ಸೂಕ್ಷ್ಮಜೀವಿಶಾಸ್ತ್ರ ಅಧ್ಯಯನ ವಿಭಾಗ ಶಿವಗಂಗೋತ್ರಿ, ದಾವಣಗೆರೆ– 577007

ಡಾ. ಎಸ್ ಶಿಶುಪಾಲ ಬಿಓಎಸ್-ಅಧ್ಯಕ್ಷರು

ಪೋ.ನಂ.8792674905

ಸಂಖೈ:ದಾವಿವಿ:ಸೂಅವಿ:2024-25/219

ದಿನಾಂಕ:07.11.2024

ಗೆ, ಕುಲಸಚಿವರು ದಾವಣಗೆರೆ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ ಶಿವಗಂಗೋತ್ರಿ. ದಾವಣಗೆರೆ–577007

ಮಾನ್ಯರೆ,

ವಿಷಯಃ ಸಿ.ಬಿ.ಸಿ.ಎಸ್ ರನ್ವಯ ಸ್ನಾತಕೋತ್ತರ ಸೂಕ್ಷ್ಮ್ರಜೀವಿಶಾಸ್ತ್ರ ವಿಷಯದ ಪಠ್ಯಕ್ರಮವನ್ನು ಅಧ್ಯಯನ ಮಂಡಳಿಯಿಂದ ಅನುಮೋದಿಸಿ ಸಲ್ಲಿಸುತ್ತಿರುವ ಬಗ್ಗೆ, ಉಲ್ಲೇಖಃ ಸಂಖೈ:ದಾವಿವಿ/ಅ.ಮ/466/2024–25/1718 ದಿನಾಂಕ:16.08.2024

ಪೇಲ್ಕಂಡ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, ರಾಷ್ಟ್ರೀಯ ಸಿ.ಬಿ.ಸಿ.ಎಸ್ ರಸ್ವಯ ಸ್ನಾತಕೋತ್ತರ ಸೂಕ್ಷ್ಮುಜೀವಿಶಾಸ್ತ್ರ ವಿಷಯದ ಪಠ್ಯಕ್ರಮವನ್ನು ಪರಿಷ್ಕರಿಸಿ ಅಧ್ಯಯನ ಮಂಡಳಿಯ ಸಭೆಯಲ್ಲಿ ಅನುಮೋದಿಸಲಾಗಿರುವ ಸಭೆಯ ನಡವಳಿಗಳು, ಪಠ್ಯಕ್ರಮ ಹಾಗೂ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯ ಮಾದರಿಯನ್ನು ಹಾರ್ಡ್ ಮತ್ತು ಸಾಫ್ಟ್ ಪ್ರತಿಯನ್ನು ಈ ಪತ್ರದೊಂದಿಗೆ ಲಗತ್ತಿಸಿ ತಮ್ಮ ಸೂಕ್ತ ಕ್ರಮಕ್ಕಾಗಿ ಸಲ್ಲಿಸಲಾಗಿದೆ.

ವಂದನೆಗಳೊಂದಿಗೆ,

We have heart only

ght Dear Syllabory

3/11/2024

ತಮ್ಮ ವಿಶ್ವಾಸಿ,

BOS in Microbiology Department of Microbiology Shangarents D. July Lany

Department of Microbiology, Shivagangothri, Davangere-577 007

Dr. S. Shishupala Chairman-BoS

No: DU: MB:2024-25/123(A)

Date: 29.08.2024

Ph No: 8792674905

Proceedings of the meeting of Board of Microbiology (PG) held On 29th August 2024 at the Department of Microbiology, Davangere University, Shivangangothri, Davangere. at 10. 30 am.

MEMBERS PRESENT:

- 1. Dr. Vedamurthy A B Senior Professor
- 2. Dr. Chandrakanth Kelamani Senior Professor
- 3. Dr. Gayathri Devaraja. Senior Professor
- 4. Dr. Ramalingappa Senior Professor
- 5. Dr. Virupakshaiah DBM Professor
- 6. Dr. S. Shishupala Professor and Chairman

committee for discussion.

- -- External Member- Online
- -- External Member- Online
- -- Member
- -- Member
- -- Member

-- Chairman-BoS

The Chairman welcomed the board members and placed the agenda before the

1. Revision of M.Sc. Microbiology Syllabus:

All the paper titles were finalised and the changes in syllabus (2024-25 M.Sc. CBCS) was thoroughly discussed and approved.

2. Preparation of Model Question paper of M.Sc. Microbiology:

Model question paper was prepared and approved.

The Chairman thanked all the members for their active participation and kind cooperation.

Chairman-Bob



New syllabus

5 messages

dudvg microbiology <dudvgmicrobiology@gmail.com> To: dudvg microbiology <dudvgmicrobiology@gmail.com>

Wed, Sep 25, 2024 at 9:58 AM

Cover page 1st semester.pdf 703K

dudvg microbiology <dudvgmicrobiology@gmail.com>

Wed, Sep 25, 2024 at 10:13 AM

To: gayathridevaraja@gmail.com, "Dr.Virupakshaiah DBM" <virudbm@gmail.com>, R L Sir <ramalingappa.88@gmail.com>, Kelamani <ckelmani@gmail.com>, vedamurthy15

<vedamurthy15@gmail.com>

Dear Sir/Madam

Good morning please go through the tentative syllabus of 1st semester. Some aspects have been fine tuned without any major changes for your approval. A detailed discussion will be held shortly. With regards.

Shishupala

Forwarded message -

From: dudvg microbiology <dudvgmicrobiology@gmail.com> Date: Wed, 25 Sept, 2024, 9:58 am

Subject: New syllabus

To: dudvg microbiology <dudvgmicrobiology@gmail.com>

Cover page 1st semester.pdf 703K

dudvg microbiology <dudvgmicrobiology@gmail.com>
To: uucmsacademicdu@davangereuniversity.ac.in

Wed, Sep 25, 2024 at 10:19 AM

[Quoted text hidden]

Cover page 1st semester.pdf

Wed, Sep 25, 2024 at 11:29 AM

ckelmani R <ckelmani@gmail.com>
To: dudvg microbiology <dudvgmicrobiology@gmail.com> Cc: gayathridevaraja@gmail.com, "Dr.Virupakshaiah DBM" <virudbm@gmail.com>, R L Sir <ramalingappa.88@gmail.com>, vedamurthy15 <vedamurthy15@gmail.com>

Thank you sir, I am herewith sending approval of the syllabus

[Quoted text hidden]

Thu, Sep 26, 2024 at 6:33 PM

vedamurthy15 <vedamurthy15@gmail.com>
To: dudvg microbiology <dudvgmicrobiology@gmail.com>

Dear Sir

Greetings

I have gone through the attached syllabus pertaining to M.Sc Microbiology of Davanagere University. The syllabus has been framed perfectly as per the requirements of the PG program with course outcomes and references. I hereby approve the syllabus as it is

Thanking you With warm regards

Dr.Vedamurthv.A.B Professor and Chairman Processor and Colliman
P.G. Department of Studies in Biotechnology and Microbiology
Director- Karnatak University Press
Coordinator- Department of Applied Genetics
Coordinator- Innovation and Incubation Centre Member- PIG-DST-PURSE Phase-II Programme Karnatak University Dharwad-580003 Cell: +91 9341314101, 8892554999

Profile URL: https://vidwan.inflibnet.ac.in/profile/238652

[Quoted text hidden]

DAVANGERE UNIVERSITY

SHIVAGANGOTHRI - 577 007, DAYANGERE, INDIA.



SYLLABUS FOR

Master of Science (M. Sc.) Semester Scheme - CBCS

MICROBIOLOGY

with effect from 2024-25

Leen

Davangere University Shivagangotri, Davangere-577 007, Karnataka Department of Microbiology

Program Objectives:

- **PO-1** The Choice based credit system will provide opportunity for students to take up specialization of their choice and also opt for interdisciplinary courses.
- **PO-2** In depth understanding of basic and applied aspects of microbiology and overall skill development for further advanced study.
- **PO-3** Program aims to equip students with knowledge and skills, thus enabling the student to pursue a career.
- PO-4 Uphold the responsibility as a global citizen maintaining professional and ethical values and ability to upgrade knowledge independently for lifelong learning.

Program specific objectives:

- **PSO** -1Thestudent will understand fundamental concepts of microbiology with knowledge on different microbial diversity and its significance.
- **PSO-2** The learner should be able to understand microbial metabolism and genetics with tools of molecular biology.
- **PSO-3** The pupil will comprehend the role of microbes in agriculture, clinical and immunological aspects with special reference inter/intra-departmental choice based courses.
- **PSO-4**To understand applied aspects of microbiology and independently be able to handle research projects in microbiology through literature search, finding research gaps, framing objectives and execute in order to strive for innovation and skill development.

Program outcome:

- The student is rendered with adequate knowledge of beneficial and harmful microorganisms in the environment.
- The student is trained in presentation and articulation of the subject with enhanced skills.
- With strong theoretical knowledge and robust hands-on training will enable handle quality assurance, diagnostics and production at corporate or health care sectors.
- The program will provide suitable human resource in the field of academics and research as per the relevance.

Program specific outcome: Hands-on skill provides competent wards to work independently in pharmaceutical, health, food, agriculture and allied industries, R &D sectors, educational and research institutions without undergoing additional training.



