphology.
- Toworkinmedicallaboratories,pharmacological,foodandfermentation industries.

THEORY48hours

UNITI **12 hours**

Introduction: Important events in development of bacteriology, Scope and relevance of bacteriology.Economicimportanceof bacteria.

Cell Structure: An overview of bacterial size, shape and arrangement, structure, chemical compositionof cell wall of Archaebacteria, gram-negative bacteria, gram-positive bacteria and acid fast bacteria, cellwalldeficientorganismsincludingL-formstructure,compositionandfunctionofcellmembrane,capsule, flagella, pili, Inclusion bodies, ribosomes, mesosomes, reserve food materials , magnetosomesand phycobilisomes, endospores, bacterial nucleic acids – chromosome, plasmid, transposons, integronsandantibiotic resistancecassettes.

Microscopy: WorkingPrinciplesofbrightfieldmicroscope,fluorescentmicroscope,darkfieldmicroscope,phasecontrastmicroscope,stereomicroscope,confocalmicroscopyandelectronmicroscope.Preparationof sample forelectronmicroscopicstudies.Applicationandimportance ofabovemicroscopes.Measurement ofmicroscopicobjects.

UNIT II **12 hours**

Bacterialclassificationandtaxonomy: Criteriafortheclassificationofbacteria.Phenetic,Phylogenetic, Genotypic, Numerical taxonomy. Techniques for determining microbial taxonomy andPhylogeny.ICNB rules. Classification systems of major categories and groups of bacteria according toBergey are manual of Systematic Bacteriology and Determinative Bacteriology. Non-culturable methodsforthe identification ofpathogenicmicroorganisms.

UNIT III **12 hours**

Growth, Cultivation and control of Bacteria: Nutrient requirements, nutritional types of bacteria,culture media, classification of media. Growth: Nutritional uptake, Growth kinetics, generation time,growthcurve,factorsaffectinggrowth.Methodsformeasurementofmicrobialgrowth–directmicroscopy, viable countestimates,turbidometry, and biomass.Aerobic, anaerobic, batch, continuousand synchronous cultures.Methods of pure culture isolation, Enrichment culturing techniques, single cellisolation, and pure culture development. Preservation and Maintenance of Microbial cultures: Repeatedsub culturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deepfreezingandliquidnitrogenpreservation,lyophilization.IUBS–InternationalUnionofBiologicalSciences.World federation for culturecollections– guidelines, statuetsand bylaws.

Controlofmicroorganisms: Antimicrobialagents,physicalandchemicalmethods.Principles,functioningand types ofBiosafety cabinets.

UNIT IV **12 hours**

CharacteristicsandSalientfeaturesofmajorgroupsofBacteria:Archaebacteria:generalcharacteristicsandclassification;extremophiles,halophiles,thermophilesandbarophiles;Generalcharacteristics,classification,diversityanddistribution,economicimportanceof**Actinomycetes,Cyanobacteria**.**Bioluminescentbacteria;**characteristicsandexamples,mechanism ofbioluminescence.Generalcharacteristics,lifecycle,growth,multiplicationandsignificanceof**Mycoplasma,Rickettsiae andChlamydia.**

References:

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2. JacquelynG.Black(2012)Microbiology:PrinciplesandExplorations,8th edition,Wiley.
3. JeffreyC.Pommerville(2010)Alcamo's FundamentalsofMicrobiology,9thRevisededition,JonesandBartlettPublishers,Inc.
4. JeffreyC.Pommerville(2010)Alcamo'sLaboratoryFundamentalsofMicrobiology,JonesandBartlettPublishers,In c.
5. JeromeJ.Perry,JamesStaley,StephenLory(2002),MicrobialLife,SinauerAssociates.
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7. MichaelJ.Leboffe,Burton E.Pierce, DavidFerguson(2012)MicrobiologyLaboratoryTheory &Application,Brief, 2ndEdition, Morton Publishing Company
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9. Sherwood, and Woolverton Willey (2007), Prescott, Harley, and Klein's Microbiology (7th InternationalEdition),McGraw-Hill
10. StuartHogg(2013)EssentialMicrobiology,2ndEdition,Wiley-Blackwell

MB1.3Hardcore: MYCOLOGY

CoursePedagogy:

- Itincludes thestudy oftaxonomicclassification,fungi assymbionts.
- Fungiinproductionoffoodsupplementslike SCP,vitamins,enzymes,organicacidsandproduction ofsecondarymetabolites likeantibiotics.
- Inpracticalclassesthey mountthefungi,learnmicroscopicviewsandthe keycharacteristicstoidentifydifferentspecies offungi.

Courseoutcome:

Afterthe completion ofthe coursestudentswould beable

- Tounderstandthegeneralcharacteristicsandreproductioninfungiandlichens.
- Tounderstandthe economicandpathological importanceoffungi.
- Toidentifycommonfungalplantdiseasesanddevicecontrolmeasuresandworkasplantdoctor.

THEORY **48hours**

UNIT I **12 hours**

Introduction: History and Development of Mycology, scope of mycology. Recent developments inMycology.

Fungal taxonomy: Taxonomic problems associated with variation in fungi, Classification of fungi(Alexopoulosand Mims).

UNIT II **12 hours**

General characteristics of fungi and reproduction: Morphology and somatic structures: The thallus,organization, fungal cell, nuclear components, specialized somatic structures; Aggregation of hyphae,tissues, mycangia, General aspects of fungal nutrition and reproduction (Asexual, Sexual reproduction,Heterothalismand Parasexuality)

UNIT III **12 hours**

Salient features of fungal major groups: Chytridiomycota, Zygomycota,Basidiomycota, Ascomycota,Deuteromycota,Oomycota,Hypochytriomycota,Labyrinthulomycota,Plasmodiophoromycotaand Myxomycota.Symbioticfungi-Lichens.

Opportunisticfungalinfections:*Candidaalbicans,Aspergillusfumigatus*andMucormycosis.

UNIT IV **12 hours**

Economicimportanceoffungi: Fungiasbiocontrolagent,EconomicimportanceofFungiinAgriculture, Industry and medicine. Fungi as SCP, Fungi as parasites of human and plants.Role of fungiinbio-deteriorationofwoodandpaper.Mycorrhiza–
ectomycorrhiza,endomycorrhiza,vesiculararbuscularmycorrhiza.Fungi as insectsymbionts.

Important metabolites of Fungi – aflatoxin, Ochratoxin, Ergot alkaloids, T-2 toxin, DON, Fumonisin.Impact of mycotoxins on human health.Importance of secondary metabolites of fungi as nephrotoxins,neurotoxins,hapatotoxins,mutagens/carcinogens.

Reference:

1. AlexopoulasCJandMimsC W,1979IntroductoryMycology3rdedn,WileyEastern.,New Delhi.
2. David Moore, Geoffrey D. Robson, Anthony P. J. Trinci (2011) 21st Century Guidebook to Fungi.CambridgeUniversityPress.
3. Deacon,JW,1997-ModernMycology 3rdEdition,BlackwellSciencepublishers,London.
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7. MichaelJohnCarlile,SarahC.Watkinson,G.W.Gooday(2007)Thefungi.AcademicPress.London,U.K
8. Odum,E.P. 1971.Fundamentals of Ecology;Third Edition.Toppan Co. Ltd.Tokyo,Japan.

MB1.4Soft-core:MICROBIALGENETICS

CoursePedagogy:

- Describethefundamentalmolecularprinciple ofgenetics.
- Understandthe relationshipbetween phenotypeandgenotype.
- Describethebasics ofgeneticmapping.
- Understandhowgeneexpressionisregulated

CourseOutcome:

Afterthe completion ofthe coursestudentswould beable

- ToUnderstandtheGenetic constituentsofbacteriawithspecialemphasisoninheritance.
- Toextend theknowledgeonmolecularbasis ofmutation atmicrobiallevel.
- Tofocus ongeneregulationand expressionmechanisms.
- Tounderstandtheprinciplesroleofplasmidsandgenetransfermethodsandmapping.

THEORY **48hours**

UNITI **12 hours**

ConceptsinMicrobialGenetics: HistoryanddevelopmentsofMicrobialgenetics.Essentialsofmicrobial genetics: Microbes as Genetic Tools for Basic and Applied Genetic studies. Advantages anddisadvantages of Microbes, Generalized reproductive cycles of microbes- *Neurospora*, *Saccharomyces,Chlamydomonas*and*Acetabularia.*

UNIT II **12 hours**

Viral Genetics: Lytic and Lysogenic cycles, Phage Phenotypes, Phenotypic Mixing, Recombination inviruses:Mutations, Recombination and Mapping (rIIloci)

BacterialGenetics: BacterialTransformation:Typesoftransformationmechanismsfoundinprokaryotes, Bacterial Conjugation: properties of the F plasmid, F+ x F - mating, F' x F- conjugation, Hfrconjugation,genemappinginbacteria. Transduction:Generalizedandspecializedtransduction,Transposable elements.Regulation of competence in *Bacillus.*

UNIT III **12 hours**

Fungal Genetics: *Neurospora*- Tetrad analysis and linkage detection - 2 point and 3 point crosses,chromatidand chiasmainterference, Mitoticrecombinationin*Neurospora*and*Aspergillus*.

