RCS - 2022

NEHRU ARTS AND SCIENCE COLLEGE

(An Autonomous Institution affiliated to Bharathiar University)
(Reaccredited with "A" Grade by NAAC, ISO 9001:2015 & 14001:2004 Certified
Recognized by UGC with 2(f) &12(B), Under Star College Scheme by DBT, Govt. of India)
Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105, Tamil Nadu.

Moulding True Citizen

REGULATIONS, CURRICULUM & SYLLABUS

M. Sc., MICROBIOLOGY

Effective from 2022 – 2023

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PG MICROBIOLOGY PROGRAMME OUTCOMES

PO1	**Critical Thinking**	Expertise knowledge in the core areas with wide range of problems solving, environmental factors and administrative placement.
PO2	**Usage of Technology**	Acquire eligibility, competency to be placed in various Microbiological industries.
PO3	**Effective Communication**	Student will communicate scientific concept, experimental result, skills through effective understanding of scientific literature.
PO4	**Environment and Sustainability**	Experiencing the impact of scientific information pertinent to unfamiliar problems through literature survey, experiments, able to apply Research Intelligence in investigations and innovations
PO5	**Individual andTeam Work**	Function effectively understanding of group dynamics, recognise opportunities and contribute positively to collaborative - multidisciplinary domains, demonstrate a capacity for self-management and.
PO6	**Ethics and Values**	Develop knowledge in ethical thinking, quantitative analytical skills and its application to the issues in society.
PO7	**Social Interactions**	Acquire knowledge on harmful and beneficial role played by microbes in human health.
PO8	**Life Long Learning**	Comprehend the role of recent technologies in microbiological applications & research data management.

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Department: Microbiology

PROGRAM EDUCATIONAL OBJECTIVES

After 2 years of the programme, the graduates are expected to attain

PEO1	Offer a sound exposure to students about the theory and practical of microbiology for attaining academic excellence in the field of microbiology.
PEO2	Equip students with adequate research knowledge, techniques for successful career in the field of academics, research, industries and for to pursue higher education.
PEO3	Advance the research skills to conduct research in the thrust areas of Microbiology to benefit the society. The student shall be able to analyze and interpret scientific data to solve technical, conceptual and abstract scientific problems.
PEO4	Make students able to integrate various aspects of microbiology to achieve holistic and societal development.
PEO5	Inculcate entrepreneurship among the students so as to start their own ventures in the field of microbiology and shall be able to develop networking and entrepreneurship skills and establish links with industry and alumni.

PROGRAMME SPECIFIC OUTCOME

M. Sc. (Microbiology)

On completion of M. Sc. (Microbiology), students are able to understand the concept of,

PSO 1	Advanced techniques related to screening, Isolation and Identification of microorganisms from various sources
PSO 2	Microorganisms and their relationship with the environment and their genetic Principles with essential mechanism of biological processes.
PSO 3	Acquiring knowledge in Biomolecules and its clinical applications
PSO 4	The techniques related to Collection, Transport and Processing Clinical Specimens and identification of pathogens and prevention, treatment of infectious Diseases
PSO 5	Acquiring knowledge in relation to skill-based techniques with reference to recombination

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M. Sc. MICROBIOLOGY

Programme Code: PGMB

SCHEME OF EXAMINATION

(Applicable to the students admitted during the academic year 2022– 2023 onwards)

Semester	Course Code	Name of the Course	Ins. Hrs/ week	Examinations				Credit
				Dur / Hrs.	CIA	ESE	Total Marks	
I	22PGMBC101	Paper I – Basics of Microbiology	5	3	50	50	100	4
	22PGMBC102	Paper II – Microbial Physiology and Biochemistry	5	3	50	50	100	4
	22PGMBC103	Paper III – Analytical Methods in Microbiology	5	3	50	50	100	4
	22PGMBC104	Paper IV – Environmental and Agricultural Microbiology	5	3	50	50	100	4
	22PGMBE 101 22PGMBE 102 22PGMBE 103	Elective Paper – I	5	3	50	50	100	4
	22PGMBQ101	Practical I – Lab in General and Analytical Microbiology	5	9	50	50	100	4
	Sub Total		**30**				**600**	**24**
II	22PGMBC205	Paper V – Microbial Genetics and Molecular Biology	5	3	50	50	100	4
	22PGMBC206	Paper VI – Immunology	5	3	50	50	100	4
	22PGMBC207	Paper VII – Microbial Food Technology	5	3	50	50	100	4
	22PGMBC208	Paper VIII – Bioprocess Technology	5	3	50	50	100	4
	22PGMBE201 22PGMBE202 22PGMBE203	Elective Paper – II	5	3	50	50	100	4
	22PGMBQ202	Practical II – Lab in Lab in food microbiology and Immunology	5	9	50	50	100	4
	Sub Total		**30**				**600**	**24**

Elective Papers	Course code	Group	Name of the Course
Elective Paper I/ Sem. I	22PGMBE101	**A**	Principles of Quality Assurance in Food
	22PGMBE102	**B**	Diagnostic Microbiology
	22PGMBE103	**C**	Fundamentals of Plant tissue Culture
Elective Paper II/Sem. II	22PGMBE201	**A**	Principles of Quality Assurance in Pharmaceuticals
	22PGMBE202	**B**	Techniques in Parasitology
	22PGMBE203	**C**	Fundamentals of Animal tissue Culture

SEMESTER – I

Course Code	Title		
22PGMBC101	Paper I – Basics of Microbiology		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To Provide the student with basic knowledge of microorganisms and describe the general properties & characteristics of bacteria.
Course Category	Skill Development
Development Needs	Global
Course Description	This course describes about the history of Microbiology biology of microorganisms, identification of microbes and control of microbes

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the development of microbiology.	Presentations and lectures	Assignment
CO 2	Acquaintance on study of microbial diversity using different methods and systematics of bacteria.	Interactive lecture	Seminar
CO 3	Identify unique structures, capabilities and functions of microorganisms.	Presentation	Assignment
CO 4	Discuss reproduction and life cycle of Bacteria.	Presentation	Seminar / Assignment
CO 5	Familiarize how to control microorganisms.	Presentation and lectures	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week : 4

Unit	Description	Text Book	Chapters
I	**Historical Development:** Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, John Tyndal. History and Scope of Microbiology. Spontaneous generation conflict – Germ Theory of disease.	1	1
		Instructional Hours	**12**
Suggested Learning Methods : Video lectures and discussion			**02 Hrs**
II	**Microbial Taxonomy:** Domains and Kingdom of life – Bacterial Nomenclature – Various criteria used in bacterial classification: Whittaker's Five kingdom classification. Morphological, physiological, metabolic, serological, ecological and genetic analysis. Outline of Bergey's Manual of systematic bacteriology – Numerical taxonomy – 16S rRNA based classification.	2	2
		Instructional Hours	12
Suggested Learning Methods: Video lectures			**02 Hrs**
III	**Morphology and Fine Structures:** Overview of bacterial cell structure (size, shape, arrangement of membrane and cellwall), cytoplasmic inclusions, mesosomes, flagella and motility, slime, capsule, pili, and endospore, Staining -Gram, Capsule, Spore, Flagellar, Nuclear, Acid fast.	2	4
		Instructional Hours	18
Suggested Learning Methods: Video lecture			**02 Hrs**

IV	**Reproduction and Growth:** Binary fission, Budding, Fragmentation, Microbial growth and life cycle of bacteria. Population growth and its measurement, effect of environmental conditions on growth (pH, temperature, aeration). Continuous and batch culture, cultures and anaerobic cultures.	2	5,6
		Instructional Hours	18
Suggested Learning Methods: Video lecture and Group Discussion			**02 Hrs**
V	**Control of growth of Microbes:** Sterilization, disinfection, antiseptic, sanitizer, germicide, antimicrobial agent, physical methods of sterilization- dry-heat, moist-heat, filtration, radiation, chemical controls- dye alcohols, halogen, formaldehyde, phenols its derivatives, ethylene oxide, detergents.	3	7
		Instructional Hours	15
Suggested Learning Methods: Group discussion and Video lecture			**02 Hrs**
		Total Hours	75 Hrs

Text Books	1. Prescott,Harley, and Klein's, **Microbiology**, 7th Edition, McGraw Hill Education,2008. 2. Dubey R.C., A **Text Book of Microbiology**, S. Chand & Company Ltd., 2013. 3. Jeffrey C. Pommerville, **Fundamentals of Microbiology**, 10th Edition, Jones &Barlett, 2014.
Reference Books	1. Alcamo, E. **Fundamentals of Microbiology**, 6th Edition. Jones and Bartlett Publishers,New Delhi. 2001 **2.** Brooks, G.F., E. Jawetz, J.L. Melnick and E.A. Adelberg. **Medical Microbiology.** 3. 26thEdition, New York: McGraw Hill Medical. 2013. 4. Patricia, M.T. Bailey and Scott's **Diagnostic Microbiology**,13th Edition, Mosby, Inc.Publishers, China. 2014.
Web. URLs	https://microbiologyinfo.com/