Shivagangothri, Davangere-577 007, Karnataka M.Sc. Microbiology (Academic Year 2024 onwards)

Semester scheme with Choice-Based Credit System (CBCS)

Course Structure

M. Sc MicrobiologyI Semester

					Mark	S			
	Code Code Title of the Paper	Instruction Hrs./week	Examination	*Internal Assessment	Total Marks	Credits	duration (Hrs.)		
	THEORY PAPERS								
	MB 1.1	Biodiversity and Microbial taxonomy	4	70	30	100	4	3	
(annound)	MB 1.2	Environmental Microbiology	4	70	30	100	4	3	
	MB 1.3	Microbiological Methods	4	70	30	100	4	3	
	MB 1.4	Cell Biology and Biochemistry	4	70	30	100	4	3	
SEMESTER	PRACTICAL PAPERS								
	MB 1.5	Biodiversity and Microbial taxonomy	4	40	10	50	2	3	
(D)	MB 1.6	Environmental Microbiology	4	40	10	50	2	3	
	MB 1.7	Microbiological Methods	4	40	10	50	2	3	
	MB 1.8	Cell Biology and Biochemistry	4	40	10	50	2	3	
	Mandatory Credits: English Language / Communication Skill		2	page their task	that then	SIGN WERE STATE	2	No. SQL SSG	
			34			600	26		

*Internal assessment: Theory : 2 Tests=10 marks; 1 Assignment-05 marks; 1 Seminar=05 marks; Attendance=10 marks

Practical: Record – 05 marks and Attendance – 05 marks

Registrar
Davangere University
Shivagangotri, Davangere

Core Code: MB. 1.1: BIODIVERSITY AND MICROBIAL TAXONOMY

Course Credits: 4

Total No. of Hours: 64

No. of Teaching Hours per Week: 4 Hrs

Course Learning objectives:

- Understand concept of biodiversity and development of microbiology
- Learn classification and tools in microbial taxonomy
- Knowledge on virus, viroids, prions and bacteria; their characteristics and reproduction.
- Comprehend eukaryotic microorganisms and their significance.

Unit 1: Biodiversity and Fundamentals of Microbiology:

16 hr

- a) Biodiversity: concept and elements; significance of biodiversity; species diversity and richness, documentation, conservation and maintenance of biodiversity.
- b) Historical perspectives and developmental milestones of microbiology; biogenesis theory, germ theory of diseases: branches of microbiology based on organisms and fields. Scope of microbiology in the present scenario. Role of microbiologists in society.

Unit 2: Microbial Taxonomy:

16 hrs

- a) Classification concepts: Linnaeus concepts of taxonomy, Binomial nomenclature, Hierarchical organization. Five-kingdom classification system; Three-domain classification system; Evolutionary relationships, Universal phylogenetic tree.
- b) Microbial Classification: Criteria- Morphological, physiological, ecological, genetic analysis, molecular characteristics, phage typing, serotyping, G+C ratio, comparison of proteins, nucleic acid hybridization, nucleic acid sequence comparison, DNA and RNA homology, significance of rRNA in microbial taxonomy, Chemotaxonomy and Numerical Taxonomy. Metagenomics.

Unit 3: Virology and Bacteriology:

16 hrs.

- a) Virology: Characteristics of viruses, components of viruses, genetic material, capsid morphology, size and shapes, viral envelop, viral enzymes. Viral classification, viral replication; Brief account of animal, plant and bacterial viruses with suitable examples. Baltimore system of viral classification; Viroids and Prions: Properties, study of significant diseases caused.
- b) Bacteriology: Prokaryotic cell structure, size, shape and arrangement, Cell wall, Cell membranes, Cytoplasm, nucleoid, plasmids, Outer membrane, flagella, fimbriae, endospores. Methods of reproduction. Criteria for bacterial classification. Brief account of Bergey's manual of systematic bacteriology.

Unit -4: Eukaryotes:

16 hrs

- a) Mycology: Structural details of unicellular and multicellular fungi; cell wall composition and mycelial organization; Homothallism, parasexuality and Heterothallism; Methods of reproduction in fungi and types of spores. Classification fungi to the level of classes;
- b) Phycology: Morphological features of prokaryotic algae; structure of unicellular and colonial forms; cell wall, pili, sheaths, pigments, akinetes, heterocysts. Classification of micro-algae to the level of divisions; Methods of reproduction.
- c) Lichenology: Types and structural organization; Classification of lichens; Methods of reproduction.
- d) Protozoology and Parasitology:
 - i) Protozoa Morphology; encystment, excystment, locomotory organelles; Classification of protozoa to the level of phyla; Methods of reproduction.
 - ii) Helminths Characteristics, structural features and life cycle of parasitic forms Flukes, Round worm, Tapeworm.

Course Outcome:

- Acquaint the knowledge of biodiversity and its significance.
- Explore taxonomic strategies and approaches used to name microorganisms, and the criteria used to define genus and species
- Unravel the structure and replication of viruses and bacteria.
- Understanding the eukaryotic microbial diversity.

References:

- 1. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869 pp.
- 2. Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA. 987pp.
- 3. Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 846 pp.
- 4. Chapman, J.L., and Reiss, M.J. 2006. Ecology: principles and applications. 2ndedn. Cambridge University Press, Cambridge.330 pp.
- 5. Dimmock, N.J., Easton, A.J. and Leppard, K.N. 2001.Introduction to Modern Virology. Blackwell Publishing, Oxford. 449 pp.
- 6. Krasner, R.I. 2010. The Microbial Challenge. 2ndedn. Jones and Bartlett Publishers, Sudbary. 476 pp.
- 7. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett Pub..Sudburry, 835 pp.
- 8. Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655 pp.
- 9. Toratora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9th ed. Pearson Education Pte. Ltd., San Francisco. 958pp.
- 10. Willey, J., Sandman, K., and Wood, D. 2023. Prescott's Microbiology, 12 edn., McGraw Hill Education, New Delhi. 1024 pp

Core - MB-1.2: Environmental Microbiology

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- Student will be able to learn Origin, Concept and Development Environmental Microbiology
- Understand the biogeochemical cycles and their significance.
- Comprehend the microbial distribution in soil, water and air. Understand the interactions and influence of biotic and abiotic factors.
- Learn biodegradation, bioterrorism, and microbes from extreme environments.

Unit 1: Ecosystem and Soil microbiology:

16 hrs.

- a. <u>Ecosystem</u>: Origin, Concept and Development of Environmental Microbiology. Microbial Community: Ecosystem, habitat and niche. Concept and dynamics of microbial population and community. Structure and functions of microbial communities. Ecological succession. Biogeochemical cycles carbon, nitrogen, phosphorus and Sulphur.
- b. <u>Soil Microbiology</u>: Historical development of soil microbiology; Physical characteristics and nutrient status of soil. Distribution of microorganisms in soil, their importance in maintaining soil fertility, organic matter and composting. Influence of environmental factors on soil microorganisms. Role of microorganisms in formation of different soils. Enumeration of soil microorganisms. Microbial interactions among soil microorganisms-mutualism, commensalism, antagonism, competition, synergism, parasitism and predation. Rumen microbiology; Significance of coprophilous microorganisms.

Unit 2: Aquatic microbiology:

16 hrs

Aquatic environment: Physical, chemical and biological parameters: temperature, hydrostatic pressure, light, salinity, turbidity, pH, nutrients. Fresh, brackish, estuarine, marine and subterranean water environment and distribution of microorganisms in the aquatic environment, planktons, lentic, lotic, benthic, euphotic, neustons, microbial mats, biofilms. Methods in the study of fresh and marine water microorganisms.

Water Pollution: Sources, Characteristics of water pollutants, health hazards due to water pollution. Standard water quality criteria, Water quality testing (MPN technique). Eutrophication - causes, consequences and prevention. Waste water treatment: Primary-physical processes; Secondary-biological treatment by fixed biofilm systems (trickling filters, RBC, fluidized bed reactors), suspended systems (activated sludge process, oxidation lagoons, anaerobic digesters, septic tank, ETP, current technologies); Tertiary- Filtration (sand beds & membrane filters) chlorination, ozonization, radiation and reverse osmosis.

Unit 3: Microbiology of the atmosphere:

16 hrs

- a) <u>Microorganisms in air</u>: sources of air-borne microorganisms, aerosols microbial survival in air: pH, temperature, radiation, oxygen, and other factors. Aerobiology biological components air, aeroallergens, air-sampling devices and techniques.
 - <u>Air pollution and Radiation hazards</u>: Sources and characteristics of air pollutants; Health hazards due to air pollution; Green house effect. Ozone depletion and acid rain. Radiation hazards and safety measures.
- b) <u>Geomicrobiology</u>: Rock and Mineral Weathering, Mineral Transformations, Microbial Metal Binding, Microbiota of Subsurface Crystals, Stromatolite studies.

Unit 4: Extremophiles, Bioremediation and bioterrorism:

16 hrs

a) <u>Extreme environments</u>: Physical environment- temperature, salinity, pressure, pH, magnetic force, starvation strategies. Extreme thermophiles, psychrophiles, halophiles, barophiles and other

- microorganisms in extreme environments; Biotic and abiotic factors influencing survival and adaptations of extremophiles, mechanisms of survival.
- b) <u>Biodeterioration and Bioremediation</u>: Biodegradation of xenobiotics: Microbial degradation of pesticides, polycyclic aromatic hydrocarbons, natural and synthetic polymers (cellulose, pectin, lignin, detergents). Microbial remediation: Concept and scope of bioremediation.
- c) <u>Bioterrorism</u>: Microbial agents as weapons of bioterrorism. Bioterrorism and potable water, contaminant transport mechanisms; Bioterrorism in agriculture, contamination through airborne microbial agents, formites. Case study (anthrax, SARS, foot and mouth diseases and others).