AlgalGenetics:*Chlamydomonas*– unorderedtetradanalysis-RecombinationandMapping,Nucleocytoplasmicinteractionsandgeneexpressionin*Acetabularia*.Extranuclear(Cytoplasmic)inheritance.

UNIT IV **12 hours**

Mutation and mutagenesis: Nature, type and effects of mutations. Concept of gene: muton, recon and cistron. Mutagenesis – physical and chemicalmutagens,baseandnucleosideanalog,alkylatingagents,interrelatingagents,ionizingradiation.Induction anddetectionofmutationinmicroorganisms.Sitedirectedmutagenesisand itsapplications.

References:

1. D.PeterSnustad,MichaelJ. Simmons(2011)PrinciplesofGenetics, 6thEdition;Wiley
2. Dr.EvelynJ.Biluk(2012)MicrobiologyStudyGuide:MicrobialGenetics, ControllingMicrobialGrowth,and AntimicrobialAgents; CreateSpaceIndependentPublishingPlatform
3. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick(2013)Molecular Biology ofthe Gene,7thedition; BenjaminCummings
4. JocelynE.Krebs,ElliottS.Goldstein, StephenT.Kilpatrick(2012)Lewin'sGENES XI,11thedition;Jones& BartlettLearning
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11. UldisN.Streips,Ronald E.Yasbin(2002)ModernMicrobialGenetics,2nd edition;Wiley-Liss
12. VenetiaA.Saunders(1987)Microbialgenetics appliedtobiotechnology:principlesandtechniquesofgenetransferand manipulation;Springer

MB1.5Soft-core:MICROBIALECOLOGYANDDIVERSITY

CoursePedagogy:

- Tounderstandtheubiquitous natureofmicrobes.
- Togivebasicknowledge onextremophiles.
- Toprovideknowledgeoncharacteristics ofMicrobes.

CourseOutcome:

Afterthe completion ofthe coursestudentswould beable

- Studentsabletodifferentiatevarious groupsofMicrobes.
- Getknowledgeonadaptabilityofextremophiles.
- Knowledgeabout microbialtaxonomy.

THEORY **48hours**

UNITI **12 hours**

Introduction to microbial ecology: Structure of microbial communities. Interaction among microbialpopulations.Interactionbetweenmicroorganismsandplants.Biotransformation,biodegradation,bioremediationandphytoremediation.EcologicalandEvolutionarydiversity(Geneticdiversity)ofmicrobialworld

Development of Microbial communities: Dynamics of community, ecological succession, structure,dispersion,microbial communities in natureand ecosystem models

UNIT II **12 hours**

Physiological Ecology of microorganisms: Adaptation to environmental conditions **-** abiotic limitationstomicrobial growth.

Viral Diversity: Group I – T2 Bacteriophage, Group II – Banana bunchy top virus, Group III – Reovirus,GroupIV-TMV,GroupV –Rhabdovirus, GroupVI– HIV,GroupVII–Hepatitisvirus.

Sub-viralparticles:Discovery,Structure,Classification,replicationanddiseasescausedbySatellite,Satellitesvirus, Virusoids, Viroids and Prions.

UNIT III **12 hours**

BacterialDiversity: Archaebacteria,PhotosyntheticEubacteria,ChemoautotrophicandMethophilicEubacteria, Gliding Eubacteria, Spirochetes, Rickettsiae and Chlamydiae, Actinomycetes, Mollicutes,Protists

FungalDiversity:salientfeaturesofthefollowinggroup:Zygomycota(*Rhizopus*),Ascomycota*Neurospora*),Basidiomycota(*Agaricus*),Deuteromycota(*Penicillium*),Chytridiomycota(*Allomyces*)Myxomycotaand Yeast.

UNIT IV **12 hours**

ImportanceandConservationofMicrobialDiversity:Importanceofmicrobialdiversityinenvironment,pharmaceuticals&humanhealth.Metagenomics.Importanceofconservation.*Insitu*conservationand *Exsitu*conservation.Role ofculturecollectioncenters inconservation.

References

1. Atlas, Ronald M., Bartha, Richard (1997) Microbial Ecology Fundamentals and Applications; Addison-Wesley
2. Colwell,R.R., Simidu,Usio, Ohwada,Kouicki (1996)Microbial Diversityin TimeandSpace;Springer
3. DavidL.Kirchman (2008)MicrobialEcologyoftheOceans;Wiley-Liss
4. DavidL.Kirchman (2012)ProcessesinMicrobial Ecology;OxfordUniversityPress
5. JamesW.Brown(2014)PrinciplesofMicrobial Diversity;ASMPress
6. McArthur,J.Vaun(2006)MicrobialEcologyAn EvolutionaryApproach; AcademicPress
7. Nelson,KarenE.(1997) AdvancesinMicrobialEcology;Springer
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9. OladeleOgunseitan(2008)MicrobialDiversity:FormandFunctioninProkaryotes;Wiley-Blackwell
10. Osborn,A.M.,Smith,Cindy(2005)MolecularMicrobialEcology;Taylor &FrancisGroup
11. PierreDavet(2004)MicrobialEcology oftheSoilandPlant Growth;SciencePubInc
12. RonaldM.Atlas,RichardBartha(1997)MicrobialEcology:FundamentalsandApplications(4thEdition);Benjamin Cummings
13. Satyanarayana,T.,Johri,B.N.(2005)MicrobialDiversity:CurrentPerspectivesandPotentialApplications;I.K.International Publishing HousePvt.,Limited

MB1.6Softcore:PracticalI(VirologyandBacteriology)

1. Laboratorysafetyrules
2. Microscopicmeasurementofmicroorganismsbymicrometry
3. Culturingandmaintenanceofbacterialcultures
4. Isolationand enumerationofbacteriafromsoil
5. Isolationand enumerationofbacteriafromwater
6. Culturalcharacteristicsofbacteria
7. Stainingtechniques–simple(positiveandnegative),differential(Gramsandacidfast),structural(endosporeand capsule)
8. Motilitytest(hanging dropmethodand softagarmethod)
9. Biochemicaltestsforthe identification ofbacteria–catalase,oxidase, IMViC,Urease,TSIA, Nitrate reduction, gelatin, starch, casein,esculinhydrolysis and Litmus Milk test.
10. Determinationofgrowth curvein *E.coli*.
11. DiauxicgrowthcurveinE.coli
12. Isolationofcoliphagesfromsewage
13. Studyofmorphological changesduetoviralinfection inplants

MB1.7Softcore:PracticalII(MycologyandMicrobialGenetics)

1. Isolationofslimemolds.
2. Isolationofaquaticfungi.
3. Isolationofsoilfungi.
4. Isolationoffungifromair.
5. Isolationoffungifromcerealsandcerealbasedproducts.
6. Studyofthefollowingrepresentativegenera:*Aspergillus,Penicillium,Fusarium,Neurospora,Saccharomyces, Erysiphae,Polyporus,Agaricus,Puccinia,Ustilago,Alternaria,Drechslera,Saprolegnia,Rhizopus, Trichoderma*and symbiotic fungi-Lichens.
7. MeasurementofconcentrationoffungalconidiabyHaemocytometer.
8. Measurementoffungalcellsby Micrometer.
9. Replicaplatingtechnique fortransferofbacterialcolonies.
10. Ultra-violetkillingcurveanddeterminationofmutanttypesin *Saccharomycescerevisiae.*
11. Inductionofmutation
12. Isolationofstreptomycin resistantstrainof*E.coli*by gradientplatemethod.
13. Study of Conjugation in *E.coli*
14. IsolationofgenomicDNAfrom bacteriabyheat lysismethod.
15. Isolationof genomicDNA fromyeast by DNAspooningmethod.
16. ExtractionofmycotoxinsanddetectionbyTLC.

SEMESTERII

MB2.1Hardcore: MICROBIALPHYSIOLOGY

CoursePedagogy:

- Todevelopunderstandingaboutmicrobialmetabolism,growthandenergygeneration.
- Gainknowledgeofvariousfermentationpathways,microbialcommunicationandenergetics.
- Toacquireknowledgeonmicrobialstressresponse.

CourseOutcomes:

Afterthe completion ofthe coursestudentswould beable.

- Toacquaintwithbasicsofmetabolism andgrowthundernormalandstressedconditions.
- To understand major fermentation, aerobic and anaerobic pathways for energy generation in microbialcells.
- Toknowtheconceptsofmicrobialcross-talk.

THEORY **48hours**

UNITI **12hours**

Microbialbioenergetics:TheroleofATPinmetabolism.Microbialenzymesandmechanismof Enzymeaction and kinetics.Inhibition andregulation– allosteric,feedback,competitive,non-competitive.

Metabolism of Carbohydrate: Glycolysis, Citric acid Cycle and different types of Phosphorylation,Fates of pyruvate, Fermentation. Utilization of sugars other than glucose: Lactose, Galactose, Maltose,Mannitol.Degradation ofcellulose, Starch andGlycogen.

UNITII **12 hours**

Lipidmetabolism:β-oxidation,Biosynthesisoffattyacids,degradationoffattyacids.

Nitrogen metabolism: Nitrogen metabolism, Biological nitrogen fixation process, symbiotic and non-symbiotic nitrogen fixation. Degradation and biosynthesis of essential and non-essential amino acids.**Nucleicacidmetabolism**: Biosynthesis anddegradation ofpurines andpyrimidines.