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	H	H	H	L	M	M	L	M	M	H	H	M	M
CO2	M	M	M	M	H	M	M	M	H	H	H	M	H
CO3	H	L	M	H	M	M	L	H	M	H	H	M	M
CO4	M	H	L	M	L	L	H	M	H	M	H	H	M
CO5	M	M	H	H	M	H	M	H	H	H	M	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBC102	Paper II - Microbial Physiology and Metabolism		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	This course provide the students basics of microbial physiology and know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement
Course Category	Employability
Development Needs	Global
Course Description	Students will be able to explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the concept of nutrition metabolism, transport mechanism across bacterial cells.	Lecture	Assignment
CO 2	Describe the properties of amino acids, proteins and enzymes.	Lectures/ Video lessons	Seminar
CO 3	Know various types of bacteria involved in photosynthesis and its mechanisms.	Lectures / Video Lessons	Assignment
CO 4	Explain the mechanisms of lipid and its connected metabolism.	Lectures/ Video lessons	Assignment
CO 5	Develop knowledge on bacterial reserve food material and its role.	Lectures and Videos	Seminar

Offered by	**Microbiology**

Course Content	**Instructional Hours / Week : 4**

Unit	Description	Text Book	Chapters
I	**Cell structure and Function:** Cell structure and function Biosynthesis of peptidoglycan - outer membrane, teichoic acid – Exopolysaccharides; cytoplasmic membrane, pili, fimbriae, S-layer. Transport mechanisms – active, passive, facilitated diffusions – uni, sym, antiports. Electron carries – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation cycles.	1	3-5
		Instructional Hours	**15Hrs**
Suggested Learning Methods: Video Lectures			**02 Hrs**
II	**Microbial Growth**: Microbial growth Phases of growth curve – measurement of growth – calculations of growth rate – generation time – synchronous growth – induction of synchronous growth, synchrony index – factors affecting growth – pH, temperature, substrate and osmotic condition. Survival at extreme environments – starvation – adaptative mechanisms in thermophilic, alkalophilic, osmophilic and psychrophilic..	3	9, 16-18
		Instructional Hours	**15Hrs**

Suggested Learning Methods: Demonstration and Presentation			**02 Hrs**
III	**Microbial pigments:** Microbial pigments Autotrophs - cyanobacteria - photosynthetic bacteria and green algae – heterotrophs – bacteria, fungi, myxotrophs. Brief account of photosynthetic and accessory pigments – chlorophyll – fluorescences, phosphoroscenses - bacteriochlorophyll – rhodpsin – carotenoids – phycobiliproteins.	2	12
		Instructional Hours	15Hrs
Suggested Learning Methods : Presentations and Video lectures			**02 Hrs**
IV	**Carbon assimilation:** Carbohydrates – anabolism – autotrophy – oxygenic – anoxygenic Photosynthesis – autotrophic generation of ATP; fixation of CO2 – Calvin cycle – C3 – C4 pathways. Respiratory metabolism – Embden Mayer Hoff pathway – Enter Doudroff pathway – glyoxalate pathway – Krebs cycle – oxidative and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Fermentation of carbohydrates – homo and heterolactic fermentations	3	13, 14
		Instructional Hours	15Hrs
Suggested Learning Methods : Videos and demonstration			**02 Hrs**
V	**Spore structure**: function Cell division – endospore – structure – properties – germination. Microbial development, sporulation and morphogenesis. Hyphae vs yeast forms and their significance. Multicellular organization of selected microbes. Dormancy.	1	13
		Instructional Hours	15
Suggested Learning Methods : Seminars and Group learning			**02 Hrs**
		Total Hours	**75Hrs**

Text Books	1. Byung Hong Kim, Geoffrey Michael Gadd, **Bacterial Physiology and Metabolism**, Cambridge University Press, 2008. 2. Alber G. Moat, John W. Foster, Michael P. Spector, **Microbial** 3. **Physiology**, Wiley & Sons, 2002. 4. Jain J.L., **Fundamentals of Biochemistry**, S. Chand and Company, 2004.
Reference Books	1. Caldwell. D.R. **Microbial Physiology and Metabolism**, Wm C. Brown Publisher.1995. 2. Stainier R.Y. Ingraham,J.L. Wheolis, H.H. and Painter. P,R.**Microbiology**.1986David Freifelder. **Physical Biochemistry**. (2nd Edition) 3. Prescott, L.M J.P. Harley and C.A. Klein. **Microbiology,** 2nd Edition Wm, C. Brown publishers. 1995. 4. Marion G. Macey. Flow **Cytometry Principles and Applications**. 5. Wilson Keith and Walker John, Principles **and Techniques of Biochemistry and Molecular Biology**, 6th Edition. Cambridge University Press, New York, 2005
Web. URLs	https://www.easybiologyclass.com/carbohydrates-simple-lecture-notes

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	L	L	H	H	M	H	H	M	L	L	H
CO2	H	H	M	L	H	H	M	H	L	M	L	L	H
CO3	H	H	M	M	H	L	M	H	L	L	H	M	H
CO4	H	H	M	M	H	H	L	H	H	M	H	M	M

CO5	H	H	M	M	H	H	L	H	M	M	H	H	M
H-High; M-Medium; L-Low													
Course designed by								**Verified by**					

Course Code	Title		
22PGMBC103	Paper III - Analytical Methods in Microbiology		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To make the students to gain knowledge on techniques commonly performed in microbial laboratory
Course Category	Employability
Development Needs	Global
Course Description	The course serves as an introduction to chromatographic analysis, basic principles of mass spectrometry, and reviews different choices of methods and instruments.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Gain knowledge about microscopy history and principles.	Lecture	Assignment
CO 2	Describe the colorimetric principles by specific methods.	Lectures/ Video lessons	Seminar
CO 3	Develop knowledge on centrifugation basic principles and applications.	Lectures / Video Lessons	Assignment
CO 4	Understand the principles and application of chromatography.	Lectures/ Video lessons	Assignment
CO 5	Explain the electrophoresis principle, types, and applications.	Lectures and Videos	Seminar

Offered by	Microbiology

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Historical Development:** Microscopy: history and principles of microscopy, properties of light, magnification power, resolution, limit, resolving. Bright field - Dark Field - Phase contrast Fluorescence microscope confocal microscopy, atomic force microscope Electron Microscope - Specimen preparation -TEM and SEM.	2	4
	Instructional Hours		**15Hrs**
Suggested Learning Methods : Video Lectures			**02 Hrs**
II	**Colorimetry:** Principles, Instrumentation and Applications– Basic principles of spectrophotometry. The laws of absorption, principles, and instrumentation for UV-visible and IR spectroscopy. Principles, theory, and applications of Flame photometry, and spectrofluorometry.	1	5
	Instructional Hours		**15Hrs**
Suggested Learning Methods: Demonstration and Presentation			**02 Hrs**
III	**Centrifugation:** Basic principles of centrifugation, differential and density gradient: zonal and isopycnic centrifugation. Sedimentation coefficient, factors affecting sedimentation coefficient. Ultracentrifuges: analytical and preparative with application. Rotors: types and applications.	1	3

		Instructional Hours	15Hrs
Suggested Learning Methods : Presentations and Video lectures			**02 Hrs**
IV	**Chromatography:** Principles, Instrumentation, Types and Detection methods – Ion- exchange, Column, Paper Chromatography, TLC, HPLC, GC, GCMS, LCMS, Chromatography Applications.	1	4
		Instructional Hours	15Hrs
Suggested Learning Methods : Videos and demonstration			**02 Hrs**
V	**Electrophoresis:** Principles, Instrumentation, Types. Staining and Detection methods – Isoelectrophoresis – isoelectric focusing – Applications MALDI-TOF, 2D gel electrophoresis Native PAGE and SDS-PAGE.	1	4
		Instructional Hours	15
Suggested Learning Methods : Seminars and Group learning			**02 Hrs**
		Total Hours	75 **Hrs**

Text Books	1. Rodney Boyer. **Biochemistry Laboratory Modern theory and techniques** 2rd Edition, Pearson Education, 2012 edition 2. Keith Wilson and John Walker. **Principles and Techniques in Practical Biochemistry**, 7th Edition, Cambridge University Press, 2000.
Reference Books	1. Kathleen Talaro and Arthur Talaro. **Foundation in Microbiology**. WCB Publishers. 1993. 2. David Freifelder. **Physical Biochemistry**. (2nd Edition) 3. 3. Prescott, L.M J.P. Harley and C.A. Klein. **Microbiology,** 2nd Edition Wm, C. Brown publishers. 1995. 4. Marion G. Macey. Flow **Cytometry Principles and Applications**. 5. Wilson Keith and Walker John, Principles **and Techniques of Biochemistry and Molecular Biology**, 6th Edition. Cambridge University Press, New York, 2005
Web. URLs	1. https://www.saylor.org/site/wp-content/uploads/2012/07/Chapter121.pdf 2. http://gnu.inflibnet.ac.in:8080/jspui/bitstream/123456789/1262/1/colorimetry.pdf.