Course outcome:

- Understanding of the microbial diversity and microbial communities inhabiting a multitude of ecological habitats.
- Thorough knowledge of the occurrence, abundance and distribution of microorganism in the soil, water and air.
- Competency in various aspects of environmental microbiology and appreciate trends in microbial ecology.
- Understanding the various cellular, molecular and biochemical adaptations related to extremophiles.

Reference Books:

- 1. Brock T.D. (1971), Principles of Microbial Ecology. Prentice Hall Publ. Co. Philadelphia.
- 2. Martin Alexander. (1971) Microbial Ecology. John Willey & Sons. New York.
- 3. Atlas & Bertha. (1998). Microbial Ecology. 3rd Ed.
- 4. Gabriel Britton, (1994), Wastewater Microbiology, John Willey & Sons, New York.
- 5. Ralph Mitchell, (1995), Environmental Microbiology, Wiley Liss, New York.
- 6. Criston J. Hurst, (2007), Manual of Environmental Microbiology, ASM Publ., New York.
- 7. Feltcher, M. & Grey TRG, (1987), Ecology of Microbial Communities, Cambridge Univ. Press.
- 8. Rose R.D. (1972), Air Pollution & Industry. Reinhold Co., New York.
- 9. Metcalf and Eddy. (1991). Waste Water Engineering. McGraw Hill Int. Publ.
- 10. APHA, (1994), Standard Methods, 17th Ed., American Public Health Association

Core: MB. 1.3 MICROBIOLOGICAL METHODS

Course Credits: 4

Total No. of Hours: 64

No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- Introduction of various techniques and methods required for microbiology student to be used in entire program and skill development
- Concepts on preparation and culture media for diverse group of microorganisms
- Inculcate the technique of microbial isolation, cultivation and preservation
- Handling of different types of microscopes and instruments

Unit-1 Basics of Microbiological methods: Safety, sterilization and control measures: 16 hrs Concept, handling of microbiological specimen and microorganisms.

Sterilization techniques: Principles, types of Sterilization and their mode of action. Physical methods: Heat-dry heat, Incineration, Moist heat (Autoclave and other methods), Mechanical methods: Filtration-Types of filters, Radiation methods (UV radiation, Gamma rays, fumigation and other methods) Standardization of disinfectants (phenol co-efficient). Biosafety cabinets – Level I to IV, Lab Containment.

Control of Microorganisms: Chemical methods Disinfectants, Antiseptics, Sanitizers, Microbistatic, Microbicides; Use and mode of action of Alcohols, Aldehydes, Halogens, Phenols, Heavy metals, and Detergents.

Unit-2 Microbial nutrition and growth:

16 hrs

Nutritional requirements, micro and macro nutrients, nutritional types of microorganisms, growth factors/trace elements. Microbial culture media: Culture media, media components, formulation, types of bacteriological, fungal and algal media.

Microbial growth; Concept, growth type, Measurement of microbial growth-cell number, turbidity and biomass, determination of microbial growth curve, Continuous and synchronous culture, balanced and unbalanced growth, influence of environmental factors on growth, dioxygrowth curve. Growth measurement Techniques: Direct method-microscopic count (Breed's count and other methods), standard plate count, MPN, haemocytometry. Indirect method-turbidometry, metabolic activity, dry weight, microbial cell size determination (micrometry).

Unit-3 Microbial Isolation, staining and identification:

16 hrs

Isolation techniques: Types of inoculation techniques- dilution, spread, streak, pour plate, bait, stamp, warcup, slide and single spore culture methods; Identification of bacteria and fungi - morphological, biochemical and molecular methods. Automated microbial identification system with examples. BIOTYPER, SARAMIS, VITEK, Enterotube.

Cultivation of human virus: Egg, animal and cell culture methods.

Cultivation of Anaerobic microorganisms: principles, types and methods.

Microbiological stains and staining techniques: Composition, Types of stains and principles of staining- simple staining, Differential staining, Structural staining (nuclear and cytoplasmic inclusions) flagellar staining (types) and special staining protocols and applications.

Maintenance and preservation of pure cultures (methods and types), National and International culture collection centers. Method of procurement of cultures.

Unit-4 Microscopy and instrumentation

16 hrs

<u>Microscopy</u>: Working principle, magnification (Aperture angle and numerical aperture) and resolving power of simple and compound microscopes (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 (TEM and SEM), limitations; Atomic force microscope and confocal microscopy; Use and care of microscopes.

Sample preparation, staining and image processing techniques (Bright field and Electron microscopy)

<u>Instrumentation</u>: Autoclave: principle and types. Hot air oven: pH meter, nephalometer. Biosafety cabinets: types and applications. Colony counters: Micrometers, Incubators: types, CO₂ incubator, Spectrophotometers (types), MALDI-ToF-MS, GC-MS, SDS-PAGE, TLC, Centrifuges (types) and other instruments in Microbiology laboratory: Use and care: safety measures

Course Outcome:

- Understand various Culture media and various physical and chemical means of sterilization
- Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures
- Maintenance of microbial culture and instant cultivation methods skill enable the pupil to develop pure microbial culture collection
- Students are skilled and trained in understanding the instruments used for microbial handing and sample analysis

Reference:

- 1. Atlas, R.M. (1998). Microbiology, Fundamentals and Applications (II ed) Macmillan Publishing Company.
- 2. Kango, N. (2009). Textbook of Microbiology. I.K. International Publishing House Ltd. New Delhi.
- 3. Black, J.G., Larry M. Lewis. (2005). Microbiology: Principles & Explorations. Edition 6. Wiley, John & Sons.
- 4. Edward, K. Wanger & Martinez, J. Heweltt (2004). Basic virology. Blackwell publishing.
- 5. Tortora, G.J., BR Funke and Christine L Case (2009) Microbiology an introduction, 9th Edition, Pearson publisher, p 957
- 6. Nester, E.W., Roberts, C.E., Pearsall, N.N., Anderson, D.G., Nester, M.T. (1998). Microbiology- A Human Perspective.2nd Edition.Mc Graw Hill.
- 7. Becker, W. M., Kleinsmith, L.J. and Hardin, J. (2000). The world of the Cell. 1 st ed. Benjamin/Cummings.
- 8. Madigan M.T., Martinko M. J. and Parker, J. (2003). Brock Biology of microorganisms. 3. Pearson education., New Jercy
- 9. Hawkes, P.W., and John C H Spence (2019) Springer Handbook on Microscopy, Edition 1, Springer Nature
- 10. Bajapai PK (2010) Biological instrumentation and methodology .S Chand and company publisher

Core: M.B.1.4 CELL BIOLOGY AND BIOCHEMISTRY

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- Introduce the basic concept of qualitative and quantitative analysis of biomolecules.
- Understand cell structure and functions.
- Provide the core principles and specialized knowledge of Carbohydrates, Lipids, Proteins, Vitamins, Porphyrin, cellular transport, Law of thermodynamic, Lipid and Nitrogen metabolism.
- Learn various techniques used in the analysis of biomolecules.

Unit 1: Cell biology:

16 hrs

- a) Evolution of cell: Origin and evolution of cells: Chemical and physical foundations of biomolecules, procell organelles, Stanley Miller experiment, Difference cell types of prokaryotic Eukarya and Archaea. Endoplasmic reticulum-Types and Functions, Golgi Complex, Lysosomes, Ribosomes, Structure and their function, Mitochondria, Cytoskeleton, Microtubules
- b) Cell cycle and Differentiation: Mitosis and Meiosis, cell division and cell cycle overview in bacteria, Yeast and cell cycle check points, cell cycle and cancer; Apoptosis, Properties of cancer cell, Genetic basis of Onset of cancer, Carcinogenic effect of chemicals and radiation, endosymbiotic theory. Plasma membrane: structure and organization of plasma membrane, models if plasma membrane, membrane structure and transport mechanisms; membrane channels and pumps. Cell signaling and signal transduction pathways; Molecular motors.

Unit-2 Bio-molecules

16 hrs

- a) Water as solvent, Acids, bases and buffers, Strength of acids, Normality, Molarity and units of measurements in preparation of solutions and lab Reagents.
- b) Amino acids and Proteins; Classification, Properties of amino acids, structure and function Ionization constants of aminoacids, Acid and Base properties of amino acids.
 - **Proteins** Classification, physical and chemical properties; Biological functions of proteins, Structure of proteins Primary, Secondary tertiary and quaternary. Ramachandran's plot, structure and function relationship of certain proteins hemoglobin, myoglobin, collagen chaperones, Protein folding-Afinsen's Expermenet Qualitative detection methods of proteins, principles of thermodynamics and Bioenergetics.

Unit-3 Carbohydrates and Nucleic acids:

16 hrs

- a) Chemistry of carbohydrates: Definition, Classification, Structure and general properties. Importance and properties of Monosaccharide, Optical isomers, anomeric forms, mutarotation; Disaccharides fructose, sucrose, lactose, maltose,; Polysaccharides starch, cellulose, dextrins, hemicellulose, gellans, pulluans, lignins, chitin, Pectin, heparin, Proteoglycans Blood group polysaccharides, Agar agar and bacterial cell wall polysaccharides.
- b) Nucleic acids: Structure of purine and pyrimidine, modified bases, Chargaff's rules, nucleoside, nucleotides denaturation and renaturation of nucleic acid, Classification, synthesis and oxidation of fatty acids
- c) Lipids and Vitamins: Simple, Complex and derived lipids, Properties classification, chemical reaction detection methods lipids, Microbial derived lipids Co-factors. Importance of vitamins, Classification, Vitamins as enzyme co-factors and properties of enzymes.