UNIT III **12 hours**

MicrobialPhotosynthesis: PhotosyntheticPigmentsandapparatusinbacteria.OxygenicandAnoxygenic.Photosynthesis.Autotropic CO_2 fixation and mechanism of Photosythesis.Utilization oflightenergy by Halobacteria.

Autotrophic Mechanisms in bacteria: Hydrogen bacteria, Nitrifying bacteria, Purple sulphur bacteria,Non-sulfurbacteria,Green sulfurbacteria,Ironbacteria, Methylotrophs.

UNIT IV **12 hours**

MicrobialSignalingandStressresponse:TwoComponentsignaltransductioninprokaryotes:Chemotaxis, Quorum sensing, biofilms, response to anti microbials, sporulation inducing signals andeventsinsporulation;Dormancy,osmolarityporinregulationin*E.coli*(*Omp*system),phosphateassimilationin*E. coli*(Phosystems),Nitrogenfixationin*Klebsiella*and*Rhizobium*(Ntrsystem).Oxidativestress, Thermal stress, Starvation stress,Aerobicto anaerobictransitions.

References:

1. AlbertG.Moat,MichaelP.Spector JohnW.Foster(2009)Microbial Physiology;BWSTM
2. ByungHongKim,GeoffreyMichaelGadd(2008) BacterialPhysiologyandMetabolism;CambridgeUniversityPress
3. DanielR.Caldwell(1999) MicrobialPhysiology andmetabolism; StarPubCo
4. DavidWhite,James Drummond,Clay Fuqua(2011)ThePhysiologyandBiochemistry ofProkaryotes,OxfordUniversityPress
5. Frederick C. Neidhardt, John L. Ingraham , MoselioSchaechter (1990)Physiology of the Bacterial Cell:AMolecularApproach; Sinauer AssociatesInc
6. RobertK. Poole (2014)Advances in Microbial Systems Biology, Volume64 (Advances inMicrobialPhysiology);AcademicPress
7. Rose,AnthonyH.()Advances inMicrobialPhysiology,Vol. 9;ElsevierScience&TechnologyBook
8. Rose,AnthonyH.(1976) ChemicalMicrobiologyAn IntroductiontoMicrobialPhysiology;BasicBooks

MB 2.2 HARDCORE: IMMUNOLOGY

CoursePedagogy:

- Toprovideoverviewofimmunesystem,antigen,antibody structureandinteractions.
- Understandingofinnate andadaptiveimmunityalongwithmajorcellsandmoleculesinvolved.
- To integrate immunology with health and enrich the knowledge for autoimmune disorders,hypersensitivity reaction.

CourseOutcomes:

Afterthe completion ofthe coursestudentswould beable

- Togainknowledgeofimmune system,cells involvedalong withcomplement systemandautoimmunity.
- Toevaluatetheusefulnessofimmunologyindifferentpharmaceuticalcompanies
- Tounderstandimmunesystem,antigenantibodyinteractions.
- Togaintheoreticalknowledgeofvariousdiseasedconditionsgeneratedduetointerplayofimmunesystem components

THEORY 48hours

UNIT I **12 hours**

Introduction to Immunology: An overview of immune system, Phagocytes, Natural killer cells, mastcells, basophils, Dendritic cells and other cells of the inmate immune system. Immunity: Types- Innateimmunity: (nonspecific) physical, biochemical and genetic factors involved in governing innateimmunity, molecules of inmate immunity – complement, acute phase proteins and interferons;Chemokines and Cytokines . Acquired immunity: (specific) natural, artificial, passive immunity, humoral or antibody mediated immunity, cell mediated immunity.

UNIT II **12 hours**

Antigens and Antibodies:

Antigens: Properties of antigen, Super antigen, Hapten. `**Major Histo-compatibility Complex (MHC) and Antigen presentation:** Types, Structure and functions of MHC molecules, Presentation of Bacterial and Viral Antigens: Phagocytosis, Processing and presentation of antigens by Class I and class II MHC molecules.

Antibodies (Immunoglobulins) – Structure and function.Ig gene organization and generation of Ab diversity.Monoclonal antibodies production and its clinical applications; Antibody engineering. **Hypersensititivity**: Hypersensitivity reactions, Types and their roles in Immunopathological processes. Autoimmune processes: Immunologic tolerance, genetic predisposition to the development of autoimmune processes. Autoimmune disorders- Immunopathogenesis of sclerosis multiplex, psoriasis vulgaris, Rheumatoid arthritis), Immunodeficiency diseases

UNIT III **12 hours**

Transplantation of tissues and organs: Nomenclature of transplantations. Recognition of self and non-self-Transplantation reactions, HvG and GvH. Exception from rejections. HLA Typing: Antibody dependent cell mediated cytotoxicity, mixed lymphocyte reactions. Kidney and bone marrow transplantations.

Immuno stimulatory and immune suppressive drugs and their mechanism.

Antigens and Antibody reactions: Agglutination, complement fixation test, ELISA, immunodiffusion, immunoelectrophoresis, immunoflourescence,immunoprecipitation, radioimmunoassay, Western blotting, flow-cytometry and immunohistochemistry.

UNIT IV **12 hours**

Immune response to infectious diseases and Vaccines:

Viral Diseases: Neutralization of Viruses, Cell mediated immunity to control viral pathogens, Viruses can evade defense mechanisms. **Bacterial Diseases:** Immune response to extracellular and intracellular bacteria, bacteria can evade defense mechanisms, Immune response to Bacterial pathogenesis. **Parasitic Diseases:** Immune response to Malaria, Trypanosoma, Leishmaniasis. **Fungal Diseases:** Innate and Acquired Immunity to control fungal infections.

Vaccines – Definition,active and passive immunization, designing vaccines for active immunization. Live attenuated vaccines, Inactivated or killed vaccines, Subunit vaccines (Toxoids, Bacterial polysaccharide capsules, viral glycoproteins, Recombinant vaccines, multivalent subunit vaccines), DNA vaccines. Effectiveness ofvaccines, Vaccine safety, current vaccines andNational vaccination schedule**.**

References:b

1. AbulK.Abbas(2014)CellularandMolecular Immunology ;Saunders
2. AbulK.Abbas,Andrew H.H.Lichtman,ShivPillai(2011)CellularandMolecularImmunology;Saunders
3. AbulK.Abbas,Andrew H.H.Lichtman,ShivPillai(2012)Basic Immunology:FunctionsandDisordersofthe ImmuneSystem,;Saunders
4. Delves,PeterJ.,Martin,SeamusJ.,Burton,DennisR.(2011)Roitt'sEssentialImmunology;Wiley&Sons,Incorporated, John.
5. GeorgePinchuk(2001)Schaum'sOutlineof Immunology;McGraw-Hill
6. HelenChapel,ManselHaeney,SirajMisbah,NeilSnowden(2014)EssentialofClinicalImmunology;Wiley-Blackwell
7. JudyOwen,JenniPunt,SharonStranford(2013) KubyImmunology;W.H.Freeman
8. LouiseHawley,Benjamin Clarke,RichardJ.Ziegler(2013)Microbiologyand Immunology;LWW
9. PeterParham(2009)The ImmuneSystem,3rdEdition;GarlandScience
10. WilliamE.Paul(2012)Fundamental Immunology;LWW

MB2.3:Soft-core:FOODMICROBIOLOGY

CoursePedagogy:

- Thecourseaimsto provideinstructionin thegeneralprinciples offoodmicrobiology.
- Thecoursecoversthebiologyandepidemiologyoffoodbornemicroorganismsofpublichealthsignificance,including bacteria, yeasts, fungi, protozoaandviruses.
- Understand food spoilage microorganisms; the microbiology of food preservation and food commodities;fermented and microbial foods; principles and methods for the microbiological examination of foods;microbiological quality control, andquality schemes.
- To supplement the academic input of students by way of seminars, conferences, guest lectures and industry oriented projects/visits.

CourseOutcome:

Afterthe completion ofthe coursestudentswould beable

- Tounderstandtheprinciplesofmicroorganismsduringvariousfood-processingandpreservationsteps.
- Tocomprehendtheinteractionsbetweenmicroorganismsandthefoodenvironment,andfactorsinfluencingtheir growthand survival.
- Tounderstandthesignificanceand activitiesofmicroorganismsinfood.
- To recognize the characteristics of food-borne and spoilage microorganisms, and methods for theirisolation,detection andidentification.
- Toanalyzetheimportanceofmicrobiologicalqualitycontrolprogramme's in foodproduction.
- To describe the rationale for the use of standard methods and procedures for the microbiological analysisoffood.

THEORY **48hours**

UNITI **12hours**

Introduction to food microbiology: Definition, concepts and scope. Food as substrate for microbes.Factorsinfluencingmicrobialgrowthinfood – Extrinsicandintrinsicfactors.Principlesoffoodpreservation-ChemicalpreservativesandFoodadditives.Asepsis-Removalofmicroorganisms,(anaerobicconditions,hightemperatures,lowtemperatures,drying).Canning,processingforHeattreatment.

UNIT II **12 hours**

Contamination and food spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products,Fishand seafoods-poultry-spoilageofcannedfoods.

DairyMicrobiology: Microbiologyofrawmilk,Milkasavehicleofpathogens,Preventionofcontamination of raw milk, Microbiology of processed milk, Spoilage and defects fermented milk andmilk products, Microbiological standards for milk and milk products. Cream and butter bacteriology.Prebioticsand Probiotics.