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	L	L	H	H	M	H	H	M	L	L	H
CO2	H	H	M	L	H	H	M	H	L	M	L	L	H
CO3	H	H	M	M	H	L	M	H	L	L	H	M	H
CO4	H	H	M	M	H	H	L	H	H	M	H	M	M
CO5	H	H	M	M	H	H	L	H	M	M	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBC104	Environmental and Agricultural Microbiology		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To gain understanding the role of microbes in soil physiology, as well as air pollution and its sources and causes, as well as environmental contamination and toxicology, environmental health, monitoring, technology, geology, and management
Course Category	Skill Development
Development Needs	Global
Course Description	Acquire knowledge about different microbes from air, soil and water Pollution and their water borne diseases, biogeocycles. And the use of biofertilizer and chemical fertilizer.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Acquire the knowledge of different microbes from air, air sanitization and air sampling by using various techniques.	Lecture	Assignment
CO 2	Understand the factors influencing presence of and activities of microorganisms in different soils.	Lectures/ Video lessons	Seminar
CO 3	Know the Microorganisms responsible for water pollution especially Water-borne pathogenic microorganisms and their transmission.	Lectures / Video Lessons	Assignment
CO 4	Understand various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc. and microbes involved.	Lectures/ Video lessons	Assignment
CO 5	Understanding the use of Biofertilizers is being emphasized along with chemical fertilizers and organic manures.	Lectures and Videos	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Aerobiology**-Microbial contamination of air-Biological indicators of air pollution. Air sampling Devices. Significance of air Microflora, Air sanitation- methods and applications. Room sanitation in Hospitals, Industries and Pharmaceuticals etc. Outline of Airborne diseases and preventive measures. Effect of Air pollution on plants and Humans.	2	15
	Instructional Hours		**15Hrs**
Suggested Learning Methods: Video Lectures			**02 Hrs**
II	**Soil Microbiology**-Structure, Types, Physical and Chemical properties-Soil microbes (Types and Enumeration). Soil as a source of industrial strains. Biogeochemical cycling-Nitrogen, Carbon, Phosphorous, Sulphur, Iron cycles and its importance alkalophilic, osmophilic and psychrophilic.	1	2
	Instructional Hours		**15Hrs**
Suggested Learning Methods: Demonstration and Presentation			**02 Hrs**

III	**Water Microbiology-** Water Pollution and Waterborne Pathogens- Assessment of water quality (Microbial) Bacteriological examination of water-Indicator organisms. Bacteriological analysis of drinking water and other quantitation techniques; drinking water purification. Waste water- Sources, types, composition and characteristics (DO, BOD, COD). Microbiology of waste water. Sewage treatment.	1	9-11
		Instructional Hours	15Hrs
Suggested Learning Methods : Presentations and Video lectures			**02 Hrs**
IV	**Microbial interactions:** Positive and Negative interactions. Microbial flora of soil. Plant – Microbe interactions:-.Nitrogen fixation- Symbiotic and non-symbiotic, physiology and genetics of nitrogen fixation. Mycorrhizae, Rhizosphere and Phylloplane microorganisms. Animal-Microbe Interactions - Rumen microflora, Nematophagous fungi, Bioluminescent bacteria, Termite nutrition	2	48
		Instructional Hours	15Hrs
Suggested Learning Methods : Videos and demonstration			**02 Hrs**
V	**Applications of microbes in agriculture:** Biofertilizers. Mass production of biofertilizers. Bio pesticides- bacterial, fungal and viral. Advantages and disadvantages of biopesticides over the chemical counterparts. GM crops and its significance.	2	14,15, 37 & 45
		Instructional Hours	15
Suggested Learning Methods : Seminars and Group learning			**02 Hrs**
		Total Hours	**75Hrs**

Text Books	1. Subba Rao N.S. **Soil microbiology**, 4th Edition Oxford and PHB publishers. 2020. 2. Vijay Ramesh.K. **Environmental Microbiology.** 2019.
Reference Books	1. Gupta P.K. **Biotechnology and genomics,** Rastogi Publications. 2013. 2. Larry. L. Barton, **Microbial Ecology**, Atlas and Bartha. 1st Edition. 2011. 3. Singh DP& SK Dwivedi. **Environmental Microbiology and Biotechnology.** 1st Edition, New Age International (P) Ltd., Publishers, New Delhi. 2005. 4. Joseph C Daniel. **Environment Aspects of Microbiology.**1st Edition, Bright sun Publications, Chennai. 1999.
Web. URLs	1. https://drive.google.com/file/d/1R7kCrPX14ejScvHuEAxIs3a1N9NC1EdO/view?usp=sharing 2. https://drive.google.com/file/d/1kz/Q4K6Ta8pHneJxzdRcuqFG7UOhWq9y/view?usp=sharin

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	L	L	H	H	M	H	H	M	L	L	H
CO2	H	H	M	L	H	H	M	H	L	M	L	L	H
CO3	H	H	M	M	H	L	M	H	L	L	H	M	H
CO4	H	H	M	M	H	H	L	H	H	M	H	M	M
CO5	H	H	M	M	H	H	L	H	M	M	H	H	M

H-High; M-Medium; L-Low	
Course designed by	**Verified by**

Course Code	Title		
22PGMBQ101	Core Practical I: Lab in General and Analytical Microbiology		
Semester: I	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To develop skills to isolate and identify the microorganisms
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	Gain knowledge on sterilization techniques and develop skills to isolate and identify the microorganism on the basis of morphology by staining techniques and cultural characteristics.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	To understand about the laboratory guidelines for safety and about different sterilization methods.	Lecture / Hands on training	Behaviour
CO 2	To develop skills to identify the morphology of microorganisms by performing different staining techniques.	Hands on training / Video lectures	Observation and performance
CO 3	To acquire knowledge on media preparation, culture techniques and preservation of microorganisms.	Hands on training	Performance
CO 4	To understand and develop skills on cultivation of anaerobic microorganisms	Hands on training	Performance
CO 5	To demonstrate the working principles of advanced instruments.	Demonstration	Observation

Offered by	Microbiology

Course Content	Instructional Hours / Week : 5

Exp. No.	Experiments
1	Laboratory precautions, basic Lab glass wares.
2	Methods of Sterilization - Principles and Methods - Physical Methods - Dry heat - Hot Air Oven, Moist heat –Autoclave, Chemical methods - Alcohols, Aldehydes
3	Bacterial Staining - Simple, Grams, Acid fast, Spore, Capsule
4	Isolation of bacteria and fungi from food waste samples
5	Culture media preparation, Liquid and Solid media. Types of media - Simple, Defined, Complex, Enriched, Enrichment, Differential, Selective, transport and Anaerobic media
6	Pure Culture Techniques – Pour plate, Spread plate and Streak plate
7	Enumeration of Bacteria, fungi and Actinomycetes from soil
8	Cultural Characteristics of Microorganisms

9	Measurement of microbial cell load – Turbidometry method
10	Isolation of bacteria from samples by Standard Plate Count
11	Cultivation of Anaerobic Bacteria - Robinson's Cooked meat media, Wright's tube method
12	Micrometry – Size and Shape of an Organism
13	Advanced Lab Instrumentation – Thermal cycler, Spectrophotometer, SDS PAGE, Blotting, HPLC, GCMS
	Instructional Hours | **75 Hrs**
Text Books	1. Rajan S and Selvi Christy R. Experimental Procedures in Life Sciences. Anajana Book House, Chennai, 2015. 2. James G Cappuccino and Natalie Sherman. Microbiology – A Laboratory Manual. Pearson Education Limited, 2017.
Reference Books	1. Dubey R C and Maheshwari D K., Practical Microbiology. S Chand and Co. Ltd., New Delhi, 2002. 2. P. Gunasegaram, Laboratory Manual in Microbiology. New Age International. 2007.
Web. URLs	1. https://microbenotes.com/fields-of-microbiology/ 2. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/1%3A_Introduction_to_Microbiology/1.3%3A_The_Science_of_Microbiology/1.3B_Applied_Microbiology

Tools for Assessment (50 Marks)

Laboratory Performance			Test I	Test II	Observation Note Book	Total
Level of Engagement in Lab	Preparation	Result				
8	8	8	10	10	6	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	M	M	H	H	M	M	H	M	M
CO2	H	M	H	H	M	H	M	M	H	H	H	M	M
CO3	M	H	M	M	M	H	L	H	H	M	M	H	M
CO4	L	M	M	H	M	M	H	H	H	M	L	H	H
CO5	L	H	H	M	L	H	L	M	M	M	L	M	L