Unit -4: Biochemical techniques

16 hrs

- a) Centrifugation techniques: Basic principles of sedimentation. Methods and applications of density-gradient centrifugation, preparative centrifugation, ultracentrifugation of sub-cellular organelles, viruses and other micro molecules
- b) Chromatographic techniques: General principles and techniques. Methods and applications of paper chromatography, thin-layer chromatography, exclusion chromatography affinity chromatography, ion-exchange chromatography, HPLC, Gas-liquid chromatography. MALDI-TOF, LC- MS/MS.
- c) Electrophoretic techniques: General principles and applications of electrophoresis, Agrose, Native and SDS phage, gel electrophorsis, and isoelectric focusing.
- d) Spectroscopic techniques: Electromagnetic spectrum of light, Beer's Lambert law, Transmittance, Exctinction co-efficient, Light sources, monochromators types of detectors, working principles of UV-visible, IR, Raman, ESR, Mass, Plasma emission, Atomic Absorption and NMR spectrophotometery fluorimetry and flame photometry, ORD and CD, X-ray diffraction and X-ray Crystallography.
- e) Radio isotopic techniques: General principles, nature of radio activity, detection and measurement of Radio activity, applications of radioisotopes in biological investigation.

Course Outcomes:

- Overview of major biomolecules –carbohydrates, lipids, proteins, aminoacids, nucleic acids, classification, structure, function of biomolecules
- Understanding the laws of thermodynamics, concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions.
- Comprehend principles and applications of various techniques used in analysis of biomolecules.

Reference:

- 1. Gottschalk. G. (1985). Bacterial metabolism. 2nd Ed. Springer, New York, United States of America.376 pp.
- 2. Lundblad, R. L. and Macdonald, F. (Eds.). (2018). Handbook of Biochemistry and Molecular Biology 5 th Ed. CRC Press, Boca Raton, United States of America. 1001 pp.
- 3. Voet, D., Voet, J. G. and Pratt, C. W. (2016). Fundamentals of biochemistry. 5 th Ed. ISBN: 978-1-118-91840-1. John Wiley and Sons, Germany. 1264 pp.
- 4. Stryer, L. (2022). Biochemistry (9th ed.). Macmillan Higher Education. 560 pp.
- 5. Nelson, D. L., and Cox, M. M. (2024). *Lehninger Principles of Biochemistry* (8th ed.). W.H. Freeman 1096 pp.
- 6. Moat, A. G., Foster, J. W., and Spector, M. P. (2002). *Microbial Physiology* (4th ed.). Wiley-Liss.736 pp.
- 7. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P. (2007). *Molecular Biology of the Cell* (5th ed.). W.W. Norton and Company.1446 pp.
- 8. Karp, G. (2020). *Cell and Molecular Biology: Concepts and Experiments* (8th ed.). John Wiley and Sons.944 pp.
- 9. De Robertis, E. D. P., and De Robertis, E. M. F. (1987). *Cell and Molecular Biology* (8th ed.). Lea and Febiger.576 pp.
- 10. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., and Scott, M. P. (2020). *Molecular Cell Biology* (9th ed.). W.H. Freeman.1184 pp.



Davangere University

Shivagangotri, Davangere-577 007, Karnataka M.Sc. Microbiology (Academic Year 2024 onwards)

Semester scheme with Choice-Based Credit System (CBCS)

Course Structure

M.Sc. Microbiology II Semester

					Mark	S			
Suhier/Paner	Code	Title of the Paper		Examination	Internal Assessment	Total Marks	Credits	duration (Hrs.)	
		THEORY PAPI	ERS						
	MB 2.1	Microbial Physiology	4	70	30	100	4	3	
	MB 2.2	Microbial Genetics and Genomes	4	70	30	100	4	3	
jerana jerana	MB 2.3	Molecular Biology and Genetic Engineering	4	70	30	100	4	3	
SEMESTER-II	MB 2.4	Biophysics, Biostatistics and Bioinformatics	4	70	30	100	4	3	
ES	PRACTICAL PAPERS								
EM	MB 2.5	Microbial Physiology	4	40	10	50	2	3	
5 0	MB 2.6	Microbial Genetics and Genomes	4	40	10	50	2	3	
	MB 2.7	Molecular Biology and Genetic Engineering	4	40	10	50	2	3	
	MB 2.8	Biophysics, Bioinformatics, Biostatistics and Research Methodology	4	40	10	50	2	3	
	Manda	tory Credits: Computer Skill	2		Prof. park	333 kas car	2	Ris IGM OVA	
			34			600	26		

*Internal assessment: Theory: 2 Tests=10 marks; 1 Assignment-05 marks; 1 Seminar=05 marks; Attendence=10 marks

Practical: Record – 05 marks and Attendence – 05 marks

Microbiology SEMESTER-II Core - MB-2.1: MICROBIAL PHYSIOLOGY

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course objectives:

- Understand about microbial metabolism, growth and energy generation.
- Gain knowledge of various fermentation pathways, microbial communication and energetics.
- Familiarize with the concepts of nitrogen and phosphate assimilation, electron transport chain and transfer of genetic information among microbial communities.

Unit 1: Physiology and Enzyme kinetics:

16 hrs.

- a) Biological solvent: Structure of water, physical and chemical properties of water molecule. Water as a universal solvent. Polarity, cohesion, adhesion, capillary, surface tension, boiling, melting, hydrophilic and hydrophobic properties.
- b) Physiology: Introduction, macro and micro nutrients, nutritional types of microorganisms photolithotrophic autotrophy, photoorganotrophic heterotrophy, chemolithotrophic autotrophy, chemoorganotrophic heterotrophy; growth factors, growth curves, uptake of nutrients by the cell-facilitation diffusion, active transport, group translocation, iron uptake; growth yields and limiting nutrients. Biofilms and Quorum Sensing.
- c) Enzyme Kinetics: Enzyme classification and nomenclature, properties, Structure-function relationship: active site, enzyme reactions single-substrate and multiple substrates, chemical mechanism of enzyme catalysis; experimental measures of enzyme activity, enzyme inhibition, enzyme catalysis, factors affecting enzyme activity.

Unit 2: Photosynthesis and fermentation:

16 hrs

- a) Microbial Photosynthesis: Light Energy, Photolysis of Water, Photosynthetic Pigments, Cyclic and Non-Cyclic Photosynthesis, Calvin's Cycle. Photophosphorylation and substrate level phosphorylation. Photosynthetic Bacteria and Cyanobacteria, Unique bacterial metabolism: Hydrogen Bacteria, Nitrifying Bacteria, Sulfur Bacteria, Iron Bacteria, Methylotrophs and Methanogens.
- b) Fermentation Reactions: Types of fermentation reactions, Homo and Heterofermentation pathways; Alcohol and Lactic acid fermentation pathways. Yeast Fermentation, Lactic Acid Fermentation, Butyric Acid and Solvent-Producing Fermentations, Mixed-Acid Fermentations, Propionic Acid Fermentation, Acetic Acid Fermentation.

Unit 3: Metabolism

16 hrs

- a) Microbial fueling reactions: energy an overview of metabolism; Glycolytic pathway, Pentose Phosphate Pathway, Entner Doudoroff Pathway, Tricarboxylic Acid cycle; electron transport and oxidative phosphorylation, yield of ATP in glycolysis and aerobic and anaerobic respiration, intracellular reserve polymers glycogen, volutin granules, lipid catabolism, protein and amino acid catabolism; oxidation of inorganic molecules, degradation of fatty acids.
- b) <u>Biosynthesis</u>: Use of energy in biosynthesis principles, photosynthesis fixation of CO2; carboxylation, reduction, regeneration, synthesis of sugars and polysaccharides; phosphorus assimilation of phosphorus, sulphur and nitrogen, synthesis of amino acids, fatty acids, anaploerotic reactions biosynthesis of purines, pyrimidines and nucleotides; peptidoglycan and chitin synthesis.

Unit 4: Bioenergetics and metabolites:

16 hrs

Principles of thermodynamics, activation energy, free energy, enthalpy, entropy, high energy compounds-ATP, NAD, FAD and FMN; components and mechanisms of respiratory chain, mechanism of substrate level phosphorylation;

Secondary metabolism: Secondary metabolites from fungi and bacteria; regulation of secondarymetabolism; structure and outline of synthesis of antibiotics; bacterial toxins; fungal toxins-patulin, aflatoxin, fuminosin; fungal and bacterial pigments; fungal hormones- sirenin, sterols, trisporic acid; fungal alkaloids; bioluminescence in microorganisms – mechanisms and significance.

Course outcome:

- Understanding the major fermentation, aerobic and anaerobic pathways for energy generation in microbial cells.
- Distinguish the microbial transport systems and the modes and mechanisms of energy conservation in microorganisms.
- Recognize the various unique metabolic processes in microorganisms.

References:

- 1. Felix Franks, (1993); Protein Biotechnology, Humana Press, New Jersey.
- 2. Stryer L, (1995); Biochemistry, Freeman and Company, New York.
- 3. Voet & Voet, (199)5; Biochemistry, John Wiley & Sons, New York.
- 4. Nelson & Cox, (2000); Lehninger's Principles of Biochemistry, Elsevier Publ.
- 5. Freifelder D, (1982); Physical Biochemistry, Freeman & Co. New York.
- 6. Harper, (1999); Biochemistry, McGraw Hill, New York.
- 7. Colowick SP and Kaplan N D, (1955); Methods in Enzymology. Vol. I. Academic Press.
- 8. Price & Steeves, (1989) Fundamentals of Enzymology
- 9. Kapler, (1993); Advances in Enzymology, Academic Press
- 10. Moat, A.G., Foster, J.W. and Spector, M.P. (2002) Microbial physiology. 4th Edition, Wiley-Liss Inc., New York.