UNIT III **12 hours**

Food poisoning and intoxication: Significance of food borne diseases, Food poisoning and intoxication:Botulism,Listeriosis,*Bacilluscereus*foodpoisoning,FoodborneGastroenteritisby*Salmonella,Shigella, Vibrio, Campylobacter* and *Yersinia*, Staphylococcus and Staphylococcal enterotoxins, fungalspoilage and Mycotoxins. **Introduction to biowarfare**: Food and water as media to transmit food bornethreatto health; policiesandpractices.

Microbes as alternate food – single cell proteins, sea weed (algae), mushroom cultivation.Bioconversions-productionofalcohol-fermentedbeverages – beerandwine.Geneticallymodifiedfoods.

UNITIV **12 hours**

Detection of food-borne microorganisms: Culture, Microscopic and Sampling methods. Chemical:Thermostable nuclease *Limulus* Lysate for Endotoxins, Nucleic Acid (DNA) probes, DNA Amplification(PCR),Adenosine-TriphosphateMeasurement,Radiometry,Fluoro-andChromogenicsubstrates.ImmunologicMethods:FluorescentAntibody,EnrichmentSerology,Salmonella1-2.Test,Radioimmunoassay,ELISA.

Microbialindicatorsoffoodsafetyandqualitycontrol: Principlesofqualitycontrolandmicrobiologicalcriteria,Indicatorsofproductqualityandmicrobiologicalsafetyoffoods,Hazardanalysis,criticalcontrolpoints(HACCP),Goodmanufacturingprocess(GMP)MicrobiologicalstandardsCodexAlimentarius andFood legislationwithrespect toFSSAI,NABLandISO

References:

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2. AhmedE.Y.andCarlstromC.2003FoodMicrobiology: ALaboratoryManual,JohnWileyandSons,Inc.New Jeresy.
3. BibekRay,ArunBhunia.2013.FundamentalFoodMicrobiology,FifthEdition.CRCPress
4. CBlackburn.2006.FoodSpoilageMicroorganisms.WoodheadPublishing.
5. DongyouLiu.2009.MolecularDetection of FoodbornePathogens.CRC Press.
6. ElmerH.Marth,James Steele.2001.Applied DairyMicrobiology,SecondEdition. CRCPress.
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8. Jay,JamesM., Loessner, MartinJ., Golden,David A.2004.ModernFoodMicrobiology.7thed. Springer
9. Marshall,RichardJ.(Ed.).2007.FoodSafety. Springer.
10. Pina M. Fratamico, Arun K. Bhunia, and James L. Smith. 2008. Foodborne Pathogens: Microbiology andMolecularBiology. CaisterAcademicPress.
11. Pitt,JohnI.,Hocking,Ailsa D.2009.Fungiand Food Spoilage3rdEdition.Springer.
12. Sperber, William H., Doyle, Michael P. (Eds.). 2010. Compendium of the Microbiological Spoilage ofFoodsand Beverages. Springer.
13. StephenJ.Forsythe.2010.TheMicrobiologyofSafeFood,2ndEdition.Wiley-Blackwell.

MB2.4:Softcore:SOILMICROBIOLOGY

CoursePedagogy:

- Lecturesareheldwith thehelpof slides,thelaboratory lessonswillbeperformed inalaboratorydesignedand equippedfor microbiological practices.
- The laboratory practices will be performed in groups of students. The e-learning site will be used toprovideteaching materialand to communicate with thestudents.
- Theinteractionbetweenteacherandstudentstake placethroughtutorials,seminarsandIntermediatewrittentests.

CourseOutcome:

Afterthe completion ofthe coursestudentswould beable

- Tohaveknowledgeaboutsoilas anexcellenthabitat formultitudeof microorganismsbalancingthesoilecosystem.
- Tobeemployableinthe fieldofAgronomy/SoilScience
- Toacquireskillsand knowledge on theimportanceofmicroorganismsinbiogeochemicalcyclesbiologicalfertility ofsoil.

THEORY **48hours**

UNIT I **12hours**

Soil Microbiology: Historical accounts and the "Golden Age" of soilmicrobiology and significantcontributionsof pioneersoil microbiologists.

SoilMicrobialdiversity:Soilashabitatformicrobes;soilpH,temperatureandsoilatmosphere.Diversity and abundance of dominant soil microorganisms, Methods of isolation of soil microflora, soilorganicmatter decomposition,

UNIT II **12 hours**

Biogeochemical cycles: Organic matter decomposition, humification. Carbon, sulphur, nitrogen and ironcyclesin soil.

Soil microbe interaction - Antagonism, commensalism, mutualism, symbiosis, predators and parasiterelationship and competition.Interaction of soil microflora with vascular plants - Rhizosphere, rhizoplanemicroorganisms, *Rhizobium*, *Azatobacter*, *Azospirillum*, *Cyanobacteria*and*Azolla*.

UNIT III **12 hours**

Techniques to study soil organisms: Microbial biomass estimation**;** fumigation-incubation technique,fumigation-extraction method, substrate-induced respiration method and Using ATP or enzyme activity.

Applied soil microbiology: soil microbial inoculants, Manipulations of soil microorganisms foragriculture, Soil environmental contaminants and Bioremediation, Microbial products- Plant growthpromotingHormones, Antibiotics, Toxins and Enzymes

UNITIV **12 hours**

Soil-Borne Diseases and Human Health: *Clostridium tetani*(tetanus), Toxoplasmosis, Aspergillosis,Actinomycosis.

Soil microorganisms in agro ecosystems: Types of microbial communities; soil microbial diversity:significance and conservation; effect of agricultural practices on soil organisms. Biological nitrogen-

fixation:Therangeofnitrogenfixingorganisms;mechanismofnitrogenfixation(biochemistryofnitrogenase);

genetics of nitrogen-fixation; *Rhizobium*-Legume Association; Sym plasmids, N2 fixationbynon-leguminous plants.

References:

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2. Bergersen, F.J.andPostgate,J.R.1987.ACentury ofNitrogenFixationResearchPresentStatusandFutureProspects. The RoyalSoc.,London.
3. Buchanan,B.B.,Gruissem,W.andJones,R.L.2000.BiochemistryandMolecularBiologyofPlants.
4. Burges,H.D.1981.Microbialcontrolofinsectpests,Mitesandplantdiseases.Academic,London.
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6. Kannaiyan,S.1999.BioresourcesTechnologyfor sustainableagriculture.Assoc.Pub.Co.NewDelhi.
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9. Metcalf,R.L.andLuckmann,W.H.1994. Introductiontoinsectpestmanagement 3 edn.JohnWilleyandSons,Inc.
10. Motsara, I.M.R.,Bhattacharyya,P.andSrivastava,B.1995.BiofertilizerTechnology,Marketingandusage-AsourceBook-cum-glossary-FDCO, NewDelhi.
11. Somasegaran,PandH.J.Hoben,1994.HandbookforRhizobia;methodsinlegume*Rhizobium* Technology.Springer-Verlan,NewYork.

MB2.5Softcore:PRACTICALIII(MicrobialPhysiologyandImmunology)

1. Populationgrowthofyeast –*S.cerevisiae*.
2. Populationgrowthofbacteria –*E.coli*.
3. Sugarfermentationtests.
4. Catalaseactivity.
5. Hydrolyticrancidity.
6. Caseinhydrolysis.
7. Carbohydratecatabolism bymicrobes
8. StudyofacidandpHstresstolerancebymicrobes.
9. Effect of temperature on microbial growth
10. Effectofmolecularoxygenonmicrobialgrowth.
11. Effectof osmotic pressureonmicrobialgrowth.
12. Effectofrelativehumidityonmicrobialgrowth.
13. Effectofdifferentwavelengthsoflightonmicrobialgrowth.
14. Precipitintest,ELISA,OuchterlonyImmunodifusiontest,and Radial Immunodiffusion
15. Determination of Blood grouping and rh factor
16. WIDALTest.
17. VDRLTest (RPR).
18. HBsAgTest.
19. HCGtest (Agglutinationinhibition test).
20. DetectionofRAfactor.
21. CRPtest.
22. ASOTest(Antistreptolysin‘O’Test).

MB2.6Softcore: PRACTICALIV(FOOD MICROBIOLOGY)

1. Detection and enumeration of Microorganisms present in Utensils.
2. Isolation and identification of pathogenic microorganisms from canned food.
3. Enumeration of bacteria in raw and pasteurized milk by SPC method.
4. Determination of quality of a milk sample by Dye reduction test (MBRT, Rezasurin).
5. Detection of number of bacteria in milk by breed-count method
6. Microbial quality of milk and milk products.
7. Microbiological examination of Fermented products
8. Evaluation of antimicrobial activity of food preservatives
9. Isolation and identification of common food borne pathogens (Enterobacteriaceae – *E.coli*, *Enterobacteraerogenes*, *Salmonella*, *Shigella*, *Staphylococcus*, *Listeria*, *Vibrio*, *Aspergillus*, *Penicillium*, and *Fusarium*)
10. Bacterialexaminationof drinkingwaterbymembranefilterstechnique.
11. DeterminationofTDT.
12. DeterminationofTDP.
13. Detectionandquantificationof AflatoxinB1.

