Shree M. & N. Virani Science College (Autonomous), Rajkot

Department of Applied Microbiology

SCHEME OF INSTRUCTION AND EXAMINATIONS

M.Sc. Microbiology

Semester- IV									
Course Code	**Course**	**Hrs of Instruction / week**			**Exam Duration (Hrs)**	**Max Marks**			**Credit**
		Th	**Pr**	**Tu**		**CIA**	**SEE**	**Total**	
Part-I: Core									
19PMBCC401	**Core13**: Agricultural Microbiology	4	2	-	3	90	60	150	4+1
19PMBCC402	**Project / Internship/ Training**		18		3	200	100	300	9
Discipline Specific Elective – Core (Theory)									
19PMBDC401/ 19PMBDC402	**Discipline Specific Elective-** Pharmaceutical Microbiology /Advanced Molecular Techniques	4	2	-	2.5	50	50	100	4+1
Total		**30**						**550**	**19**
TOTAL OF ALL SEMESTERS								**2600**	**96**

Feedback of faculties over Sem IV

Sr No.	Name of faculty member	Course Name	Suggested changes
1	Dr. Shraddha Shukla	**Core13**: Agricultural Microbiology	Minor Revision in module 3 and 4
2	Abhijeet Joshi	**Discipline Specific Elective-** Pharmaceutical Microbiology	No change
3	Dr. Debashis Banerjee	**Discipline Specific Elective-** Advanced Molecular Techniques	Minor revision

4		**Project / Internship/Training**	No change

SN.	Name of faculty	Course Name	Suggested changes
1	Dr. Shraddha Shukla	18MMBCC401 Core 13: Agricultural Microbiology	
		Module 3: Harmful effect of microbes on plant 1. Classification of plant diseases 2. Recognition and entry of pathogens into host cells 3. Alteration of host behavior by pathogen 4. Molecular mechanisms of disease diagnosis 5. Resistance mechanisms in plants: Systemic resistance	**Module 3: Harmful effect of microbes on plant** 1. What is a disease and what causes disease, 2. pathogenesis, pathogenesis in relation to environment, 3. Recognition and entry of pathogens into host cells 4. Alteration of host behavior by pathogen, 5. Biochemical basis of plant diseases: Enzymes and toxins in plant diseases, phytoalexins. 6.
		Module 4: Plant disease mechanism 1. Molecular mechanism of disease diagnosis. 2. Resistance Mechanism in Plants: Systemic Resistance 3. Resistance genes: Phytoalexins. 4. Role of PR and cry Proteins in plant disease control 5. Signaling Mechanisms of plant hormone	**Module 4: Plant disease mechanism** 1. Resistance Mechanism in Plants: Systemic Resistance 2. Role of PR and cry Proteins in plant disease control 3. Genetics of host-pathogen interactions, resistance genes 4. Signaling Mechanisms of plant hormone 5. Molecular mechanisms of disease diagnosis
2	Dr. Debashis Banerjee	**Discipline Specific Elective-** Advanced Molecular Techniques	Module 1: qPCR & RT-PCR not needed separately as 'Types of PCR' covers the two also Module 5: Practicals: i) 'DNA finger printing using PCR' can be changed to RAPD ii) Southern and Western Blotting can be given as full practicals and not only as Demo

Semester IV

18MMBCC401	Core 13: Agricultural Microbiology	4 + 2 hrs/wk	4 + 1 Credits

Course Description:

The course deals with soil, microorganisms and its interaction with plants. It explains fundamental concepts deals with plant growth promotion and disease control. The course appreciates the practical aspect of plant growth promoting microorganisms and isolation, identification and control of important plant pathogens.

Course Purpose:

The course makes the students understand the basics of soil with its interaction and applications. The course provides the student in depth knowledge on plant growth promotion. It also makes the students understand the behavior of plants after pathogen attack and preventive measures for it.

Course Outcomes: Upon completion of this course the learner will be able to		
CO NO.	**CO Statement**	**Bloom's Taxonomy Level (K1 to K5)**
CO1	Show soil and its characteristics	**K3**
CO2	Choose microorganisms in soil as per their role in agriculture	**K3**
CO3	Produce biofertilizer and biopesticides	**K5**
CO4	Differentiate Plant Microbe interaction	**K4**
CO5	Summarize harmful interaction between plant and microbes	**K2**

Module 1: Microbes in Soil **12 hrs**

- Role of Microbes in soil
- Decomposition of organic matter by microorganisms
- Role of Microbes in evaluation and improvement of soil

- Rhizosphere Microorganisms : Phyllosphere, Spermosphere and Rhizoplane
- Factors affecting Rhizosphere Microorganisms