Microbiology SEMESTER-II CORE -MB 2.2 MICROBIAL GENETICS and GENOMES

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- Understand the Genetic principles of microorganisms with special emphasis on types of genomes
- Develop the mechanism of genetic recombination in microorganisms and construction of genetic map.
- Study on viral, fungal and algal genetics.
- Familiarize different techniques used to study the microbial genomes with applications

Unit 1 Concepts in Microbial Genetics:

16 hrs

- a) Historical development: Basic principles of heredity, Mendelian Principles, Laws of inheritance, Genetic elements, Chemical basis of heredity, Experimental proof of Genetic materials, Modern concept of gene, Co-linearity and polypeptide, Types of genes.
- b) Genome diversity: Viruses Linear, Circular and divided genomes of RNA and DNA Viruses, Prokaryotic Genome E.coli chromosome- Nucleoid, coiled, supercoiled (plectonemic, solenoid), folded fiber model and chromosome organization, genome evolution in microorganism, Phylogenetic trees.
 - Eukaryotic Genome: Chromosome organization / genome complexity, Structure of chromatin, chromosome, centromere, telomere, nucleosome structure, genome organization, split gene, overlapping genes and Cot curves, chromatin remodeling; types of histones, histone modifications- methylation, acetylation, phosphorylation and their effects on structure and function of chromatin, Significance of repetitive and non-repetitive DNA sequences. Law of DNA constancy, C value paradox and genome size, karyotype and idiogram, chromosome banding techniques and application in Medicine and forensics.

Unit 2: Bacterial Genetics

16 hrs

Methods of Genetic recombination: Models of General recombination (Holiday model). Role of *Rec*A Bacterial Transformation: Types of transformation mechanisms found in prokaryotes, Bacterial gene linkage (2/3 point), construction of genetic map-gene order and frequency determination (problems solving) Bacterial Conjugation: properties of the F plasmid, F+ x F - mating, F' x F- conjugation, Hfr conjugation. Conjugation mapping and construction of genetic map. Colicins and Col Factors, R plasmids. Sexduction, conjugational transfer of colicinogenic and resistance transfer factors,

Transduction: Generalized and specialized transduction, Host restriction and modification.

Plasmid structure, Replication and incompitability, Control of copy number.

Transposons – Insertion sequences and composite transposons, phages as transposons, replicative, non-replicative and conservative transposition. Mutations i.e. deletions, inversions and frameshift due to transposition.

Unit 3: Viral, Fungal and Algal Genetics:

16 hrs.

- a) Viral genetics: Phage phenotypes, Phenotypic mixing, recombination in viruses: Mutations, circular map, Recombination and mapping. Lytic and Lysogenic cycles in bacteriophages and their uses in microbial genetics. Lytic phages-T7 and T4, Lysogenic phages Lamda temperate phage: Structure, genetic map, lytic and lysogenic cycle, lysogenic repression and phage immunity. [Lambda regulon], M13 and ΦX174. Applications of phages in microbial genetics.
- b) Fungal Genetics: *Neurospora* Tetrad analysis and linkage detection 2 point and 3 point crosses, chromatid and chiasma interference, Mitotic recombination in *Saccharomyces, Neurospora* and *Aspergillus*.

c) Algal Genetics: *Chlamydomonas* - unordered tetrad analysis - Recombination and Mapping, Nucleocytoplasmic interactions and gene expression in *Chlamydomonas, Acetabularia*. Extra nuclear (Cytoplasmic) inheritance.

Unit 4 Genomes: 16 Hrs

Introduction to Genomes, Genetic mapping of genomes, tools and techniques used in genomic analyses, variation and genome-scale analysis of gene/protein expression; Genomes across the tree of life, Completed genomes: viruses, bacteria and Archaea, fungi, plants and animals. Nucleic acid Hybridization, Minisatellite and Microsatellite analysis, RFLP, microarray; Heteroduplex analysis, Model organisms for genome analysis – *Escherichia*, *Neurospora*, *Saccharomyces*, *Caenorhabditis*, *Drosophila* and *Arabidopsis*, Mouse, Human. metagenomics analysis and databases of microbial genomics.

Forensic genetics: Biocrime, Biothreats, Epidemiology, investigations, Detections, Characterization and genetic engineering technologies, Interpretation of microbial forensic results, Methods and system elements, Robust collection presentation of evidence based samples.

Course Outcomes:

- Understanding the fundamentals of genetics and genomics of microorganisms.
- Comprehend the mechanism of types of bacterial recombination with construction of genetic map.
- Knowledge on viral, fungal and algal genetic processes and their importance.
- Study on microbial genomics and forensic applications:

Reference:

- 1. Dale, J.W. and Simon F Park. (2010). Molecular Genetics of Bacteria. Fifth Edition. Wiley-blackw.
- 2. Robert J. Brooker. (2009). Genetics: Analysis and Principles, 3rd Edition. McGraw-Hill.
- 3. Hartwell, L., Goldberg, M. L, Fischer, J. A., Hood, L., Aquadro, C. F., Silver, L. M., and Reynolds, A. E. (2015). Genetics: From Genes to Genomes (5th ed.). McGraw-Hill Education. 825 pp.
- 4. Maloy, S. R., Cronan, J. E, and Freifelder, D. (1994). Microbial Genetics (2nd ed.). Jones and Bartlett Publishers 568 pp.
- 5. Kruiz, H. 2001. Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition ASM Publications.
- 6. Watson, J.D., N.H. Hoppkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. 1987, Molecular Biology of the Gene. Pearsons India.
- 7. Birge, E.A. 2006.Bacterial and Bacteriophage Genetics. Springer
- 8. Larry, Snyder and Wendy, 2013 Molecular Genetics of Bacteria, Champness, ASM Publications.
- 9. Griffiths, A.J.F. 2020. Introduction Genetic analysis. 12th edn. W.H. Freeman & Co.
- 10. Streips & Yasbin (2001). Modern microbial Genetics. Wiley Ltd.675 pp.

CORE MB-2.3: MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- Understand about basic structure, chemical composition and function of biologically important molecules.
- Comprehend the mechanisms of transcription and translation.
- Recognize the gene regulation process with respect to microorganisms.
- Familiarize the versatile tools and techniques employed in genetic engineering.

Unit 1: Nucleic acids:

16 hrs.

- a) Central dogma of molecular biology, DNA as the source of genetic information. Structure and types of DNA, Chargaff's rule; Watson-Crick's model of DNA; denaturation and renaturation kinetics of DNA; Replication: Semiconservative, Meselson and Stahl's experiment, modes of replication, requirements and direction of replication, enzymes in replication, prokaryotic and eukaryotic DNA replication, end replication problem.
- b) RNA as the genetic material, RNA structure and classes of RNA.

Unit 2: Transcription and Translation:

16 hrs.

- a) <u>Transcription</u>: Process of RNA synthesis template, substrate and transcription apparatus. Bacterial transcription -initiation, elongation and termination. Eukaryotic transcription nucleosome structure, promoters, initiation, elongation and termination. RNA processing spliceosome, 5'-capping, polyadenylation, RNA splicing, alternative processing pathways, RNA editing.
- b) Genetic code: Triplet codon, reading frame and initiation codons and termination codons, rules governing the genetic code.
- c) <u>Translation</u>: tRNA charging, mechanisms of translation in prokaryotes and eukaryotesinitiation, elongation and termination, polyribosomes, post-translational modifications of proteins.

Unit 3: Gene regulation and Mutations:

16 hrs.

Genes and regulatory elements, levels of gene regulation, DNA-binding proteins, regulation of gene expression in prokaryotes, Operon concepts: *lac*-operon and *trp*-operon; gene regulation in eukaryotes; principles of transcriptional regulation; gene regulation in bacteriophages, gene silencing. Mutations and DNA repair:

Nature, type and importance of mutations; molecular basis of spontaneous and induced mutations; Mutagenesis – physical and chemical mutagens, base and nucleoside analog, alkylating agents, interrelating agents, ionizing radiation, repair mechanisms- direct repair, excision repair, mis-match repair, post-replication repair. Significance in genetic diseases.

Unit 4- Genetic Engineering:

16 hrs

- a) Introduction, Isolation and purification of DNA, Restriction endonucleases, cloning vectors: Bacterial plasmids, pBR 322, pUC18, large DNA inserts-Phage λ, M13 vectors and Cosmids. Expression vectors; vectors for insects, yeast and mammalian system. Methods for gene cloning in prokaryotes and eukaryotes. Construction of genomic and cDNA libraries, Artificial chromosomes- BACs and YACs Screening of DNA libraries using nucleic acid probes.
- b) Sequencing and amplification of DNA: Maxum and Gilbert method, Sanger's dideoxy method, Next generation sequencing technologies (NGS): Pyrosequencing, Sequencing by ligation (SOLiD), Sequencing by illumina and nanopore sequencing. Large scale DNA sequencing strategies-shotgun cloning strategy and Cyclic array sequencing. Polymerase

Chain reaction (PCR) – Real time, inverse, RT-PCR and nested PCR. Genome editing technologies- CRISPER technology and TALEN.