H-High; M-Medium; L-Low

Course designed by	Verified by

SEMESTER – II

Course Code	Title		
22PGMB205	Paper V - Microbial Genetics and Molecular Biology		
Semester: II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To make the students to gain knowledge about the structure and function of biologically important molecules. Students will gain inputs of how the DNA, RNA and the molecular events that governs the cell functions.
Course Category	Employability
Development Needs	Global
Course Description	This course develops concept of Microbial genome organization, DNA, RNA, (Prokaryotic and Eukaryotic), Viral Genetics, Mutagenesis, Bacterial plasmids as research tools, transcription and translation in prokaryotes and eukaryotes and application of microbial genetics.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Describe the structure and function of DNA and RNA in a cell	Video Lecture	Assignment
CO 2	Elucidate the biological process in the cell and the regulation	Video Lecture	Seminar
CO 3	The RNA synthesis and the control mechanisms is understood	Video Lessons	Quiz
CO 4	To understand how molecular transformation process happens	Video Lessons	Assignment
CO 5	To understand and comprehend DNA repair and recombination	Presentations	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**DNA**: Discovery of DNA as a genetic material, Structure, Salient features of double helix, Types of DNA, denaturation, and renaturation, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure	1	10
	Instructional Hours		**15Hrs**
Suggested Learning Methods : Group Learning			**02 Hrs**
II	**Replication:** Bidirectional and Unidirectional replication, semi-conservative, semi-discontinuous replication, Mechanism of DNA replication; Enzymes and Proteins involved in DNA replication -DNA polymerases, DNA Ligase, Primase, telomerase-for replication of linear ends.	3	3
	Instructional Hours		**15Hrs**
Suggested Learning Methods: Group learning and Videos			**02 Hrs**
III	**Transcription:** Definition, Promoter, concept, and strength of promoter. Transcriptional machinery and mechanisms of transcription. Reverse transcription, Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons.	1	13

		Instructional Hours	15Hrs
Suggested Learning Methods : Group learning			**02 Hrs**
IV	**Transformation:** Discovery, Mechanism of natural competence conjugation- Discovery, Mechanism, Hfr and F^+ strains Transduction-Generalized transduction, specialized transduction. Property and functions of plasmids, types of Plasmids.	2	15
		Instructional Hours	15Hrs
Suggested Learning Methods : Seminars and Presentation			**02 Hrs**
V	**DNA repair and recombination:** DNA Mismatch Repair, Double strand, break and repair, Recombination as a molecular biology tool mutations and mutagenesis. Definition and types of mutations; Physical and chemical mutagens; Uses of mutations.	1	18
		Instructional Hours	15
Suggested Learning Methods : Seminars and Group learning			**02 Hrs**
		Total Hours	75 **Hrs**

Text Books	1. Benjamin A. Pierce, Genetics- **A Conceptual Approach** W.H. Freeman and Company, 5th 2014. 2. Peter J. Russel, Genetics- **A Molecular Approach**. Pearson Education Inc., Third edition, 2010.' 3. Primrose, S.B., R.M Twyman , **Principles of Gene manipulation and Genomics**, Black well Publishing, Seventh edition 2006.
Reference Books	1. James D. Watson, Alexander Gann, Tania A. Baker, Michael Levine, Stephen P.Bell Rishardlosick, **Molecular Biology of Gene,** Cold Spring Harbor Laboratory Press. New York, 7th edition, 2017.\ 2. Primrose S.B.,R.,M Twyman and R.W.Old, Principle of Gene manipulation Sixth edition, Blackwell Science Publishing, 2008. 3. Brown T.A. Gene Cloning and DNA Analysis- An Introduction, Wiley Blackwell publishing, 2016, 7th edition
Web. URLs	1. https://ocw.mit.edu/courses/hst-161-molecular-biology-and-genetics-in-modern-medicine-fall-2007/.

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	L	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	M	H	H	H
CO3	H	H	L	M	H	H	H	H	H	H	H	M	H
CO4	H	L	L	L	H	H	H	H	H	H	H	H	H
CO5	H	M	L	M	H	H	H	H	H	H	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMB206	Paper VI - Immunology		
Semester: II	Credits: 4	Semester: II	Credits: 4

Course Objective	To make the students to gain knowledge on techniques commonly performed in a microbiology laboratory
Course Category	Employability
Development Needs	Global
Course Description	Course covers the study of the molecular and cellular interactions and principles of the immune system. Topics include immune system development, humoral & cell-mediated immunity, disease and treatments involving immunization, immunodeficiency, and autoimmunity.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Gain knowledge about the cells and organs of the immune system	Lecture / Flipped Classroom	Assignment
CO 2	To gain knowledge about the antibody reaction and determination	Tutorial / Videos	Seminar
CO 3	Acquire knowledge about various types of antigens and antibodies	Lectures / Video Lessons	Model Preparation
CO 4	To understand the various types of hypersensitive reactions and allergic reactions	Tutorial / Case Studies	Quiz
CO 5	To understand and explain the basis of immunological tolerance, autoimmunity, and transplantation and to understand and explain the immune system in cancer; tumour immunology and principles of immunotherapy	Lecture / Video Lectures	Assignment

Offered by | **Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Cells and Organs of Immune system** : Cells of the immune system- lymphoid cells, mononuclear cells, granulocytic cells, mast cells. T&B -cell maturation, activation, and differentiation. Organs of the immune system	2,3	3,2
		Instructional Hours	**15**
Suggested Learning Methods : Video lectures			**02 Hrs**
II	**Antigen -Antibody reactions:** Agglutination and precipitation, Immunoelectrophoresis, Complement fixation test, Immunofluorescence, ELISA, RIA, Immunoelectron microscopy, Forensic serology, Immunohematology- ABO, RH incompatibility.	1,3	13,6
		Instructional Hours	15
Suggested Learning Methods : Demonstration			**02 Hrs**

III	**Antigens and Immunoglobulin's:** Factor influence immunogenicity -Haptens- study of antigenicity, Immunoglobulin's-structure, types of biological activities. Antigenic determinants, Monoclonal antibodies.	1,3	11,14
		Instructional Hours	15
Suggested Learning Methods : Videos			**02 Hrs**
IV	**Hypersensitive reaction-** Types of hypersensitivity I-V reactions, complement system- classical, lectin pathways, biological consequences. T-cell receptor, cytokines – Structure, functions, and receptors.	3	7,13
		Instructional Hours	
Suggested Learning Methods :			**02 Hrs**
V	**Antigen processing and Presentation:** Transplantation immunology- Transplantation antigens, HLA typing. Tumour immunology- treatment of tumours. Immune response to infectious disease	1,3	19,20
		Instructional Hours	15
Suggested Learning Methods : Laboratory practice			**02 Hrs**
		Total Hours	75 Hrs

Text Books	**1.** Ananthanarayan, R., and Panicker, C.K.J., Text Book of Microbiology. Orient Longman, New Delhi, 2004. **2.** Coleman, R.M., Lombard, M.F., Sicard, R.E., Fundamental Immunology, 4th edition, Wm.C. Publishers. London.2000 3. Goldsby, RA., Barbara, T.J.K., and Osborne, A., Kuby Immunology, 6th edition, W.H Freeman and Company, New York, 2006
Reference Books	1. Coleman, R.M., Lombard, M.F and Sicard, R.E., Fundamentals of immunology, 4th edition, WMC Publications. London, 2000 2. Hyde, R.M. NMS-Immunology. 4th edition, Lippincott Williams and Wilkins Baltimore, 2000. 3. Janeway, Jr. C.A., Walport, P.T.M., and Shlomchick, M.J., Immunobiology-The Immune system in Health and Disease, 5th edition, Churchill Livingstone-Garland Publishing company, New York, 2001
Web. URLs	https://www.roitt.com/

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	L	M	M	M	L	H	H	H	M	H
CO2	H	H	H	L	H	L	L	M	H	M	H	H	M
CO3	H	M	L	M	M	L	H	H	H	H	H	M	H
CO4	H	L	M	M	M	H	L	M	H	H	H	H	H
CO5	H	L	M	M	H	H	H	H	H	H	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBC207	Core Paper VII: Microbial Food Technology		
Semester: II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks
(Common to all PG Programmes)			

Course Objective	To gain the knowledge of various types of food spoilage and an understanding the principles of food processing and to improve the food quality for the general public
Course Category	Employability / Entrepreneurship
Development Needs	Global
Course Description	Food borne pathogens caused by spoiled food and methods used to preserve them by physical methods. Also understand the importance of HACCP protocols