Module 2: Biofertilizer and Biopesticides **12 hrs**

- Biofertilizer -types, production and quality control.
- Cultivation and mass production of bioinoculants- Azotobacter, Rhizobium,
- Phosphate solubilising microorganisms.
- Carrier-based inoculants -production and applications.
- Biopesticides –types and applications (*Bacillus thuringiensis, Trichoderma harzianum*)

Module 3: Harmful effect of microbes on plant **12 hrs**

- What is a disease and what causes disease,
- pathogenesis, pathogenesis in relation to environment,
- Recognition and entry of pathogens into host cells
- Alteration of host behavior by pathogen,
- Biochemical basis of plant diseases: Enzymes and toxins in plant diseases, phytoalexins

Module 4: Plant disease mechanism **12 hrs**

- Resistance Mechanism in Plants: Systemic Resistance
- Role of PR and cry Proteins in plant disease control
- Genetics of host-pathogen interactions, resistance genes
- Signaling Mechanisms of plant hormone
- Molecular mechanisms of disease diagnosis

Module 5: List of Practicals **24 hrs**

- Isolation of Siderophore producing microrganisms
- Permanent slide demonstration of VAM
- Isolation of symbiotic Nitrogen Fixation *(Rhizobium sp)*

- Isolation of asymbiotic Nitrogen Fixation *(Azotobacter sp)*
- Production and Quality control of biofertilizer (Azotobacter/ Rhizobium)
- Production and Quality control of Phosphate Solubilizing Microorganisms
- Interactions among soil microorganisms: Antagonistic study using *Trichoderma*sp
- Isolation and characterization of plant pathogen from plants. (Smut/ Rust/ Mildew)

Pedagogic tools:

- Chalk and Board
- Presentations
- Videos
- Assignments
- Class activity

Text Books:

1. Rangaswami, G., Mahadevan, A. (2004). Diseases of Crop plants in India: 2nd Edition PHI publication.
2. K.R. Aneja (2017) Experiments in Microbiology, Plant Pathology and Biotechnology, 2nd Edition New Age Publication.

Reference Books:

1. Purohit, S.S. (2007). Microbiology-Fundamentals and Applications, 6th Edition. New Delhi: Agrobios Publications.
2. Atlas, R.M., Bertha, R. (2002). Microbial Ecology, 4th Edition: Pearson Education India
3. Kowalchuk, G.A., de Bruijn, F., Head, I.M., Van der Zijpp, A.J., van Elsas, J.D. Molecular Microbial Ecology Manual
4. Prescott L.M, Harley J.P. And Klein D.A. (1996) Microbiology 2nd Edition Wm. C. Brown Publishers.
5. R. C. Dubey and D.K. Maheshwari (2002) Practical Microbiology, 2nd Edition,–S. Chand Publications.
6. Dickinson M. (2003). Molecular Plant Pathology, 1st edition, BIOS Scientific Publishers.
7. Alexander, M. (1991). Introduction to soil microbiology, 2nd edition. Krieger Pub Co.

8. W. F. Harrigan Margaret E. McCance (2014) Laboratory Methods in Microbiology, 1st EditionAcademic Press.
9. Marylynn V. Yates, Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai (2016) Manual of Environmental Microbiology, 4th Edition, American Society for Microbiology.
10. Dhananjaya P. Singh, Harikesh B. Singh, RatnaPrabha (2017) Plant-Microbe Interactions in Agro-Ecological Perspectives Volume 1: Fundamental Mechanisms, Methods and Functions, Springer.

Suggested readings / e-resources:

- https://www.mooc-list.com/course/understanding-plants-part-i-what-plant-knows-coursera

Methods of Assessing the Course Outcomes:

The COs of the course will be assessed through

Components of CIA: 90 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	Any 2 Modules	$1^{1/2}$ hours	05 (Set for 30)	20
	Test 2	All 4 Modules	3hours	15 (Set for 60)	
	Practical CIA 1	75% of practical completion	3hours	30 (Set for 60)	30
B	Assignment	-	-	20	40
C	Class activity	-	-	20	
Grand Total					90
Assignment		●Assignment 1 ●Assignment 2			
Class activity		●Survey report/Map project/Model making/Illustration of steps involved in production of biofertilizer			

Suggested MOOCs

- https://www.agmoocs.in/course/integrated-disease-management
- https://www.agmoocs.in/course/integrated-pest-management-ipm

18MMBDC401	Discipline Specific Elective- Pharmaceutical Microbiology	4 + 2 hrs/wk	4 + 1 Credits

Course Description:

The course deals with role of microbiologist in pharmaceutical industry. The course enlightens the importance of regulatory authorities along with its working protocols and guidelines.