Course Outcome:

- Understanding the properties, structure and function of genes in organisms.
- Recognize the molecular mechanisms involved in replication, transcription, translation, and mutations
- Appreciate the process of gene regulation in prokaryotes and eukaryotes.
- Familiarize with tools of recombinant DNA technology and their applications.

Reference:

- 1. Lewin, B. 2000. Gene VII. Oxford University Press.
- 2. Larry S. and Wendy 1997. Molecular Genetics of Bacteria. ASM Publications.
- 3. Nicholl D. S. T. 2008. An Introduction to Genetic Engineering, Cambridge University Press.
- 4. Glick BR and Pasternak JJ. 2003. Molecular Biotechnology. ASM Press, Washington D.C.
- 5. Old R.S. and Primrose 2001. Principles of Gene Manipulation. Blackwell Scientific Publication.
- 6. Brown T.A. 2006. Gene Cloning. Blackwell Publishing.
- 7. Sambrook J. & Russell D. W. 2001. Molecular cloning- A laboratory manual. Cold Spring Harber Laboratory Press.
- 8. Weaver R., (2007) Molecular Biology, 4th Edition, McGrew Hill Science.
- 9. Old, R.S. and Primrose ,(2005) An introduction to gene manipulation
- 10. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., and Losick, R. 2004. Molecular biology of the gene, 5th edn. Pearson Education, Delhi.

CORE COURSE CODE: MB. 2.4 BIOPHYSICS, S BIOINFORMATICS, BIOSTATISTICSAND RESEARCH METHDOLOGY

Course Credits:4

Total No. of Hours: 64

No. of Teaching Hours per Week: 4 Hrs

Course objectives:

- To impart the biomolecules bonding and energy strengths to fulfil proper biological functions.
- Provide an overview of various bioinformatics tools, databases available and sequence analysis.
- Impart basic knowledge of statistics and tools used for several quantitative analysis in microbiology.
- Understand basic concept of research methodology including literature survey, experimental design and data presentation.

Unit 1- Biophysics:

16 hrs

Chemical bonding;- Quantum mechanics, Pauli's exclusion principle, Ionisation energy, Electron affinity, Electronegativity and strong bonds, Secondary bonds. Energies, forces and bonds Interatomic potentials and spring constants, Free energy and internal energy.

Techniques and methods; - X-Ray diffraction, NMR, Scanning tunneling microscope, Atomic force microscopy, patch clamping Molecular dynamics, potential energy and contour tracing

Biological polymers: Nucleic acid Conformation DNA and RNA, Biological membranes chemistry and structure, Bacterial motion, chemical memory in primitive organisms, Excitable membranes, Diffusion and mobility of ions. Nerve Signals and Memory; Hebbian learning Neural networks.

Unit-2: Bioinformatics 16 Hrs

- a) **Biological Databases:** Introduction to Nucleic acid databases: NCBI, EMBL, DDBJ & GENBANK. Protein database: Swiss-prot, Prosite, Prints blocks & pfam. Genome database, Literature database (Pubmed and PMC). Protein Data Bank (PDB), Gene bank flat file, FASTA Format. OMIM, OMIA, Metabolic Pathway-KEGG.
- b) Sequence Alignments and Phylogenetic Analysis: Methods of sequence alignment: Pair wise (Global and Local Alignment) and Multiple Sequence Alignment (MSA). Progressive sequence alignment method, Internet based analysis tools- Clustal W and T-coffee. Database similarity searching: BLAST and FASTA, PSI-BLAST &PHI-BLAST. Phylogenetic tree: Introduction, types of trees phylogenetic trees and multiple alignments. Distance matrix method (MD), character based methods, Steps in constructing alignments and phylogenesis. Phylogenetic softwares (CLUSTAL-W, PHYLIP etc).

Unit-3- Biostatistics: 16 hrs

Introduction to Biostatistics, Sampling techniques, Data-Types, Data presentation styles. Measures of Central tendency, Skewness and Kurtosis. Scattered plots, Regression and Correlation methods. Multiple regression analysis Probabilities, Mean, median, mode, measure of dispersion, range, standard deviation, mean deviation, standard errors, confidence limits, simple significance tests based on the normal distribution; use of t-tests, regression analysis, ANOVA, LSD, Chi-square test, statistical basis of biological assays direct and indirect assays, probit, logit, LD₅₀, ED₅₀, slope ratio assay; Bioassay-their types, Dose response curves, Design and analysis of Epidomological model studies. Statistical software- Excel, Python, SAS, R -Studio, MATAB.

Unit-4: Research Methodology:

- Scientific research: Essential steps in research; components of research, general laboratory organization, laboratory setup and equipment, laboratory note book-types, format and content.
- b) Information retrieval: Types of literature books, reviews, research articles. Review process and analysis of information. Components of research article. Literature citation
- c) Scientific data presentation: Design of experimens, units of measurement, collection, classification and tabulations of research data; preparation of tables, figures, diagrams, presentation of research data.

Course outcomes:

- Understanding the chemical bonding concepts, Biological polymers and neurobiology insights.
- Able to understand the Databases and its types and tools and to understand the sequence alignment and database searches and phylogenetic constructions.
- Exploring the fundamentals of biostatistics, analysis of statistical techniques and overview of the bioassays and the statistical software proficiency.
- Comprehend methods of research, tools and techniques literature survey and research

References:

- 1. Parke, W. C. (2020). Biophysics: A Student's Guide to the Physics of the Life Sciences and Medicine. Springer. 368 pp.
- 2. Cotterill, R. (2002). Biophysics: An Introduction. John Wiley & Sons. 416 pp.
- 3. Pappu, R. V., & Sosnick, T. (2024). Biophysics: A Student's Guide to the Physics of the Life Sciences and Medicine. Springer. 368 pp.
- 4. Rastogi, V. B. (2015). Biostatistics 3rd edn. MedTech, 768 pp.
- 5. Randles, R. H. (2019). Biostatistics: Principles and Applications 3rd edn. Pearson, 456 pp. 7. Motulsky, H. (2018). Intuitive Biostatistics 2nd edn. Oxford University Press.320 pp
- 8. Stuart M B (2000) Bioinformatics Medical Center, NY USA.. 567 pp.
- 9. Arthur Lesk (2006) Introduction to Bioinformatics –Oxford Press 567 pp.
- 10. Krane D E and Raymer M L (2006)Fundamental Concepts of Bioinformatics Pearson, .456 pp.



Davangere University

Shivagangotri, Davangere-577 007, Karnataka

M.Sc. Microbiology (Academic Year 2024 onwards) Semester scheme with Choice-Based Credit System (CBCS) Course Structure

M. Sc Microbiology III Semester

	_				Mark	S			
	Subject/Paper Code	Title of the Paper	Instruction Hrs./week	Examination	Internal Assessment	Total Marks	Credits	duration (Hrs.)	
		THEORY PAPE	ERS	<u> </u>				L	
	MB 3.1	Agricultural Microbiology and Phytopathology	4	70	30	100	4	3	
	MB 3.2	Immunology	4	70	30	100	4	3	
	MB 3.3	Medical Microbiology	4	70	30	100	4	3	
SEMESTER-III	MB 3.4	(A) Mycology(B) Gut Microbiology(C) Microbial Enzymology(D) Bioinformatics	4	70	30	100	4	3	
	MB 3.5	(A) Microbial Genetics(B) Diagnostic Microbiology(Interdisciplinary Elective Paper)	2	40	10	50	2	2	
E	PRACTICAL PAPERS								
(4)	MB 3.6	Agricultural Microbiology and Phytopathology	4	40	10	50	2	3	
	MB 3.7	Immunology	4	40	10	50	2	3	
	MB 3.8	Medical Microbiology	4	40	10	50	2	3	
	MB 3.9	(A) Mycology(B) Gut Microbiology(C) Microbial Enzymology(D) Bioinformatics	4	40	10	50	2	3	
			34			650	26		
		ectives icrobial Genetics iagnostic Microbiology	2	40	10	50	2	2	

*Internal assessment: Theory : 2 Tests=10 marks; 1 Assignment-05 marks; 1 Seminar=05 marks; Attendence=10 marks

Practical: Record – 05 marks and Attendence – 05 marks

Microbiology SEMESTER-III Core MB-3.1: AGRICULTURAL MICROBIOLOGY AND PHYTOPATHOLOGY

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course objectives:

- Understand beneficial and harmful microorganisms in relation to agriculture.
- Develop set of skills to recognize the agricultural problems and critical evaluation of diseases in plants.
- Learn the basic principles of phytopathology and adopt integrated disease management practices.
- Study specific diseases of plants of selected crop plants.

Unit 1: Agricultural Microbiology:

16 hrs

- a) <u>Plant microbiome</u>: Concept and scope, beneficial microorganisms, interactions of soil microorganisms with plants; rhizosphere and phylloplane microorganisms; modern concepts of microbial inoculants in agriculture.
- b) Microbial inoculants: Mass culturing and quality control of microbial inoculants-mother culture, shake culture and brief account of large scale production of biofertilizers. Methods of application to seed, soil and nursery. Brief account of mass production and applications of *Rhizobium*, *Azotobacter*, *Azospirillum*, Cyanobacteria, *Azolla* and *Frankia*. Plant growth promoting rhizobacteria (PGPR/PGPB), phosphate solubilizers, siderophores, ammonia, HCN, phytohormones. Beneficial fungi in agriculture, *Trichoderma*, *Metarhizium*, *Beauveria*, Mycorrhizae importance and applications.