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand about the growth factors required for the growth and food spoilage mechanism	Lecture / Chalk and talk	Assignment
CO 2	Gain knowledge about the food borne pathogens	Lectures / Video Lessons	Seminar
CO 3	Analyse about the microbiological examination of food and their preservation techniques	Lectures / Case study	Quiz
CO 4	Know about the use of microorganisms in food industries for public health benefits	Tutorial / Group Discussion	Seminar / Assignment
CO 5	Gain knowledge on production of industrially important compounds	Lecture / Tutorial	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**The Scope of Food Microbiology:** Microorganism and food, Food preservation, Food safety. **Microbial growth:** Intrinsic factors, Nutrient content, pH, anti-microbial barrier and constituents, Extrinsic factors: relative humidity, temperature, Gaseous atmosphere.	1	1,3
	Microbiology of primary food commodities: Spoilage, Spoilage of meat, Structure and composition, Spoilage of fresh meat, Spoilage of fish, structure and composition, spoilage of fresh fish.	1	4,5
		Instructional Hours	**15**
Suggested Learning Methods : Video lectures about the factors influencing growth and spoilage of meat			**02 Hrs**
II	**Food borne diseases**: Introduction to Foodborne Pathogens, Host invasion, Pathogenesis. Staphylococcal Gastroenteritis, Habitat, distribution, nutritional requirement and growth.	2	7,22

	Fermented milk products: Dairy products, Milk biota, Cheese, Butter. Health benefits of fermented milk, Anti-cancer effect, probiotics. Botulism, Salmonellosis, Gastroenteritis, Shigellosis and Yersiniosis.	2	26
		Instructional Hours	15
Suggested Learning Methods : Prepare a chart distinguishing the pathogens which cause spoilage			**02 Hrs**
III	**Microbiology of food preservation:** Preservation by use of High temperature, Low temperature, Canning, Drying, Radiation and Food additives. Heat processing - Pasteurization, Appertization**,** Quantifying Thermal Death of microorganism D values, Aseptic packaging methods**.**	1	3,4
	Methods for the Microbiological Examination of Foods: Indicator organism, Direct examination, Rapid Methods for the Detection of Specific Organisms and Toxins, Laboratory Accreditation.	1	10
		Instructional Hours	15
Suggested Learning Methods : Laboratory practice			**02 Hrs**
IV	**Food Microbiology and Public Health:** Food Hazards, Significance of Foodborne Disease, Risk Factors Associated with Foodborne Illness, The Alimentary Tract: Its Function and Microflora.	3	6
	Chemical Preservatives: Nitrite, Sulfur Dioxide, 'Natural' Food Preservatives, Control of Water Activity.	3	4
		Instructional Hours	15
Suggested Learning Methods : Video lectures about the hazards caused by the foodborne pathogens			**02 Hrs**
V	**Production of Industrially important compounds:** Organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum), glycerol. Propagation of baker's yeasts; Microbial production of vitamins (B2 and B12), antibiotics (penicillin, streptomycin, tetracycline); Enzymatic production of glucose, fructose, starch, SCP and mushrooms	3	9
		Instructional Hours	15
Suggested Learning Methods : Video lectures and visit to the industry			**02 Hrs**
		Total Hours	75 Hrs

Text Books	1. M.R. Adams and M.O. Moss, Food Microbiology. 2nd Edition. Royal society of chemistry. Thomas Graham House, science park, Cambridge. 2005. 2. James M Jay, Martin J. Loessner, David A. Golden. Modern Food Microbiology. 7th Edition. Springer Science,.2005. 3. Martin R. Adams and Maurice O. Moss. Food Microbiology. 3rd edition, Royal society of chemistry. Thomas Graham House, Science Park, Cambridge. 2008.
Reference Books	1. Jay, J.M. Modern Food Microbiology. Van Nostra and Rainhokdd Co. 4th Edition. 1991. 2. Roday. S. Food Hygiene and Sanitation. 2nd edition, Tata McGraw Hill

	Publications, 2011.
Web. URLs	1. https://rua.ua.es/dspace/bitstream/10045/39959/1/Lesson2AMIC-ARA-RUA.pdf 2. https://www.davuniversity.org/images/files/study-material/methods%20for%20detecting%20food%20borne%20pathogens.pdf

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	M	M	H	M	H	H	M	M	H	M	L	L
CO2	M	M	H	H	M	H	H	H	H	M	M	H	M
CO3	H	H	M	H	H	M	M	H	H	M	L	H	M
CO4	H	M	M	H	M	H	H	M	M	H	M	M	H
CO5	H	H	H	M	M	H	M	M	H	H	L	L	M

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBC208	Core Paper VIII: Bioprocess Technology		
Semester: II	Credits: 4	CIA: 50 Marks	ESE: 50 Marks
(Common to all PG Programmes)			
Course Objective	To gain knowledge about fermenter and develop skill with emphasis on screening, strain improvement methods and microbial production of various metabolites by using fermenter		
Course Category	Skill Development / Employability		
Development Needs	Global		
Course Description	Design, types and importance of fermenter in product production on the basis of growth kinetics and the importance of strain improvement for product production.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand about the basic design of fermenter and its types	Lecture / Chalk and talk	Assignment
CO 2	Gain knowledge about the physical factors required for fermentation process and the sterilization process	Lectures / Video Lessons	Seminar
CO 3	Attain technical knowledge on bacterial growth kinetics.	Lectures / Tutorial	Quiz
CO 4	Demonstrate the screening and strain improvement of industrially important organisms.	Lectures / Group Discussion	Seminar / Assignment
CO 5	Analyse the types of microbial products produced by using fermenter and downstream processing.	Lecture / Tutorial	Seminar

Offered by	Microbiology

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Basic Design of Fermenter:** Design of a basic fermenter, bioreactor configuration, design features, computer control of fermentation process, measurement and control of process. Types of Bioreactors and its functions. Applications of computer in fermentation technology. Fermentation economics.	1	15
		Instructional Hours	**15**
Suggested Learning Methods : Video lectures about the design and features of fermenter			**02 Hrs**
II	**Physical factors and scale-up:** Transport phenomena in fermentation: Gas-liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, heat transfer, aeration/agitation, its importance. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control, scale-up of bioreactors.	3	6

		Instructional Hours	15
Suggested Learning Methods : Prepare a flow chart or diagrammatic representation on working mechanism of fermenter			**02 Hrs**
III	**Cultures in the fermenter:** Growth of cultures in the fermenter. Importance of media in fermentation, media formulation and modification. Kinetics of growth in batch culture, continuous culture with respect to substrate utilization, specific growth rate, steady state in a chemostat, fed-batch fermentation, yield of biomass, product, calculation for productivity.	4	2
		Instructional Hours	15
Suggested Learning Methods : Practice for the media formulation, sterilization and prepare flow chart for determination of growth kinetics			**02 Hrs**
IV	**Strain improvement & Preservation:** Isolation, selection and improvement of microbial cultures. Strain improvement for the selected organism: Use of recombinant DNA technology, protoplast fusion techniques for strain improvement.	2	6
	Improvement of characters other than products and its application in the industry. Preservation of cultures after strain improvement programme.	3	4
		Instructional Hours	15
Suggested Learning Methods : Video lectures on the screening and strain improvement			**02 Hrs**
V	**Microbial Products and Downstream process:** Enzymes - Introduction, Immobilized enzyme system, large-scale production, medical and industrial application. Downstream process of microbial products (Peptides, biopolymers, surfactants, enzymes) - separation, extraction and purification, drying, crystallization centrifugation, filtration, freeze-drying, spray drying.	3	7,9,10,11
		Instructional Hours	15
Suggested Learning Methods : Video lectures and group project			**02 Hrs**
		Total Hours	75 Hrs

Text Books	1. Mansi, E.M.T., and Bryce, C.F.A., Fermentation Microbiology and Biotechnology. 3rd edition, Taylor and Francis, NewYork, 2012. 2. McNeil. B and Harvey, L.M. Practical Fermentation Technology, John Wiley & Sons, Ltd., 2008. 3. Waites, M., Morgan, N.L., Rockey, J.S., Higton, G. Industrial Microbiology: An Introduction, Wiley, 2001. 4. Stanbury, P.T., A. Whitaker and S.J. Hall. Principles of Fermentation Technology, Pergamon Press. NY, 2016.
Reference Books	1. Patel, A.H. Industrial Microbiology. McMillan India Ltd. NewDelhi, 2003. 2. Reed,G. Presscott and Dunn's Industrial Microbiology. 5th edition, CBS Publishers, New Delhi, 2002.
Web. URLs	1. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/17%3A_Industrial_Microbiology 2. https://www.cheric.org/files/education/cyberlecture/e200402/e200402-401.pdf 3. http://technologyinscience.blogspot.com/2012/08/different-types-of-fermentors.html#.YygApz1BzDc

Tools for Assessment (50 Marks)						
CIA I	**CIA II**	**CIA III**	**Assignment**	**Seminar**	**Quiz**	**Total**
8	**8**	**10**	**8**	**8**	**8**	**50**