MB2.7:OPEN ELECTIVE: MICROBIAL TECHNOLOGY

Course Pedagogy:

- The course will impart a comprehensive knowledge and understanding of techniques used in Microbiology, like microscopy, staining technique, culture media, sterilization methods and control of microorganisms.

Course Outcome:

After the completion of the course students would be able

- To acquire knowledge of culturing methods and identification of microorganisms.
- To enable them to isolate pure culture and preserve them and control measures.

THEORY **48 hours**

UNIT I **12 hours**

Microscopy: Light microscopy- Simple microscopy (dissection microscope), Compound microscopy (Bright field, Dark field, phase contrast, and Fluorescence microscopy) and stereomicroscopy. Electron-microscopy: Principles, construction and mode of operation of scanning and Transmission electron microscopy and limitations. Preparation of specimens for electron microscopic studies (Ultra-thin sectioning, negative staining, shadow casting and freeze etching). Confocal/ Laser scanning, programmable array microscopes

UNIT II **12 hours**

Microbiological stains and staining techniques: Types of stains and principles of staining. Stains for bacteria, fungi, algae, protozoa and spirochetes.Stains for Azotobacter cysts, stains for mycoplasma. Preparation of bacterial smears for light microscopy: Fixation, simple staining, Differential staining, Structural staining (Capsule, Flagella, Cellwall and Endospore of bacteria), and nuclear staining.

UNIT III **12 hours**

Culture media for Microbes Types of media- general purpose media, special purpose media, selective, elective, diagnostic, resustication media, Media for fungi, algae, bacteria, mycoplasma and viruses.

Sterilization techniques: Principles, types of Sterilization, and their mode of action. Physical methods: Heat-dry heat (Hot-Air oven), Incineration, Moist heat (Autoclave and Pressure cooker), Tyndalization (Fractional Sterilization), Filtration-Types of filters, Laminar airflow. Radiation methods (UV radiation, x-rays and cathoderays). Biosafety cabinets – Level I – IV, Containment labs – containment, high containment and maximum containment labs

UNIT IV **12 hours**

Control of Microorganisms: Chemical methods: Definition of terms- Disinfectants, Antiseptics, Sanitizers, Microbicides (bactericide, fungicide and Sporicide), Microbistatic (bacteristatic and fungistatic agents). Use and mode of action of Alcohols, Aldehydes, Halogens, Phenols, Heavy metals, and Detergents.

Pure culture techniques: Different types of inoculation techniques - Spread plate, Pour plate and Streak plate method

References:

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SEMESTER III
MB 3.1Hard-core: MOLECULAR BIOLOGY

Course Pedagogy:

- To extend the knowledge on structure and functions of genetic material
- To focus on genome organization, transcription and translation process in Prokaryotes.
- To understand the principles of oncogenes

Course Outcome:

After the completion of the course students would be able

- To have elaborate knowledge on nucleic acids
- To have better understanding of gene expressions
- To get thorough knowledge on Tumor viruses and oncogenes

THEORY **48hours**

UNITI **12 hours**

Concepts in Molecular Biology: Microbes in molecular-biology.

Organization of Genomes: Prokaryotic genome- Genetic and Physical organization of bacterial genome, Eukaryotic genome–Genetic and Physical organization of nuclear genome

DNA structure and Replication: DNA as Genetic material, Chemistry of DNA, Modes of DNA Replication, Meselson and Stahl's Experiment, θ model, replication fork. Enzymes of DNA replication, preprimosome, primosome and replisome complex. Molecular mechanism of DNA replication, Differences in prokaryotic and eukaryotic DNA replication.

UNIT II **12 hours**

DNA damage and recombination: Types of DNA damage - deamination, oxidative damage, alkylation and pyrimidine dimers; DNA repair – mismatch, short patch repair, nucleotide/base, excision repair, recombination repair and SOS repair. Recombination; Site specific recombination, Homologous recombination, transposition.

UNIT III **12 hours**

Gene Expression: Structure of RNA- Classes of RNA, Chemistry of RNA.

Transcription: Transcription in prokaryotes and eukaryotes, Eukaryotic transcription factors. RNA processing, Ribozymes, Antisense RNA, mi RNA, Si RNA, RNAi and other small RNAs. Inhibitors of transcription and their mechanism of action.

Translation: Role of ribosome and different types of RNA in protein synthesis, deciphering the genetic code, basic feature of genetic code, mechanism of initiation, elongation and termination, Non ribosomalproteinsynthesis.Translationalcontrolandposttranslationalevents.Proteintargeting,proteindegradation,protein folding. Small peptides and therapeutic peptides.

UNIT IV **12 hours**

Regulation of Gene expression: Regulation of gene expression in prokaryotes. Operon concept: lac, trp and arabinose. Regulation of gene expression in Eukaryotes. 2 component regulatory system (Sensor Kinases, response regulators, enhances and silencers): constitutive, regulatory genes. Regulation of gene expression in bacteriophage. Gene silencing – gene regulation after transcription.

Recent trends in molecular biology research: Targeted genome editing: ZFNs, TALENs, CRISPRs gene editing, Knock-ins and Knock–outs. **Oncogenes**, proto-oncogenes, activation of proto-oncogenes

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3. Flint, S.J., Enquist, L.W., Drug, R.M., Racaniello, V.R. and Skalka, A.M. 2000. Principles of Virology-Molecular Biology, Pathogenesis and Control. ASM Press, Washington,D.C.
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7. Lodish,H.,Berk,A.,Zipursky, S.A.,Matsudaira,P.,Baltimore, D.andDarnell,J.1999.
8. Molecular Cell Biology,W.H. Freeman and Company, NewYork.

MB 3.2 Hardcore: GENETIC ENGINEERING

Course Pedagogy:

- To learn about genetic engineering, principals involved in manipulating genes and DNA.
- To know about cloning strategies and expression systems.
- To acquire basic understanding of techniques in genetic engineering.
- To provide basic knowledge on intellectual property rights and their implications in biological research and product development

Course Outcome:

After the completion of the course students would be able

- To acquire knowledge on the concepts and terminology in genetic engineering.
- Familiar with various cloning strategies in prokaryotes.
- To have awareness of IPR ,the social and ethical issues concerning cloning by genetic engineering

THEORY **48hours**

UNIT I **12 hours**

Introduction to Genetic Engineering: Milestones in the development of genetic engineering. Genetic engineering as tool in biotechnology.Importance of gene cloning and future perspectives.

Tools in Genetic Engineering: Enzymes in genetic engineering. Cloning vectors; Plasmids (pUCseries,pBR 322), Phage vectors (M13, λgt 10 and λZAP series), Ti vector. YAC, BAC vectors and specialist –purpose vectors; Expression vectors (pET vectors, pLITMUS). Synthetic construction of vectors.

UNITII **12 hours**

rDNA Technology: The basic principles of gene cloning strategies: Preparation, Manipulation and Insertion of desired DNA in to vector. Introduction of DNA in to host cells– Transformation, Transduction, Transfection, Microinjection, Biolistics, Electroporation, Liposome fusion.Preparation andapplications of DNA libraries and cDNA libraries.Identification and Selection of recombinants.Applications of gene cloning in Biotechnology, Medicine, Agriculture, Forensic Science, Genetherapy.

UNIT III **12 hours**

Analysis of gene and gene products: Molecular markers. DNA based and PCR - based markers, RFLP,RAPD, AFLP STS, EST, SSCP, VNTR, Microsatellites and mini-satellites. **DNA analysis:** labeling of DNA and RNA probes. Southern and fluorescence in situ hybridization, chromosome walking. PCR –types and applications.

Techniques for gene expression: Northern and Western blotting, Gel retardation technique, DNA foot printing, Primer extension, Reporter assays. DNA sequencing and sequence assembly. Sanger's methods, Next Generation Sequencing, techniques of Site-directed mutagenesis, Shot gun sequencing, chemical synthesis of oligonucleotides. Protein analysis; PAGE, 2D-GEL, **Protein sequencing**-N-terminal sequencing by Edman degradation method, C-terminal amino-acid analysis by carboxy peptidase digestion and Dansyl Chloride method.

UNIT IV **12 hours**

Bioinformatics and Molecular Databases: Primary Databanks–NCBI, EMBL, DDBJ, KEGG; Secondary Databases–UNIPROT; Structural Database–PDB; Alignment: Pairwise and Multiple sequence alignment; Genome Annotation and Gene Prediction; Primer designing**;** Phylogenetic analysis and tree construction.

Safety of recombinant DNA technology: Restriction and regulation for the release of GMOs into Environment. Ethical, Legal, Social and Environmental Issues related to rDNA technology.

Introduction to IPR: Kinds of IPR; patents, copy right, design, trademark, geographical indicators,

Industrial design and trade secrets. India’s new National IP Policy.