Unit 2: Fundamentals of Phytopathology:

16 hrs

- a) <u>Plant disease</u>: Significance, parasitism and pathogenicity; Koch's postulates, types of plant diseases, plant disease diagnosis; disease cycle, infection cycle and plant disease triangle; Effects of pathogens on plant physiology photosynthesis, nutrients uptake, respiration, membrane permeability, plant growth and reproduction.
- b) <u>Plant pathogenesis</u>: Process of pathogen attack; role of enzymes, toxins, growth regulators in plant disease.
- c) <u>Plant disease epidemiology</u>: Effect of environmental factors on disease development; Dissemination of plant pathogens; Disease forecasting and its significance.

Unit 3: Plant defense mechanisms:

16 hrs

- a) <u>Structural defense mechanisms</u>: Pre-existing and induced structural defences, cell wall, papillae, tyloses, anatomical barriers.
- b) <u>Biochemical defense mechanisms</u>: Pre-existing and induced chemical defenses, elicitors, receptors and suppressors in disease development; phenols and phytoalexins, PR proteins, defence enzymes systemic acquired resistance.
- c) <u>Genetics of plant disease</u>: Variability in pathogens, stages of variation, types of plant resistance to pathogens; genetics of virulence in pathogens and resistance in plants, signaling in plant disease resistance, systemic acquired resistance.

Unit 4: Plant Diseases and their management:

16 hrs

- a) <u>Diseases</u>: Brief account of some important plant diseases-rots, damping-offs, downy mildews, white rust, powdery mildews, smuts, rusts, wilts, leaf spots, anthracnose, galls, ergots, bacterial, viral, phytoplasmal, nematodal, protozoal, viroid, non-parasitic diseases, seed-borne diseases and post-harvest diseases.
- b) <u>Disease management</u>: Quarantine regulations, cultural methods, physical methods, chemical control, biological control, cross protection, breeding for disease resistance, integrated disease management practices and transgenic plants for disease resistance Software for disease diagnosis and monitoring.

Course Outcomes:

- Understanding various plant microbe interactions and biofertilizer production.
- Appreciate role of microorganisms in sustainable agriculture.
- Comprehend the basic principles of phytopathology and plant pathogenesis.
- Analyze suitable disease management strategies of plant diseases.

Reference:

- 1. Agrios, G.N. 2006 Plant Pathology. Elsevier Academic press, 922 pp.
- 2. Atlas, R.M, and Bartha, R. 1997. Microbial ecology: Fundamentals and applications. 4th edn. Pearson 640 pp.
- 3. Brock, I. 2019. Plant pathology: Disease detection and identification. Callisto, 236 pp
- 4. Dhingra and Sinclair 2000. Basic Plant Pathology Methods, CRC press, London, 434 pp.
- 5. Dickinson, M. 2003. Molecular plant pathology. Taylor and Francis Ltd. 244 pp.
- 6. Gullino, M and Munkvold, G. 2014. Global perspectives on the health of seeds and plant propagation material. Springer 320 pp.
- 7. Tronsmo, A.M., Collignge, D.B., Djurarle, A., Munk, L., Yuen, J., Trosmo, A. 2020. Plant pathology and plant diseases. CABI, 461 pp
- 8. Singh, R.S. 2021. Plant diseases. MedTec Science Press, 125 pp
- 9. Wani, S.H. 2019. Disease resistance in crop plants, Springer 307 pp.
- 10. Waiters, D. 2020. Plant defense. Wiley-Blackwell publishers 256 pp.

Microbiology SEMESTER-III Core MB 3.2 IMMUNOLOGY

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- Understand the innate and adaptive immunity along with major cells and molecules involved.
- Appreciate the development of humoral and cellular responses to invading substances
- Integrate immunology with health and enrich the knowledge for autoimmune disorders, hypersensitivity reaction.
- Aquent the knowledge of development of diagnostic techniques.

Unit-1 Overview of the immune system:

16 hrs

Immunity - Types of Immunity, Innate and Acquired Immunity. Haematopoiesis, Cells of the Immune System- B & T Lymphocytes; Antigen Presenting Cells. Macrophages, Organs of the immune System: Primary lymphoid organs (Bone marrow and Thymus); Secondary lymphoid organs (lymph nodes, spleen and mucosal-associated lymphoid tissue).

Antigens - Immunogenicity versus Antigenicity, Factors that influence immunogenicity, Epitopes - Properties of B-cell epitopes and T-cell epitopes, Haptens and the study of Antigenicity. Immunoglobulins; structure, classes and distribution of antibodies. B cell maturation, activation and differentiation. Antibody diversity, Generation of humoral immune response- primary and secondary. Complement system – alternate, classical and lectin pathways.

Unit-2 Cell mediated Immunity:

16 hrs

Major histocompatibility complex and antigen presentation: MHC- organization, inheritance, genes, molecules and peptide binding, expression, disease susceptibility, immune responsiveness, self MHC restriction, cytosolic and endocytic pathway for antigen processing. T-cell receptor, T-cell maturation, activation and differentiation: TCR- genetic organization and rearrangement of genes, TCR-complex, peptide binding, thymic selection, activation and differentiation of T cells. Cell mediated cytotoxicity: Effector T cells, cytotoxic T cells, NK cells, ADCC. Cytokines- properties and functions.

Unit-3: Clinical immunology:

16 hrs

Immunity to Infection: Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity - Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Tumor immunology - Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; Immunodeficiency - Primary immunodeficiencies, Acquired or secondary immunodeficiencies. Transplantation immunology: Types of grafts, Immunologic basis of graft rejection, immunosuppressive therapy, clinical transplantations, compatibility assessment. Apoptosis.

Unit-4: Antigen antibody reactions:

16 hrs

Principles, Techniques and applications; Precipitation, agglutination and complement mediated immune reactions; Immunological techniques - ELISA, Western blotting, ELISPOT assay, Immunofluorescence, RIA, Flow cytometry and cell sorting, Immunoelectron Microscopy; tuberculin test, Chemilumniscent assays, Surface plasmon resonance, Biosensor assays for assessing ligand - receptor interactions.

Antibody production: polyclonal and monoclonal antibodies; humanized antibodies, T-cells, therapeutic and diagnostic applications.

Principle and strategies of vaccine production, types, significance and cytokines production.

Course Outcomes:

- Contrast and compare innate and adaptive immunity
- Understanding the development of humoral and cell mediated immunity
- Appreciate the mechanisms of autoimmunity, transplantation immunology
- Students should be equipped with features of antigen antibody reaction and diagnostic techniques.

Reference:

- 1. Kuby Immunology (2018) 8th ed., Punt J, Stranford S, Jones P and Owen JA, W.H Freeman and Company, ISBN: 978-1319114701.
- 2. Janeway's Immunobiology (2017) 9th ed., Murphy KM and Beaver C, WW Norton and Company, ISBN: 978-0815345510.
- 3. Roitt's Essential Immunology (2017) 13th ed., Delvis PJ, Martin SJ, Burton DR and Roitt, IM, Wiley-Blackwell, ISBN: 978-1118415771.14
- 4. Doan T, Melvold R, Viselli S and Waltenbaugh, C Lippincott's illustrated Reviews Immunology (2012) 2nd ed., Wolters Kluwer India Pvt, Ltd, ISBN: 978-8184737639.
- 5. Roitt, I.M, (2006). Essential of Immunology 12th edition, ELBS, Blackwell Scientific Publication
- 6. Abul K. Abbas, Andrew H.L, Shiv Pillai (2021) "Cellular and Molecular Immunology" 10th Edition Saunders Publications
- 7. Peter Parham Garland (2014) The Immune system-science, W W Norton & Company, 4th Edition.
- 8. Anil Sharma (2019) Introduction to immunology text book Taylor and Francis
- 9. Hardeep K & Ravi T (2021) Textbook of immunology, Dreamtech press
- 10. Shivi B & Shukla A (2020) Fundamentals of Immunology

Core: MB 3.3. MEDICAL MICROBIOLOGY

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- Emphasis on the relationship between microorganisms, portals of entry, mechanism of pathogenesis and host defense.
- Study important diseases caused by bacteria emphasizing on etiology, pathogenesis, diagnosis, treatment, and prevention.
- State the important viral, fungal and protozoal pathogens affecting human system and detection methods
- Understand the antibiotics acting on microorganisms and mechanism of resistance

Unit 1- Concepts and Mechanisms of pathogenesis:

16 hrs

Clinical microbiology; outline, concepts, normal microflora of the human body, collection, handling and transport of Specimens; brief account of isolation and identification of microorganisms from specimens.

Infection and immunity- types: Factor predisposing infectious diseases.

Factors involved in Pathogenesis –Establishment, spreading, tissues damage and anti-phagocytic factors. Mechanism of Pathogenesis-Bacterial adhesion, Colonization and invasion of mucus membranes of respiratory, enteric and urogenital tract, Role of aggressins, Depolymerizing enzymes, Cell tropisms. Quorum sensing in *Streptococcus pyogenes*.