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	M	H	M	M	L	H	H	H	M	H	H
CO2	M	M	M	H	M	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	M	M	H	M	H	H	H
CO4	H	H	M	M	H	M	M	H	H	H	H	H	M
CO5	M	H	H	H	H	H	H	M	H	M	M	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBQ202	Practical II – Lab in Food Microbiology and Immunology		
Semester: II	Credits: 4	Semester: II	Credits: 4

Course Objective	Students get hands on experience on the experiments related to molecular biology and immunology
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	This course will cover the basics of microbiology and immunology followed by the role of microorganisms in foodborne illness and intoxication, food spoilage, general food quality, food processing and preservation, and microbes in food health

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	They will learn to carry out routine analysis of potable water and rapid detection of *E coli* by MPN technique.	Lecture / Demonstration	Assignment
CO 2	The students will have a fair knowledge of food spoilage and preservation techniques used in the food industry.	Tutorial	Behaviour
CO 3	They will be competent to take up the role of microbiologists in the Food and Dairy Industry.	Lectures / Video Lessons	Performance
CO 4	Perform various serological techniques.	Hands on	Observation
CO 5	Perform various immunotechniques.	Demonstration	Observation

Offered by **Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
1.	Enumeration of microorganisms in foods		
2.	Collection, sampling and microbiological analysis of food materials from local vendors.		
3.	Study of microflora in fermented foods - Isolation of microbes from yoghurt, curd.		
4.	Dairy Microbiology - Direct microscopic count and standard plate count		
5.	Methylene blue reductase test		
6.	Production of wine		
7.	Demonstration of microbial succession		
8.	Demonstration of microbial antagonism		
9.	Agglutination reaction: Blood grouping.		
10.	Serological tests: WIDAL, ASO, CPR, RPR		
11.	Precipitation reaction: ODD, RID		
12.	Immunoelectrophoresis: Counter current and Rocket electrophoresis		

13.	ELISA
	Total Hours **75 Hrs**
Text Books	James G. Cappuccino and Chad Welsh. **Microbiology A Laboratory Manual**. PearsonEducation Limited. 11th edition. 2017. Aneja, K. R. **Experiment sin Microbiology, Plant Pathology and Biotechnology**. NewAge International (P) Limited Publisher. 2014. Richard. K. Robinson. Dairy Microbiology Handbook. 3rd Edition. A John Wiley & Sons, Inc., Publication. 2002
Reference Books	Dixit, R., K. Bisen, A. Kumar, A. Borah and C. Keswani. **Lab Manual in MolecularBiology**.1st edition. 2016. Goldsby, R. A., T. J. Kindt, B. A. Osborne and J. Kuby. **Immunology**, 5th edition.W.H.Freeman and Company, 2003.
Web. URLs	https://www.classcentral.com/course/swayam-experimental-biochemistry-12909

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	8	10	10	6	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	H	H	H	H	H	H	H	H	M	H	H
CO2	M	H	H	H	H	H	H	H	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	H	M	H	H	H
CO4	H	H	H	M	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H	M	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by

ELECTIVES

Course Code	Title		
22PGMBE101	Elective Paper I – Group A – Principles of Quality Assurance in Food		
Semester : I	Credits : 4	Semester : I	Credits : 4

Course Objective	To make the students to gain knowledge on techniques commonly performed in afood industry
Course Category	Employability
Development Needs	Global
Course Description	Typical QA and QC programs, such as the good manufacturing practices (GMP) and the hazard analysis and critical control points (HACCP), together with the new regulations related to the Food Safety Modernization Act (FSMA).

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Develop knowledge on food hazards.	Lecture / Flipped Classroom	Assignment
CO 2	Improve management of quality assurance in food industry.	Tutorial	Seminar
CO 3	Create step by step operating procedures and work on instructions.	Lectures / Video Lessons	Quiz
CO 4	Understand food safety and good manufacturing practices.	Tutorial / Case Studies	Seminar
CO 5	Gain knowledge on food safety microbial standards and applications.	Lecture / Industrial Visit	Quiz

Offered by **Microbiology**

Course Content **Instructional Hours / Week : 5**

Unit	Description	Text Book	Chapters
I	**Food Safety and Hazards in Food:** Definition, Biological hazards in foods - Pathogenic bacteria, viruses, parasites. Chemical hazards in foods - Permitted food additives, Naturally occurring harmful compounds, Unavoidable contaminants, Agricultural residues, Industrial contaminants, Chemical residues, Prohibited chemicals, Food allergens. Physical hazards in foods - Broken glass, Plastic, Metal pieces, Wood pieces, Stones, Personal articles.	1	2
		Instructional Hours	**15**
Suggested Learning Methods : You tube videos			**02 Hrs**
II	**Quality Assurance**: Theories and Applications, Functions of a Quality Assurance Program, Careers in Quality Assurance, QA Responsibilities and Operational Interactions, Need for and Roles of QA, Organization of a QA Program, QA Personnel, QA Audits, Product Quality Audits.	2	3
		Instructional Hours	15
Suggested Learning Methods : Interactions / Group Discussions			**02 Hrs**

III	**Manufacturing Audits - Control of Processing Operations**: Objectives, elements, education, training, Process control documentation, Unit Operations in the Food Industry - Materials Handling, cleaning, separation, disintegration, pumping, mixing, heating, cooling, evaporating, drying, packaging.	2	6
		Instructional Hours	15
Suggested Learning Methods : Industrial Visit			**02 Hrs**
IV	**Good Manufacturing Practice Audits**: Food Plant Sanitary Practices, Value of a Planned Sanitation Program, Quality Assurance and Sanitation, Food Plant Sanitation Management, Employee Hygiene and Sanitary Handling of Food, Sanitation and Housekeeping, Pest Control in Food Processing Plants, Sanitation Laws and Regulations, The Sanitation/GMP Audit.	2	7
		Instructional Hours	15
Suggested Learning Methods: Group Discussion			**02 Hrs**
V	**HACCP:** Concept, importance, advantages, guidelines, training, program development, principles, Implementation and maintenance of HACCP program, regulatory aspects of HACCP, sanitation and the HACCP concept.	2	9
		Instructional Hours	15
Suggested Learning Methods: Group Discussion / Industrial Visit			**02 Hrs**
		Total Hours	**75 Hrs**

Text Books	1. Inteaz Alli. Food Quality Assurance: Principles and Practices, CRC Press, 2003. 2. Andres Vasconcellos J., Quality Assurance for the Food Industry: A Practical Approach. CRC Press, 2003.
Reference Books	1. Jay JM, Loessner MJ, Golden DA. **Modern Food Microbiology**, 7th Edition. Springer,2005. 2. Rosamund M. Baird, Norman A. Hodges and Sephen P. Denyer. **Handbook ofMicrobiological Quality Control**, CRC Press, 2000.
Web. URLs	1. https://www.academia.edu/41208822/Food_Quality_Management_Notes 2. http://foodtechnotes.com/category/quality-control-and-quality-assurance-and-tqm/.

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	M	H	H	H	H	M	H	H	L	L	H
CO2	H	H	M	M	H	H	H	H	H	H	L	L	H
CO3	H	H	H	H	H	H	M	M	M	M	M	L	H
CO4	H	H	M	H	H	H	H	H	M	M	H	M	H
CO5	H	H	M	M	H	H	M	H	M	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBE102	Elective Paper I – Group B – Diagnostic Microbiology		
Semester:1	Credits: 04	CIA: 50 Marks	ESE: 50 Marks

Course Objective	To assimilate Knowledge across diagnostic procedures in microbiology
Course Category	Skill Development, Employability and Entrepreneurship
Development Needs	Global/Local/Regional
Course Outcomes	This is a skill-oriented course that will help the student to acqui8re the practical skills that will enable them to get employment in hospitals or to start their own laboratories and become an Entrepreneur

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Develop Knowledge and awareness of the basic principles and concepts of infections	Chalk & talk	Seminar
CO 2	Acquire knowledge on the diagnostic skills of bacterial infections	Videos	Assignment
CO 3	Understand the fungi and the diagnostic skills of fungal infections	Videos	Assignment
CO 4	Provide diagnostic skills to identify Viral infections	Practical	Quiz
CO 5	Apply the knowledge on the diagnostic skills of parasitic infections	Charts Model and Practical	Seminar and group discussion

Offered by	**Microbiology**

Course Content	Instructional Hours / Week : 05

Unit	Description	Text Book	Chapters
I	Infection – Definition ,Types, Sources and Mode of transmission- Selection, collection and transport of specimens – Blood, Urine, Sputum, CSF, Pus & Faeces – transport media and storage.	1,5,6	15
		Instructional Hours	**15**
Suggested Learning Methods :Video and Experiments			
II	Microscopic examination of specimen for Bacterial pathogens – simple, differential staining and motility. Identification of organisms - Biochemical reaction – Sugar fermentation test Antimicrobial susceptibility testing	1,5,6	20
		Instructional Hours	20
Suggested Learning Methods: Video and Experiments			
III	Laboratory methods in basic Mycology – Collection and transport of clinical specimens – Direct Microscopic examination, KOH method, culture media and incubation, Serological tests for fungi – Antifungal susceptibility testing.	3	10
		Instructional Hours	12
Suggested Learning Methods : Demonstration			
IV	General Structure, Properties and Classification, Spread of viral infections and diagnosis of Viral infections- Hepatitis and HIV- ELISA, IFT,	3	15
		Instructional Hours	