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MB 3.3 Hardcore: INDUSTRIAL MICROBIOLOGY

Course Pedagogy:

- To give knowledge on strain improvement methods
- To learn different fermentation techniques, bioreactor design, inoculum development.
- To understand techniques involved in down-stream fermentation process

Course Outcome:

After the completion of the course students would be able

- To get knowledge on strain improvement
- To understand methods of manipulating the metabolic pathways to get desired yield.
- To understand industrial production and purification of antibiotics, enzymes, amino-acids and steroids.
- To work in fermentation industry
- To understand the application of the bio-molecules in benefit to mankind

THEORY **48hours**

UNITI **12hours**

Introduction: Fermenter design and types of fermenters, achievement and maintenance of aseptic conditions, Types of fermentation processes (Surface, submerged, Batch, Continuous, solid-substrate, Dual, Fed batch fermentation and its applications),

Industrial Microorganisms: Screening, Isolation. Identification and characterization ofindustrially important microbes. Strain improvement- mutation, recombination-gene regulation and genetic manipulation. Preservation of industrially important microbes. Culture collection centers**.**

UNIT II **12 hours**

Media for Industrial Fermentations: Media formulation, growth factors, carbon, nitrogen, Energy and Mineral sources, buffers, inhibitors, precursors, inducers, Oxygen requirements Antifoam agents and others, Sterilization: Sterilization of bioreactor, media, air and exhaust air and filter sterilization. **Downstream processing and fermentation economics**: Steps in recovery and purification Methods of cell separation – filtration and centrifugation, cell disruption, liquid liquid extraction, chromatography, membrane processes. Fermentation economics- expenses for industrial organisms, strain improvement, media sterilization, heating, cooling, aeration and agitation. Cost of Plant and equipment, batch process cycle time, continuous culture, recovery and effluent treatment, cast recovery due to waste usages and recycling.

UNIT III **12 hours**

Industrial production of energy fuels: Industrial alcohol production: Biosynthesis, methods of production, recovery and applications of ethanol: crab tree and pasture effect, acetone – butanol and glycerol through microbial process.

Industrial production of Organic acids and Enzymes: biosynthesis, media, production process, product recovery and application of citric acid and lactic acid, Enzymes: Fungal and Bacterial Amylase; Bacterial proteases.

UNIT IV **12 hours**

Industrial production of food additives: aminoacid production, methods of production, product recovery of L-Glutamic acid and L-lysine. Commercial uses of Amino acids Vitamins: Commercial production of Vitamin B_{12}, and Riboflavin. Alcoholic beverages (Beer, Wine,)

Industrial production of health care product: Industrial production of β-lactum antibiotic (Penicillin): Biosynthesis, production and recovery. Streptomycin: Biosynthesis, production and recovery. Antitumor and anti-cholesterol agents, SCP and SCO, I P R: Patent Laws: Patent regulations of processes, products and microorganisms.

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MB 3.4 Soft-core: MEDICAL MICROBIOLOGY

Course Pedagogy:

- To understand the role of normal flora and pathogenic microbes
- To understand the pathogenesis of various diseases
- To understand the various clinical microbiological techniques.

Course Outcome:

After the completion of the course students would be able

- To learn the concept, etiology and epidemiology of infections and mechanisms of infection
- To have knowledge on clinical lab techniques
- To acquire knowledge on control measures of diseases

THEORY **48hours**

UNITI **12 hours**

Introduction to Medical Microbiology: History, Development and scope of Medical Microbiology. Concept of Disease, disorder, syndrome, Communicable diseases- Microbial infections and diseases.Factors responsible for microbial pathogenicity.

Microbial infections: Types of infections, modes of transmission, portal of entry: Urinary tract infection, sexually transmissible infection, Infection of the central nervous system, Infections of circulatory system, Oral cavity and respiratory infection, gastrointestinal infection.

UNITII **12 hours**

Nosocomial infection: Incidence of nosocomial infections, types of nosocomical infections, emergence of antibiotic resistant microorganisms, hospital infection control programs, preventing nosocomical infections and surveillance, General concepts for specimen collection and handing of specimen, specimen processing and biosafety.

Chemotherapeutic agents: antibiotics (Classification based on chemical structure, mode of action and range of effectiveness). Recent trends-Drug resistance and its consequences, antibiotic policy, NCCLS (CLSI) guidelines and standards, WHO guidelines.MDR strains.

UNITIII **12 hours**

Epidemiology, Pathogenesis, Spectrum of disease, **Laboratory diagnosis and Prevention:** Diseases caused by Viruses**:** Chicken pox, Rabies virus, hepatitis, encephalitis, AIDS, Herpes simplex infections, Influenza, Dengue

Diseases caused by Bacteria: Tuberculosis, Leprosy, cholera, Typhoid, Botulism, Shigellosis, Helicobacterpylori infection, Salmonellosis, Tetanus. Diseases caused by Fungi**:** Candidiasis, Histoplasmosis, Blastomycosis, Coccidiomycosis, Dermatomycosis, Aspergillosis and Cryptococcosis, Anthrax

UNITIV **12 hours**

Diseases caused by Mycoplasma: *Mycoplasma pneumoniae, M. urealyticum, M. homonis*.

Diseases caused by Protozoa: Giardiasis,Trichomoniasis, Celebral Malaria, Toxoplasmosis, Cryptosporidium.

Disease caused by Chlamydiae: Psittacosis, LymphogranulomaVenereum, Trachoma and Inclusion conjunctivitis.

Emergent Diseases: Hemorrhagic fever, Swine flu, SARS, Chikungunya, Ebola, Hanta, Leptospoirosis, Marburg

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MB 3.5 Soft-core: CLINICAL & DIAGNOSTIC MICROBIOLOGY

Course Outcome:

After the completion of the course students would be able

- To develop skill to isolate and identify microorganism form clinical sample.
- To do antibiotics sensitivity and resistance test
- To do detection of parasite/pathogens using diagnostic kits.

Course Pedagogy:

- Knowledge about microbes causing disease.
- Knowledge about various laboratory techniques like microscopy, immunological assessments, radiology, biomarker tests, ELISA, serology checks, vaccines and vaccines schedule.
- Many microbes have developed resistance to medications.

THEORY **48hours**

UNITI **12 hours**

Introduction to clinical Microbiology: Role of Microbiologist in Diagnostic laboratory, General concepts for specimen collection, handling, transportation, processing, specimen workup, Laboratory safety and infection control.

Scientific and Laboratory basis for Clinical/Diagnostic Microbiology: Microscopic examination of infectious diseases, Growth and biochemical characteristics, Rapid methods of identification.

UNIT II **12hours**

Immunotechniques and Immunodiagnosis: Antigens and Antibody reactions *in vitro;* Agglutination, complement fixation, ELISA, Western Blotting Immuno-diffusion, Immuno-electrophoresis, Immunoflurescence, Immuno-precipitation, Radioimmuno assay and serotyping.

Vaccines and Vaccination: Vaccines – definition, types, Antigens used as Vaccines, effectiveness of vaccines, Vaccine safety, current vaccines, adjuvants, active immunization and passive immunization.

UNIT III **12 hours**

Recent Diagnostic tools and techniques: Principle, working and application of a) Autoanalyser b)Biosensor glucometer /labon chip/microfluidics c) Diagnositic kits- ELISA, Western Blot d) Enzymes inDiseasediagnosisandtherapy:Lactatedehydrogenase,Aspartateaminotransferase,Alkalinephosphatase,Creatinekinase, Acid phosphotase, Cholinesterase.

UNIT IV **12 hours**

Antimicrobial Chemotherapy: Development of chemotherapy; General characteristics of drugs and their testing; Mechanism of action. Antibacterial drugs; antifungal drugs, antiviral and antiprotozoan drugs; antibiotic sensitivity testing, MIC, Drug resistance; mechanism of drug resistance; multi drug resistance

Reference

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2 DavidE. Bruns; Edward R.Ashwood; CarlA. Burtis; Barbara G.Sawyer (2007). Fundamentals of Molecular Diagnostics St. Louis, Mo. : Saunders Elsevier

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MB3.6Soft-core: PRACTICALV (Molecular Biology and Genetic engineering)

1. Isolation of Genomic DNA from *E.coli*.
2. Isolation of plasmids from bacteria by agarose gel electrophoresis.
3. Determination of purity and concentration of isolated DNA using spectrophotometer
4. Estimation of DNA by DPA method
5. Determination of DNase activity on isolated DNA
6. Amplification, Purification and separation of PCR product.
7. Estimation of RNA by Orcinol Method
8. Determination of RNase activity on isolated RNA.
9. Salt fractionation of Yeast protein and quantification
10. Estimation of protein by Lowry's method
11. Determination of Proteinase activity on proteins
12. Separation of proteins by SDS PAGE
13. Digestion of the gene of interest with suitable restriction enzymes.
14. Ligation of the digested gene in a vector.
15. Preparation of competent *E.coli*cells for Bacterial transformation.
16. Transformation of the vector in to the host cell and selection of the desired clones.
17. Induction of gene expression and purification of the induced protein from the host.

MB 3 .7 Soft-core: PRACTICALVI (Industrial and Medical Microbiology)

1. Study design of Fermentor and Parameters
2. Isolation of antibioticproducing microbes and their preservation.
3. Antibiotic fermentation and estimation of penicillin
4. Batch fermentation of Citric acid production, recovery and estimation of citric acid.
5. Preparation of wine and estimation of alcohol by specific gravity method.
6. Alcoholic fermentation and determination of total acidity and non-reducing sugars
7. Clarification of banana juice using Pectinase
8. Mushroom cultivation
9. Isolation of Pathogenic fungi of the skin (Dermatophytes).
10. Isolation and identification of clinically important microbes from throat swab
11. Isolation and identification of clinically important microbes from nasal swab
12. Isolation and identification of clinically important microbes from wound infections
13. Microbial flora of mouth–teeth crevices and saliva.
14. Estimation of bacteria in urine by calibrated loop direct streak method.
15. Antimicrobial assay–sensitivity test (MIC) for pathogenic bacteria.
16. Demonstration of laboratory diagnosis of important human diseases:–Tuberculosis, Typhoid, Malaria, and Hepatitis.