Course Purpose:

Students get acquainted with pharmaceutical technology, industrial requirement of microbial technology with standard operating procedures as per regulatory authorities Drug delivery system and drug resistance mechanism

Course Outcomes: Uponcompletion of this course the learner will be able to		
CO NO.	**CO Statement**	**Blooms Taxonomy Level (K1 to K5)**
CO1	Explain and differentiate role of different authorities in pharma industries	**K2, K4**
CO2	Play a role in different sectors of pharma industries	**K5**
CO3	Choose differentiate drug delivery systems	**K3**
CO4	Use different parameters for quality analysis	**K3**
CO5	Apply and analyzestandard operating procedures for different pharmaceutical products	**K3,K4**

Module 1: Introduction to pharmaceutical industry **12 hrs**

- Concept of Drugs, Medicine and Active Pharmaceutical Ingredients
- Overview of key features of Pharmacopoeias in India and United States.
- Role of Food and Drug Administration in India.
- Quality Assessment of Water
- Quality Assessment of Air: AHU

Module 2: Quality Control and Sterilization **12 hrs**

- Microbial contamination and spoilage of sterile pharmaceutical products
- Type of HEPA
- Types of Clean room: Class area
- Types of biosafety cabinets
- Sterilization: Introduction, significance, sensitivity of microorganisms, detailed methods for sterilization processes.

Module 3: Quality Analysis **12 hrs**

- Standard operating Protocol (SOP)
- Raw Material QC and Finished Product QC
- Endotoxin test methods -gel clot assay, turbidometeric assay and chromogenic methods.
- Endotoxin activity –risk assessment in parenterals manufacture
- Pyrogen test –depyrogenation methods.

Module 4: Quality Assurance **12 hrs**

- Current Good Manufacturing Practices (cGMP) in pharmaceutical industry
- Good Laboratory Practices (GLP) in pharmaceutical industry.
- Quality assurance and quality management in pharmaceuticals: ISO, WHO and US FDA certification.
- Overview of NABL accreditation of testing labs
- Calibration and validation of equipments: Concept of IQ, OQ and PQ.

Module 5: List of Practicals **24 hrs**

- Sterility testing of pharmaceutical products (sterile injectables and tablets)
- Microscopic analysis of sterile injectables and tablets
- Bacterial Endotoxin Test of pharmaceutical products (Demonstartion)
- Microbial limit test (MLT) of water
- Quality assessment of pharmaceutical products with special reference to regulatory Affairs

- Quality check of HEPA filter using settle plate method
- Design of Standard operating procedures for vitamins assay
- Design of Standard operating procedures for assay of chemical disinfectants.

Text books:

1. Stephen P. D., Norman A. H., Sean P. G., Brendan F. G. (2011) Hugo & Russell Pharmaceutical Microbiology 8th Ed. Wiley-Blackwell Publishing house
2. Vyas S. P., Dixit V. (2007) Pharmaceutical Biotechnology, CBS Publishers & Distributors
3. MehraPrahlad Singh (2011) A Textbook of Pharmaceutical Microbiology, 1st edition I.K. International Publishing House Pvt. Ltd.

Reference books:

1. World Health Organization. (2010) Handbook: Good Laboratory Practice (GLP): quality practices for regulated non-clinical research and development. World Health Organization.
2. Selvakumar, R. (2010). Good Laboratory Practices. Indian Journal of Clinical Biochemistry. 25 (3): 221-224.
3. Weinberg, S. (2007). Good Laboratory Practice Regulations: CRC Press.
4. Sidney H.W. Murray M. Tuckerman, W., S.Hitchings IV. Mercel D.,(2007) GoodManufacturing Practices for Pharmaceuticals, Second Edition, NC New York
5. Sandle Tim (2015) Pharmaceutical Microbiology: Essentials for Quality Assurance and Quality Control. 1st Edition. Elsevier Publication

Suggested readings / e-resources:

- https://www.mooc-list.com/course/essentials-good-pharmacy-practice-basics-futurelearn

Suggested MOOCs

- https://www.mooc-list.com/course/essentials-good-pharmacy-practice-basics-futurelearn
- https://www.mooc-list.com/course/essentials-good-pharmacy-practice-basics-futurelearn

Methods of Assessing the Course Outcomes:

The COs of the course will be assessed through

Components of CIA: 50 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	First Two Modules	$1^{1/2}$ hours	05 (Set for 30)	20
	Test 2	First Four Modules	$2^{1/2}$hours	15 (Set for 50)	
	Practical CIA	All Practicals included in Module V	3 hours	30 (Set for 60)	15
B	Assignment			05	15
C	Class activity			10	
				Grand Total	**50**

Assignment	●Concept mapping - 05
Class activity	●One-minute paper - 05 ●Spot Test - 05

18MMBDC402	Discipline Specific Elective-: Advanced Molecular Techniques	4 + 2 hrs/wk	4 + 1 Credits

Course Description:

The course deals with use and applications of various molecular techniques. The course covers up the steps involved in isolation, purification and characterization of biologically important molecules.