Suggested Learning Methods : Experiments and Demonstration			
V	Laboratory methods for parasitic infections – Diagnostic techniques for gastrointestinal and urino-genital specimen. Parasitic diseases- *Entamoeba histolytica, Taenia solium, Enterobius,* and *Plasmodium vivax,*	2	15
		Instructional Hours	15
		Total Hours	**75** Hrs

Text Books	1. 1.Textbook of Microbiology, Ananthanarayanan and Jayaram Panicker 2. Text book of Medical Parasitology - Jayaram Panicker 3. Clinical Mycology – Eliasw.J. Michael.R 4. Textbook of Medical Microbiology- Geo.F. and Brooks.S
Reference Books	1. Bailey and Scotts - Diagnostic Microbiology, Mosby, Inc, 2. Medical Microbiology – Jawetz 3. Virology, Textbook of Microbiology, Ananthanarayanan and Jayaram Panicker
Web. URLs	https://microbiologysociety.org/members-outreach-resources/links.html

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Quiz	Assignment	Seminar	Total
08	08	10	08	08	08	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H	H	H	H
CO3	M	M	M	M	M	M	M	M	M	M	M	M	M
CO4	M	M	M	M	M	M	M	M	M	M	M	M	M
CO5	L	L	L	L	L	L	L	L	L	L	L	L	L

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBE103	Elective Paper I – Group C – Fundamentals of Plant Tissue Culture		
Semester : I	Credits : 4	Semester : I	Credits : 4

Course Objective	To learn the basics of plant tissue culture for rapid clonal propagation *in vitro*
Course Category	Skill Development
Development Needs	Global
Course Description	Principles and culture techniques of cells, callus, organs, pollen, anthers, embryos, and protoplasts. The applications in clonal propagation and research in breeding, physiology, and pathology.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand on basic development of plant tissue culture.	Lecture	Assignment
CO 2	Gain knowledge on the setup of laboratory and sterilization techniques.	Flipped Classroom	Seminar
CO 3	Acquire knowledge on media used for culture techniques and their preparation.	Lectures / Videos	Quiz
CO 4	Understand the different concepts of tissue culture.	Case Studies	Assignment
CO 5	Learn the techniques for production of plants through *in vitro* condition.	Lecture / Demonstration	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Introduction to Plant tissue culture:** Origin and development, history, scope and applications, culture room and vessels, medium constitution and functions of each element, growth regulators; Setting up of primary culture.	1	1
		Instructional Hours	**15**
Suggested Learning Methods: Demonstration			**02 Hrs**
II	**Laboratory design and sterilization techniques:** Washing and storage facilities, Media preparation room, Transfer area, Culture room, Data collection area and specialized facilities and Transplantation area. Sterilization techniques – Dry heat, flame, moist heat, filter, surface sterilization.	2	2
		Instructional Hours	15
Suggested Learning Methods : Group Learning			**02 Hrs**
III	**Tissue Culture Media and Preparation:** Media composition, Types of media, Media preparation, Selection of new media, sterilizing the culture vessels and media, Aseptic culture technique	2 1	3 & 4 3
		Instructional Hours	15
Suggested Learning Methods : Hands on training			**02 Hrs**
IV	**Concepts of tissue culture:** Totipotency, differentiation, dedifferentiation and redifferentiation. Micropropagation; Raising of virus free and pest resistant plants, methods. Somatic embryogenesis:	3	5

	Factors and molecular aspects.		
		Instructional Hours	
Suggested Learning Methods : You tube videos			**02 Hrs**
V	**Initiation of plant tissue culture:** Induction and growth parameters; Culture initiation, Callus culture, Formation, cloning, suspension culture, regeneration. Micropropagation through various explants (Leaf, Stem, Axillary bud, Tuber, Corms and Bulbills).	2	6
		Instructional Hours	15
Suggested Learning Methods : Laboratory practice			**02 Hrs**
		Total Hours	75 Hrs

Text Books	Smith, R.H. Plant Tissue culture techniques and experiments, Academic Press. 2013. Razdan, M.K. Introduction to plant tissue culture. Science publishers, inc, USA, 2nd edition. 2002. Bhojwani, S.S. and M.K. Razdan. Plant tissue culture: Theory and Practice, Elseiver Science, 1st Edition, New York. 1996.
Reference Books	Guptha, P.K. **Elements of Biotechnology**. Rastogi Publications, 2016 Slater, A., Scott, N. and Fowler, M. Plant Biotechnology: The Genetic Manipulation of Plants, Oxford, 2008.
Web. URLs	https://nptel.ac.in/courses/102/103/102103016/ https://www.mooc-list.com/tags/biotechnology https://www.coursera.org/courses?query=biotechnology

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	H	H	M	H	L	L	L	L	H
CO2	H	H	M	H	H	H	L	H	L	L	L	L	H
CO3	M	H	L	H	H	H	L	H	H	L	L	L	H
CO4	H	H	L	H	H	L	L	H	L	L	L	L	H
CO5	H	H	L	L	H	H	L	H	L	M	L	L	H

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBE201	Elective Paper II – Group A Principles of Quality Assurance in Pharmaceuticals		
Semester : II	Credits : 4	Semester : II	Credits : 4

Course Objective	To understand and implement quality assurance and quality control measures effectively for the particular operation during drug development in the Pharma Industry
Course Category	Employability
Development Needs	Global
Course Description	The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics are taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the strategy of regulation to control microorganisms.	Lecture /	Assignment
CO 2	Identify things, situations, processes, etc. that may cause harm, particularly to people.	Flipped Learning /	Seminar
CO 3	Describe the qualifications, training and experience required.	Video Lessons	Quiz
CO 4	Implement their role within GMP with confidence and knowledge of the principle requirements.	Tutorial / Case Studies	Assignment
CO 5	Explain the principles of good laboratory practices (GLP) and its importance within a regulated laboratory environment.	Lecture / Class Projects	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Microbiological Control Strategy**: Overview, Main factors to be controlled, Controlled facilities, Controlled procedures, Controlled product ingredients, Controlled utilities, Controlled equipment's, Controlled formulation.	1	1
		Instructional Hours	**15**
Suggested Learning Methods : Group Discussion			**02 Hrs**
II	**Microbial Contamination Risk Assessment in Non-sterile Drug Product Manufacturing and Risk Mitigation:** Regulatory, Compendia, and Industry Guidance, Regulatory, Compendia, and Industry Guidance, Putting into Perspective the Microbiological Risk Associated with Non-sterile Products,	1	2
		Instructional Hours	15
Suggested Learning Methods : Videos			**02 Hrs**
III	**Qualification of Microbiological Laboratory Personnel and Equipment**: Introduction, Reasons, Requirements, and Strategies for Qualification, Critical Aspects of Microbiological	1	3

	Methods, Practical Examples for Qualification of Laboratory Personnel.		
		Instructional Hours	15
Suggested Learning Methods : Group Discussion			**02 Hrs**
IV	**Good Manufacturing Practices**: Concept and philosophy of GMP, Organization and Personal, Premises, Equipment's, Raw Material, Manufacturing Documents, In Process Quality Control (IQPC), Standard Operating Procedure, Packaging and Labelling Control, Good Ware House Practices, Materials and Management, Finished Product Release, Distribution of Records.	2	2
		Instructional Hours	15
Suggested Learning Methods : Industrial Visit			**02 Hrs**
V	**Good Laboratory Practices**: Concept and philosophy of GLP, GLP Guidelines for Manufacturing Unit, GLP Guidelines for Non-Clinical Testing, Quality Audit.	2	3
		Instructional Hours	15
Suggested Learning Methods: Industrial Visit			**02 Hrs**
		Total Hours	75 Hrs

Text Books	David Roesti and Marcel Goverde, **Pharmaceutical Microbiological Quality Assurance and Control**, John Wiley & Sons Inc., 2020. Nagori B.P., Ajay Gaur, Renu Solanki and Vipin Mathur. **Pharmaceutical Quality Assurance**, Seventh Edition, 2018.
Reference Books	Rosamund M. Baird, Norman A. Hodges, Stephen P. Denver, **Handbook of Microbiological Quality Control – Pharmaceuticals and Medical Devices**, Taylor and Francis, First Edition, 2005. Shayne Cox Gad, Pharmaceutical Manufacturing Handbook: Regulations and Quality. John Wiley & Sons Inc., 2008
Web. URLs	https://www.who.int/medicines/areas/quality_safety/quality_assurance/QualityAssurancePharmVol2.pdf. https://www.pharmaguideline.com/p/quality-assurance.html.