MB 3.8 Open elective: MICROBIAL DIVERSITY

Course Pedagogy:

- To understand the ubiquitous nature and characteristics of microbes
- To impart knowledge on viral, bacterial, fungal diversity.
- Importance and conservation of microbial diversity.

Course Outcome:

After the completion of the course students would be able

- To differentiate various groups of Microbes.
- To learn about conservation methods.
- To have knowledge about the role of culture collection centers in conservation.

THEORY **48 hours**

UNIT I **12 hours**

Viral Diversity: Morphology, ultra structure, chemical composition of virus, classification of viruses, Group I – T2 Bacteriophage, Group II – Banana bunchy top virus, Group III – Reovirus, Group IV-TMV, GroupV– Rhabdovirus, Group VI– HIV, Group VII–Hepatitis virus.

Sub-viral particles: Discovery, Structure, Classification, replication and diseases caused by Satellite, Satellites virus, Virusoids, Viroids and Prions.

UNIT II **12 hours**

Bacterial Diversity: Archaebacteria, Photosynthetic Eubacteria, Chemoautotrophic and Methophilic Eubacteria, Gliding Eubacteria, Spirochetes, Rickettsiae and Chlamydiae, Actinomycetes, Mollicutes, Protists. Classification based on Bergey's manual (Determinative& Systematic).

UNIT III **12 hours**

Fungal Diversity: Classification, Distribution, Importance, Structure, reproduction and general characteristics of the fungal divisions: Zygomycota (*Rhizopus*), Ascomycota (*Neurospora*), Basidiomycota (*Agaricus*), Deuteromycota (*Penicillium*), Chytridiomycota (*Allomyces*) , Myxomycota and Yeast.

UNIT IV **12 hours**

Importance and Conservation of Microbial Diversity: Importance of microbial diversity in agriculture, forestry, environment, industrial & food biotechnology, animal & human health. Metagenomics.Importance of conservation.*In situ* conservation and *Ex situ* conservation. Role of culture collection centers in conservation.

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SEMESTERIV

MB4.1Hardcore: AGRICULTURAL MICROBIOLOGY

Course Pedagogy:

- To study the microbes associated with the plant and soil fertility.
- To understand about beneficial microbes and their uses in protecting agriculture, preserving food, enhancing the value of food products and providing general benefits to health and wellbeing.
- To classify various aspects of N2 fixation, P solubilization, PGPR, are easily grasped by students
- To understand microbe and plant interactions
- Enable them to understand plant disease, plant defense mechanism and disease management.

Course Outcome:

After the completion of the course students would be able

- To develop newer approaches for plant disease management.
- Have better knowledge of pathogen interactions and plant defense mechanisms
- To know the application of microbial bio-control agents and to reduce drug resistance and environmental pollution.

THEORY **48hours**

UNITI **12 hours**

Introduction to Agricultural Microbiology: Introduction to agricultural microbiology, concepts and scope of agricultural microbiology, Agronomy and production of important crop plants, Green revolution. Plant Pathology: Concept of disease, History of Plant Pathology, Significance of plant diseases, Symptoms and types of plant diseases.

Plant Pathology in Practice: Plant Clinic and Plant Doctor Concept. Diagnosis of Plant Diseases – Infectious diseases, Non-infectious diseases, Koch's rules;

UNITII **12 hours**

Parasitism and Disease Development Parasitism and pathogenecity, Host range of pathogens, Disease triangle, Diseases cycle / Infection cycle, Relationship between disease cycles and epidemics; Pathogens Attack Plants–Mechanical forces, Microbial enzymes and toxins, Growth regulators. Effect on physiology of Host–Photosynthesis, Translocation and transpiration, Respiration, Permeability, Transcription and translation.Environment and Plant Disease– Effect of Temperature, Moisture, Wind, Light, Soil, pH and structure, Nutrition and Herbicides.

Defense Mechanisms of Plant: Disease Pre-existing structural and chemical defenses, Induced structural and biochemical defenses. Microbe mediated strategies for abiotic stress management.

UNITIII **12 hours**

Plant Disease & their management: Tobacco Mosaic Disease, Sandal Spike Disease, Bacterial blight of Paddy, Citrus canker, Angular leaf spot of cotton, Late Blight of Potato, Downy Mildew of Bajra, Blast of paddy, Tikka disease of ground nut, Rust of coffee, Grain and Head smut of Sorghum. Powdery mildew of Cucurbits, Wilt of Tomato, and Root Knot of Mulberry.Bunchy top of Banana.

UNITIV **12 hours**

Microbes and Plant interaction- Mycorrhizae- Biology and their applications, Bio fertilizers – microbial inoculants.Production and application of *Rhizobium, Azospirillum, Azotobacter,* phosphor bacteria and Cyanobacteria.PGPR's plant growth promoting *Rhizobacteria*and their uses.

Biopesticides: Definition, types- bacterial, viral, fungal and protozoan, mode of action, target pests, use of transgenic plants. Mode of action, Bacteria- endo and ecto- toxins production by *Bacillus thuringiensis, and Pseudomonas.*Fungi- *Beauveria, Cephalosporium,* and *Trichoderma.*

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MB 4.2 Soft-core: ENVIRONMENTAL MICROBIOLOGY

Course Pedagogy:

- To give basic idea on environmental sample analysis; Topics covered in detail include soil microbiology, aquatic microbiology, aero microbiology, bio-fertilizers and pesticides, microbial waste recycling and bioremediation etc.
- To understand the basic principles involved in waste water management
- To get the information on usage of Bioremediation- biotechnology
- To inform students about Bio-oxidation & microbial leaching

Course Outcome:

After the completion of the course students would be able

- To apply advanced knowledge on environmental sample analysis
- To use the knowledge for better waste management
- To formulate technique for bioremediation process
- To apply principles of environmental microbiology to solve the current environmental issues
- To be employable in pollution control boards

THEORY **48 hours**

UNIT I **12 hours**

Environment and Ecosystem: Physical, chemical and biological aspects of environment, natural habitats of microorganisms, microorganisms in ecosystem as producers and decomposers.

Soil Microbiology: Characteristics and classification of soil. Interactions between microorganisms: Mutualism, commensalism, ammensalism synergism, parasitism, predation, competition. Rhizosphere, rhizosphere, microflora and its beneficial activity.Role of microorganism in nitrogen, phosphorous and sulphurcycle.Detrimental effects of diverted biogeochemical cycles. Biological nitrogen fixation in detail: Symbiotic, asymbiotic and associated nitrogen fixation. Structure, function and genetic regulation of nitrogenases.

UNIT II **12 hours**

Air Microbiology: Microorganisms in air, sources of air-borne microorganisms.Airspora of indoor and outdoor environment, factors affecting airspora, Techniques of trapping air borne microorganisms.
Brief account of air-borne diseases of humans, plants and their significance.

Aquatic Microbiology: Distribution of microorganisms in the aquatic environment, Water pollution sources, Biological indicators of water pollution. Eutrophication- role of nitrogen and phosphorus in eutrophication, process and control of eutrophication.Determination of sanitary quality of water, Waste water microbiology-Primary, secondary, tertiary treatment and reclamation of wastewater.

UNITIII **12 hours**

Culture- dependent and independent approaches for microbial diversity in environment.

Culture- dependent approaches and their limitations, and culture-independent molecular approaches for understanding microbial diversity in the environment.Viable but non-culturable bacteria.Introduction to Metagenomics.

Microbes in extreme environment: acidophiles, alkaliphiles, halophiles, barophiles and their survival mechanisms.

Space microbiology: Historical development of space microbiology, Life detection methods a) Evidence of metabolism (Gulliver) b) Evidence of photosynthesis (autotrophic and heterotrophic).

UNITIV **12 hours**

Microbes in the degradation of wastes: Treatment of solid and liquid industrial wastes, Microbial degradation of pesticides, Xenobiotics, degradation of lignin, cellulose, pectin and plastic. Bio-remediation. Geo microbiology: Microbes in metal extraction, mineral leaching and mining, copper extraction byleachingandmicrobesinpetroleumproductformation.GlobalEnvironmental Problems: Global Warming, Acid rain, Ozone depletion. Bio- deterioration of wood and metals.

References:

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11. Waste Water Engineering - Treatment, Disposal and Re-use by Metcalf and Eddy, Inc., Tata MacGraw Hill, New Delhi.
12. Pollution: Ecology and Biotreatment by EcEldowney, S. Hardman D.J. and Waite S. 1993. - Longman Scientific Technical.
13. Environmental Microbiology edited by Ralph Mitchell. A John Wiley and Sons. Inc.
14. Waste Water Microbiology 2nd Edition by Bitton.
15. Chemistry and Ecotoxicology of pollution. Edited by Des. W. Connell, G.J. Miller. Wiley Interscience Publications.
16. Environmental Biotechnology. Edited by C. F. Forster and D.A., John Wase. Ellis Horwood Ltd. Publication.
17. Advances in Waste Water Treatment Technologies. 1998. Volumes II and I by R. K. Trivedy. Global Science Publication.
18. Biocatalysis and Biodegradation: Microbial transformation of organic compounds. 2000 by Lawrence P. Wacekett, C. Douglas Hershberger. ASM Publications.
19. A Manual of Environmental Microbiology. 2nd Edition. 2001 by Christon J. Hurst (Chief Editor), ASM Publications.
20. Biodegradation and Bioremediation, Academic Press, San Diego.
21. Biotechnology in the sustainable environment, Plenum Press, N.Y.
22. Basic Principles of Geomicrobiology by A. D. Agate, Pune.