Course Purpose:

To enhance the skills of students in advanced molecular techniques such as PCR, Blotting, ELISA for better understanding and application of biomolecules in research and industries.

Course Outcomes: Uponcompletion of this course the learner will be able to		
CO NO.	**CO Statement**	**Blooms Taxonomy Level (K1 to K5)**
CO1	Investigate DNA and Protein characteristics	**K4**
CO2	Compare and select various techniques used in isolation and purification	**K2,K4**
CO3	Plan sequential steps in genome analysis	**K5**
CO4	Evaluate various protein engineering steps	**K4**
CO5	Produce gene copies using PCR and analyzebimolecule by blotting studies	**K4,K5**

Module 1: Molecular Techniques for nucleic acids **12 hrs**

- Types of PCR: qPCR, RT PCR
- Hybridization: Southern and Northern; Subtractive Hybridization
- Fluorescence in situ Hybridization
- Microarray, SAGE
- Genomics, Metagenomics, Transcriptomics and Metatranscriptomics studies

Module 2: Molecular Techniques for Proteins, Metabolites and Cells **12 hrs**

- 2D Electrophoresis
- Western Blotting; Protein Sequencing
- ELISA
- Flow Cytometry

- Fluorescence Microscopy for localization studies

Module 3: Techniques for studying molecular interactions **12 hrs**

- DNA-RNA interactions, DNA-Protein Interactions and RNA-Protein Interactions
- Gel mobility shift assay, Dnase I foot printing, Sl nuclease mapping,
- Chromatin immunoprecipitation (ChIP)
- Co-immunoprecipitation (CIP),Tandam affinity tags (TAT) and Phage display
- Fluorescent resonance energy transfer (FRET), Yeast-2-hybid and Yeast-3-hybid

Module 4: Advanced Molecular Techniques **12 hrs**

- Spectroscopic techniques such as FT-IR
- Mass Spectrometry for analyzing proteins and metabolites
- Application of NMR in biological sciences
- Understanding protein structure by X-ray Diffraction
- Proteomics, Metaproteomics Metabolomics, Fluxomics& Systems Biology

Module 5: List of Practicals: **24 hrs**

- To perform DNA finger printing using PCR (RAPD)
- To perform Southern Hybridization
- To perform Western Blotting
- To study Protein crystallization
- To analyze functional groups of a compound using FT-IR spectra.

Text Books:

1. T.A. Brown. (2016) Gene cloning and DNA analysis.7th Edition Wiley-Blackwell Publishing Ltd.
2. Hofmann A., Clokie S. (2018) Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edition Cambridge University Press

Reference Books:

1. Strauch M. A (2001) Protein–DNA Interaction: Techniques Used. John Wiley & Sons, Ltd.
2. Dale J. W., Schantz M., Plant N. (2011) From genes to genomes.3rd Edition John Wiley & Sons, Ltd.
3. Nicola King (2010) Methods in Molecular Biology Real Time PCR Protocols: Vol. No. 630, 2nd Edition Humana Publication
4. Neus Visa and Antonio Jordán-Pla (2018) Methods in Molecular Biology Chromatin Immunoprecipitation Protocol: Vol. No. 1689 Humana Publication

Suggested readings / e-resources:

- https://www.futurelearn.com/courses/introduction-to-bacterial-genomics

Methods of Assessing the Course Outcomes:

The COs of the course will be assessed through

Components of CIA: 50 marks

Sr. No.	Component	Content	Duration (if any)	Marks	Sub Total
A	Test 1	First Two Modules	$1^{1/2}$ hours	05 (Set for 30)	20
	Test 2	First Four Modules	$2^{1/2}$hours	15 (Set for 50)	
	Practical CIA	All Practicals included in Module V	3 hours	30 (Set for 60)	15
B	Assignment			05	15
C	Class activity			10	
				Grand Total	**50**

Assignment	●Case study - 05
Class activity	●One-minute paper - 05 ●Spot Test - 05

Suggested MOOCs

●https://nptel.ac.in/noc/individual_course.php?id=noc17-ge04

●https://ocw.mit.edu/courses/health-sciences-and-technology/hst-508-quantitative-genomics