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO 2	PO3	PO4	PO 5	PO 6	PO7	PO 8	PSO 1	PSO2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	L	M	H	M	H	H	H	M	H	H
CO2	H	H	L	L	M	H	M	H	H	H	H	M	H
CO3	H	M	L	M	H	M	H	M	H	M	H	M	H
CO4	L	L	L	L	H	H	H	M	H	H	M	H	M
CO5	M	L	M	M	M	L	M	H	H	H	H	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by

Course Code	Title		
22PGMBE202	Elective Paper II – Group B Techniques in Parasitology		
Semester : II	Credits : 4	Semester : II	Credits : 4

Course Objective	To enable students to understand the pathogenesis, clinical presentations and complications of parasitic diseases
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	The study and identification of human parasites of medical significance, identify clinical signs, symptoms, treatment and epidemiology associated with human parasitic disease. Examine specimen collection and transportation. Explore laboratory methods used to detect and identify parasites.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Provide students with adequate knowledge about endemic parasites, national parasitic problems	Lecture	Assignment
CO 2	Provide with biological, epidemiological and ecological aspects of parasites that causing diseases to human beings.	Tutorial	Seminar
CO 3	Examine and identify the microscopic morphology of parasites and their larval stages in stained smears.	Video Lessons	Quiz
CO 4	Analyze the results obtained from history, clinical examination and investigational data into meaningful diagnostic formulation.	Tutorial / Case Studies	Observation
CO 5	Recognize sample collection, preservation and examination.	Lecture / Class Projects	Observation

Offered by	**Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**General Introduction:** Protozoa: General features, amoebae, Flagellates, Examination of feces- Microscopy, Wet mount, Thick smear, Permanent stained smear- Iron Haematoxylin stain. Wheatley Trichrome stain.	1	2, 3
		Instructional Hours	**15**
Suggested Learning Methods : **Interactions**			**02 Hrs**
II	**Symbiosis and parasitism:** Commensalism, Phoresis, Parasitism, Mutualism, Parasite-Host interactions- Effect of Parasite on host: Tissue damage, Parenchymatous, Fatty degeneration, Necrosis, Tissue changes, Hyperplasia, Neoplasia, Metaplasia. **Intestinal nematodes:** *Ascaris lumbricoides*, *Enterobius vermicularius*, *Strongilusster coralis*, *Trichuristrichiura*.	2	1,2&16
		Instructional Hours	15
Suggested Learning Methods : Video Lectures			**02 Hrs**

III	**Malarial parasites:** Examination of Blood, Examination for malarial Parasite. Thin smear, Thick smear, Wright stain, Examination for Micro filarial-wet mount, Concentration method, DEC Provocation method, **Laboratory methods for the diagnosis of parasitic Infection overview**: Intestinal protozoa, Blood and tissue protozoa. Parasitic infection in compromised host- *Entamoeba histolytica, Crytosporidium sp, Leishmania sp, Toxoplasma gondii*.	1	6
		Instructional Hours	15
Suggested Learning Methods : Group Discussion			**02 Hrs**
IV	**Human Hook worm diseases:** *Necatoramericanus, Ancylostoma duodenale, Ascaris lumbricoi des*, Life cycle, Epidemiology, Diagnosis. Nematodes-Filarial Nematodes, *Wuchereria bancrofti*, *Bruchiamalayi*, Tropical pulmonary	1	18
		Instructional Hours	15
Suggested Learning Methods : Group Discussion			**02 Hrs**
V	**Collection Preservation, Shipment of Specimen:** Preservation of Specimen: Safety, Fresh specimen Collection times, Processing of Specimen Macroscopic and Microscopic examination of fecal specimens- ova and parasite identification, Direct wet smear, Concentration sedimentation and Flotation methods, Permanent stained smear.	4	26, 27
		Instructional Hours	15
Suggested Learning Methods : Laboratory practice			**02 Hrs**
		Total Hours	75 Hrs

Text Books	1. Paniker CJK**, Text Book of Medical Parasitology**, 7th edition, Jaypee brothers Medical publishers (p) Ltd, New Delhi, 2013. 2. Burton.J.Bogitsh, Clint Carter.E, Thomas Oeltmann. N,**Human Parasitology**, 4th edition,Elsevier,AcademicPress.UK, 2013. 3. Braily& Scott, **Diagnostic Microbiology**, 13th edition,Patricia.M Tille Elsevier, 2014. 4. Lynne Shore Garcia, **Diagnostic Medical parasitology**,5th edition,ASM Press, Washington, 2007.
Reference Books	1. David Greenwood, Mike Barer, Richard Slack, Will Irving, **Medical Microbiology- Guide to Microbial Infection**, **Pathogenesis, Immunity, lab diagnosis and control**,.18th Ed.,British library, Elsevier, 2012
Web. URLs	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3109637/-2/phylum-protozoa/study-notes-on- entamoeba-histolytica.

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H	H	H	H	H	H	M	H	H
CO2	M	H	H	H	H	H	H	H	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	H	M	H	H	H
CO4	H	H	H	M	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H	M	H	M

H-High; M-Medium; L-Low	
Course designed by	**Verified by**

Course Code	Title		
22PGMBE203	Elective Paper II – Group C Fundamentals of Animal Tissue Culture		
Semester : II	Credits: 4	Semester : II	Credits: 4

Course Objective	This course aims to provide a comprehensive overview of fundamentals of animal tissue culture in terms of the development, characterization, and applications
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	Knowing the principles of cell culture techniques, importance of sterility and good aseptic technique. Manipulations with cell cultures, student's aseptic technique during these manipulations, student's accuracy and awareness during manipulations and sub culturing of animal cells in vitro.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Know and understanding the principles of cell culture techniques.	Lecture / Flipped Classroom	Assignment
CO 2	Describe the equipment's used in animal cell culture.	Tutorial	Seminar
CO 3	Manage to manipulate with cell cultures.	Video Lessons	Quiz
CO 4	Know and understanding the cell culture problems and possibilities.	Case Studies	Observation
CO 5	Demonstrate knowledge on design and use the cell culture facilities.	Demonstration / Class Projects	Observation

Offered by Microbiology

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Introduction of Animal Cell and Tissue Culture**: Introduction of Animal Cell and Tissue Culture, History of development of Animal cell culture techniques, Significance and Applications of tissue culture techniques.	1	1
		Instructional Hours	**15**
Suggested Learning Methods : Group Discussion			**02 Hrs**
II	**Requirements in Animal Cell Culture Laboratory**: Requirements in Animal Cell Culture, Equipment's used in Cell culture, Culture vessels, Aseptic techniques, Culture media, designing of culture media, Serum free media development.	1	5, 8-10
		Instructional Hours	15
Suggested Learning Methods : Experiments			**02 Hrs**
III	**Primary culture and cell line Development**: Primary culture, secondary culture, cell line, cryopreservation, contaminations, organotypic culture, Insect Cell Culture: An Overview, In vitro transformation of animal cells.	2	7
		Instructional Hours	15

Suggested Learning Methods : Group Learning / Videos			**02 Hrs**
IV	**Characterization of cell line**: Characterization, Cell cycle analysis, FBS, Temperature, authentication, species identification, lineage or tissue markers, immunocytochemistry, karyotyping, chromosome banding, molecular identification by isoenzyme.	2	9
		Instructional Hours	15
Suggested Learning Methods : Demonstration / Cell culture lab visit			**02 Hrs**
V	**Applications of cell Line**: Cell culture in virus isolation, vaccine production, drug/therapeutics development, cancer studies using cell culture, production of hybridoma and monoclonal antibody production, therapeutic cloning, tissue engineering and CRISPR-Cas in gene function studies.	1	27
		Instructional Hours	15
Suggested Learning Methods : Laboratory practice			**02 Hrs**
		Total Hours	75 Hrs

Text Books	1. Ian Freshney, R. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition, John Wiley & Sons, Inc., 2010. 2. John M. Davis. Animal Cell Culture Essential Methods, John Wiley & Sons, Inc., 2011.
Reference Books	1. Michael Butler. **Animal Cell Culture and Technology**, 2nd edition Bios Scientific Publishers Taylor & Francis Group London and New York, 2004.
Web. URLs	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7325846/

Tools for Assessment (50 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
8	8	10	8	8	8	50

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	L	M	H	L	H	L	L	H	L	H
CO2	M	H	L	L	H	M	L	M	L	L	H	L	H
CO3	H	H	M	L	M	H	L	M	L	L	H	L	H
CO4	H	H	H	L	H	H	L	L	H	L	H	H	H
CO5	M	H	H	H	H	L	H	H	L	H	L	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by