MB 4.3 Soft-core*:* GENOMICS AND PROTEOMICS

Course Pedagogy:

- The objectives of this course are to provide introductory knowledge concerning genomics, proteomics and their application
- To have knowledge about bioinformatics using web based tools (NCBI, CLUSTALW, MSA etc.,)

Course Outcome:

After the completion of the course students would be able

- To acquire knowledge and understanding of the fundamentals of genomics and proteomics, transcriptomics and their applications in various applied areas of biology.
- Do Insilco analysis using web based tools, will help the students in their research

THEORY **32 hours**

UNIT I **8 hours**

Genome - Overview of Genome; Sequence of Genome Acquisition and Analysis - Homologies - Snps – Genetic Analysis, Linkage Mapping,

High Resolution Chromosome Mapping And Analysis - Physical Mapping, Yac, Hybrid Mapping, Strategies, Sequence Specific Tags (Sst), Sequence Tagged Sites (Sts), Ish, Fish, Rflp, Rapd.

UNIT II **8 hours**

DNA Sequencing- Methods, Maxam and Gilbert Method, Ladder, Fluorescent, Shot Gun, Mass Spectrometry, Automation Sequencing – Find Gene Mutations, Implications of DNA – Sequencing and Sequencing Genomes.

Genome Data Bank, Metabolic Pathway Data - Construction And Screening of cDNA, Libraries And Microarrays - Application Of DNA Arrays - PCR - Variations In PCR - Gene Disruptions – Sage And Sade, Pharmacogenomics.

UNITIII **8 hours**

Protein Sequence Analysis - Introduction - Sequence Data Banks - Wbrf – Pir - Swissport - Databases, Data Mining – Algorithms Of Proteomics And Its Applications- Protein Expression**Profiling -** Protein- Protein Interaction - Protein Modifications. Automation-Nucleic Acid Data Bank –EMBL Nucleotide Sequence Data Bank- Aids Virus Sequence Data Bank-RNA Data Bank.

UNITIV **8 hours**

Tools For Data Bank - Pairwise Alignment - Needleman And WuschAlgorighm – Smith Waterman - Multiple Alignment- Clustral - Pras - Blast - Fast, Algorithms To Analyse Sequence Data- Pdb, Cambridge Structure Data Base (Lsd), 2d Electrophoresis, Ief, Hplc, Protein Digestion Technique, Mass Spectrometry, Maldi-Tof, Peptides, Mass Finger Printing Protein.

Metabolomics: Introduction, importance of metabolomics, designing of metaboilimic study. Data base for repository of metabolites, CHEBI, EMBL, EBI, reactome data base.

References

1. DevarajanThangadur and JeybalanSangeetha(2015). Genomics and Proteomics Principles, Technologies, and Applications. Apple Academic Press.
2. FerencDarvas, AndrásGuttman, GyörgyDormán(2013). Chemical Genomics and Proteomics (2nd Ed). CRC Press.
3. Ganapathy Subramanian and Nawin Mishra (2012). Science of Proteomics: Historical Perspectives and Possible Role in Human Healthcare. WileyPublications.UK
4. Lynn Jorde, Peter Little, Mike Dunn and Shankar Subramaniam (2014). Encyclopedia of Genetics, Genomics, Proteomics and Bioinformatics. WileyPublication.UK
5. Malcolm Campbell, Laurie J. Heyer (2003). Discovering genomics, proteomics and bioinformatics. Benjamin Cummings publications.
6. MetinAkay (2007). Genomics and Proteomics Engineering in Medicine and Biology. WileyPublications.UK.
7. NachimuthuSaraswathy and PonnusamyRamalingam (2011). Concepts and Techniques in Genomicsand Proteomics .Wood head Publishing groups.
8. Nawin Mishra (2010).Applications of Proteomics: Proteomics, Human Disease, and Medicine. Wileypublication.UK
9. R. S. Dassanayake, Y. I. N. Silva Gunawardene (2011). Genomic and Proteomic Techniques: In Post Genomics Era. Narosa Book Distributors.
10. Ruchi Singh (2014). BIOINFORMATICS: GENOMICS AND PROTEOMICS. Vikas Publications. New Delhi.
11. Suhai, Sándor (2002). Genomics and Proteomics. Springer publications.

MB 4.4 Soft core: Microbial Nanotechnology

Theory **48 hours**

Unit I **12 hours**

Introduction to Nanotechnology: Characteristic scale for quantum phenomena, nanoparticles, nano-clusters, nanocomposite, nanotubes, nanowires and Characterization of nanoparticles – UV-VIS IR spectroscopy, TEM, SEM, AFM, EDS, XRD. Emergence of bionanotechnology.

Unit II **12 hours**

Microbial nanotechnology – Microbial synthesis of Nanoparticles.Synthesis of nanodrugs – metal nanoparticles and drug delivery vehicles – Nanoshells – Tectodentrimers Nanoparticle drug systems – Diagnostic applications of nanotechnology.

Unit III **12 hours**

Preparation of nano biomaterials – Polymeric scaffolds collagen, Elastins: Mucopolysaccharides, proteoglycans, cellulose and derivates, Dextrans, Alginates, Pectins and Chitin. Nanoparticles – types (Silver, Gold and Titanium). Physical and chemical properties and functions. Drug delivery – protein mediated and nanoparticle mediated. Hybrid conjugates of gold nanoparticles – DNA oligomers in nano mechanics and Computing. Nanoparticles as carrier for genetic material.

Unit IV **12 hours**

Applications in biology and medicine: Nanotechnologies for biology and medicine – Micro and nano- fluidics - Scanning probe microscopy in biology and medicine – Self-assembly of biological molecules.

Health and safety implications: Health issues – Environmental issues – regulation guidelines. Societal implications- Possible military applications – Potential benefits and risks to developing countries – Intellectual property issues – Criticism of Nanotechnology.

Reference Books:

1. Parthasarathy, B.K. (2007). Introduction to Nanotechnology, Isha Publication.
2. Elisabeth Papazoglou and AravindParthasarathy (2007).Bionanotechnology. Morgan & Claypool Publishers.
3. Bernd Rehm (2006). Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures. Horizon Scientific Press.
4. David E. Reisner, Joseph D. Bronzino (2008). Bionanotechnology: Glo
5. ChaudheryHussain (2022) Handbook of Microbial Nanotechnology, 1st Edition.

MB4.6Soft-core: PRACTICAL VII (Agricultural Microbiology)

1. Isolation of Rhizobium from roots of leguminous plants
2. Assay of bio-fertilizers (*Rhizobium, Azotobacter, Azospirillum)* (Seed treatment/ seedling inoculation and measurement of root and shoot length)
3. Mass multiplication techniques of *Azolla.*
4. Estimation of total phenols in diseased and healthy plant tissues.
5. Isolation of phosphate solubilizing bacteria and fungi.
6. Isolation of phylloplane microorganisms
7. Soil microbes interaction In vitro by dual culture method
8. Isolation, identification and enumeration of Rhizosphere and Rhizoplane microorganism
9. Seed health testing by SBM
10. Collection and Identification of following disease:

1. Tobacco mosaic disease
2. Bunchy top of Banana
3. Bean Mosaic
4. Sandal spike
5. Bacterial blight of paddy
6. Citrus canker
7. Downy mildew of Bajra
8. Powdery mildew of mulberry
9. Head smut of sorghum
10. Leaf rust of coffee
11. Blast disease of paddy
12. Tikka disease of groundnut
13. Leaf spot of paddy
14. Grassy shoot of sugarcane

MB 4.7 Soft-core: PRACTICAL VIII(Environmental Microbiology Practical)

1. Microbes as indicators of water pollution– Determination of indices of water quality.
2. Determination of TS from Sewage Water
3. Determination of BOD of pollution water.
4. Determination of COD of polluted water.
5. Degradation of cellulose by Chaetomiumglobosum.
6. Study of Actinorhiza, Mycorrhiza.
7. Isolation of pesticide degrading microbes
8. Isolation of plastic degrading microbes

MB 4.8 Soft-core: PRACTICAL IX: Microbial Nanotechnology Practical

1. Synthesis of gold Nano particles from bacteria and its confirmation by UV-Spectroscopy
2. Synthesis of gold Nano particles from fungi and its confirmation by UV-Spectroscopy
3. Synthesis of silver Nano particles from bacteria and its confirmation by UV-Spectroscopy
4. Synthesis of silver Nano particles from fungi and its confirmation by UV-Spectroscopy
5. Synthesis of Nano metal particles from microbes and its confirmation by UV-Spectroscopy
6. Evaluation of antimicrobial properties of gold Nano particles produced by microbes
7. Evaluation of antimicrobial properties of silver Nano particles produced by microbes
8. Determination of MIC values of synthesized nanoparticles
9. Evaluation of plant growth promotion of Nano metals/composites.
10. Determination of size of nanoparticles by SEM/TEM
11. Characterization of nanoparticles by using XRD, EDX and DLS