Dental infections: Dental plaque, dental caries, periodontal diseases. Emerging and reemerging pathogens

Unit 2- Medical Bacteriology:

16 hrs

Bacteriology: Classification, Epidemiology, Pathogenesis, clinical conditions, laboratory diagnosis, epidemiology, chemotherapy and prevention of following infectious agents; *Staphylococcus*, *Streptococcus*, *Pneumococcus*, *Escherichia coli*, *Proteus*, *Salmonella*, *Shigella*, *Neisseria*: (meningo and gonococci), Corynebacterium, Pseudomonas, Vibrio, Clostridium (Cl. perfringens, Cl. tetani, Cl. botulinum and other species), *Haemophilus*, *Mycobacterium* (typical and atypical), *Spirochaetes* (Treponema, Borrelia, Leptospira)

Unit 3- Medical Virology, Mycology and Parasitology:

16 hrs

<u>Virology:</u> Etiology, clinical symptoms, laboratory diagnosis and treatment: Pox virus, Herpes virus (HSV I & II) Varicella-zoster, Adenovirus, Picorna virus, Orthomyxoviruses (influenza), Paramyxoviruses (Mumps and Measles), Corona virus, Rhabdoviruses, Hepatitis viruses (HAV, HBV HCV, HDV), H1N1, Oncogenic viruses (HPV, Epstein-barr virus, CMV), HIV, Arboviruses (Dengue, Encephalitis, chikungunya, rubella). Prion infection- Mad Cow, CJD, Kuru.

Mycology: Aetiology, clinical symptoms, laboratory diagnosis and treatment of superficial infections (dermatomycoses): *Epidermophyton*, *Microsporum* and *Trichophyton*; Madura foot; Subcutaneous mycoses: Sporotrichosis and Systemicmycoses: Blastomycosis, Coccodiodomysis, Candidiasis, Opportunistic fungal infections: Pulmonary Aspergillosis

Parasitology: Entamoeba, Giardia, Balantidium, Plasmodium, Trchomonas and Leishmania

Unit 4- Antimicrobial agents:

16 hrs.

Classification of antimicrobial agents (Classification based on source, chemical structure, mode of action and range of effectiveness), Mechanism of drug action – antibacterial (Bacteriostatic and bactericidal) antifungal and antiprotozoans drugs. Methods of testing drug sensitivity (in vitro and in vivo), antibiotic assay in body fluids. Mechanism of drug resistance and dissemination of multi drug resistance (MDR), cross resistance, Impact of antibiotic resistance, therapeutic use of antibiotics, strategies to overcome MDR among microorganisms.

Recent trends in drug resistance and its consequences (with examples), antibiotic policy, NCCLS (CLSI) guidelines and standards, WHO guidelines,

Course Outcome:

- Acquainted with fundamental principles of medical microbiology and infectious disease.
- Comprehensive knowledge on bacterial infectious disease and diagnosis
- Significant skill and practice on etiologic agents of virus, fungal species and parasites.
- Understanding of antibiotics, action mechanism and wide spread of antibiotic resistance microorganisms and implications

Reference:

- 1. Mahon. C.R. (2010). Textbook of Diagnostic Microbiology.3rd edition. Pearson.
- 2. Ananthanarayan R and J Paniker (2024). Text book of Microbiology. 13th Edition, Orient Longman
- 3. Wadher, and Bhoosreddy (2005). Manual of Diagnostic Microbiology. Himalaya Publisher.
- 4. Credric, A. Mims. (2012) Medical microbiology (5th Ed.). Eslevier.
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- 7. Warren Levinson. (2000) Medical microbiology and immunology: examination and board review. (8th Ed.)McGraw Hill.
- 8. Mackie and McCarthey (1996), Medical microbiology vol 1, Microbial infection. vol 2, practical medical microbiology, Churchil Livingstone
- 9. Connie R Mahon. (2010). Textbook of Diagnostic Microbiology. 3rd edition. Pearson.
- 10. Leslic Collier, John Oxford. (2000) Human virology: a text book for students of medicine, dentistry & microbiology (2nd Ed.) Oxford University Press.

SPECIALIZATION: MB-3.4 (A) MYCOLOGY

Course Credits: 4

Total No. of Hours: 64

No. of Teaching Hours per Week: 4 Hrs

Unit-1: Ecology of fungi and mycological methods

16 hrs

Development of Mycology, Significance of fungi to human. Distribution of fungi in nature, factors in influencing fungal distribution

Characteristics of fungi

Morphological structural and ultrastructural details of fungi. chemistry of the fungal cell and molecular architecture

Unit-2 Mycological methods:

16 hrs

Isolation, culturing and maintenance of fungi mycological media and methods culture collections. Isolation of fungi from soil, air, water, plant and animal samples. Methods of identification and modern approaches in detection and differentiation of fungi.

Unit-3 a) Fungal biodiversity and reproduction:

16 hrs

Diversity of fungi, systematic position of fungi, parameters for fungal systematic classification of fungi. Biochemical and molecular markers in fungal diversity assessment.

b) Reproduction in fungi:

Asexual and sexual reproduction. Reproductive structures in different fungi, heterokaryosis, parasexuality and heterothallism.

Unit - 4 Physiology and molecular mycology:

16 hrs

a) Fungal physiology: Fungal growth, nutritional requirements, assessment of fungal growth, effect of environmental factors on growth. Primary metabolism; Secondary metabolism in fungi-synthesis and activities of fungal antibiotics, mycotoxins, phytotoxins and other metabolites.

b) Fungal enzymes:

Nature of fungal enzymes, quantitative and qualitative assessment of fungal enzymes. Screening and selection of fungi for useful enzymes. Isozyme polymorphism in fungi; applications of fungal enzymes.

c) Fungal Proteomics and Genomics:

Identification of fungal proteins; techniques of studying fungal proteins; cellular and extracellular proteins of fungi; fungal protein antigens and their detection. Molecular biology of fungi; genome analysis; fungal genes and molecular methods for study of fungi. Usefulness of fungi in biotechnology. Fungal products of commercial importance; fungi for the production of recombinant proteins

No. of Teaching Hours per Week: 4 Hrs

SPECIALIZATION: MB 3.4 (B) GUT MICROBIOLOGY

Course Credits: 4 Total No. of Hours: 64

Unit-1 Introduction to gut microbiota;

16 hrs

Composition and structure of the human GI microbiota; Development of the human GI microbiota; Biogeography of the human microbiota in the GI tract; Factors shaping the GI microbiota

The Upper Gastrointestinal Tract

Esophagus and Stomach ;Introduction;The esophageal microbiome ;The microbiome in esophageal diseases ; Microbial niches of the intestines

Unit-2 a) Gut Microbiota;

16 hrs

Gut microbiota through life span; Gut microbiota in health and disease; Genetic and environmental factor of gut microbiota; Impact of nutrition on gut microbiota; Therapeutic manipulation of gut microbiota; Application of microbiota and nutrition; Future of gut microbiota and nutrition.

b) The Viruses of the Gut Microbiota;

The eukaryotic virome, a component of the gut microbiome; Interplay between gut virome and immune system; Pathogenic viruses of the gut virome: enteropathogenic viruses associated with systemic infections; Gut as a major source of neurotropic viruses, when pathogenesis and shedding is favored by humoral immune deficiency; An uncertain status for diet-derived animal viruses

Unit-3 a) Food Substrates Important to the Microbiota;

16 hrs

Dietary Fiber, Soluble and Insoluble, Carbohydrates, Fructose, and Lipids; The Benefits of Yogurt, Cultures, and Fermentation ;General considerations about yogurt, fermented dairy products,; Yogurt and digestive function

b) Immunologic Response in the Host;

Intestinal epithelial cells; Toll-like receptors and intestinal epithelial cells; NOD receptors and intestinal epithelial cells; Immunoregulatory role of intestinal epithelial cells; Transcytosis of immunoglobulin A by intestinal epithelial cells; Antigen presentation in the gut; Role of dendritic cells; Innate lymphoid cells; T cells; Microbial modulation of immune function

Unit-4 Role of the GI microbiota in health;

16 hrs

Bacterial Diarrheas; Enterotoxin-Mediated Diarrheal Diseases; Cholera; Enterotoxigenic E coli Diarrhea; Other Diarrhea-Causing Toxins; Gastrointestinal Disease Caused by Invasive Bacteria; Salmonella Enteritis; Shigella Dysentery; Fluid Production in Invasive Diarrhoeal Diseases; Viral Diarrhoea; Parasitic Diarrhoea. The Role of the Brain–Gut–Microbiome in Mental Health and Mental Disorders; Mood disorders;

Probiotics:

Probiotics: definition, types, properties, microbial group. Prebiotics: synbiotics and neutraceuticals, Taxonomy of Lactobacilli and Bifidobacteria, The Microecology of Lactobacilli in the Gastrointestinal Tract, Exopolysaccharide Production by Intestinal Lactobacilli

Specialization: MB-3.4 (C) MICROBIAL ENZYMOLOGY

Course Credits: 4

Total No. of Hours: 64

No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- Impart basic knowledge of enzyme kinetics, the parameters of the enzymatic reaction, mechanisms of action of enzymes and inhibitors, dependence on the temperature and pH of the enzymatic activity, knowledge of the structure of enzymes and amino acids that build active sites of enzymes.
- Integrate the practical aspects of enzymology with the kinetic theories to provide a mechanistic overview of enzyme activity and regulation in cells.
- Develop and understanding of enzyme development and rational drug designing.

Unit 1. Introduction to enzymes.

16 Hrs

Historical developments. Classification of enzymes into six major groups with suitable examples. Numerical classification of enzymes. Methods & structural conformations of enzymes. Properties of Enzymes, laws of thermodynamics, factors affecting the rate of chemical reactions. Arrhenius theory, collision theory. Free energy. Enzymes as biocatalysts, catalytic power, activation energy, substrate specificity, active site.

Unit 2. Enzyme kinetics:

16 Hrs

Importance of enzyme kinetics, Variations of velocity with [E], [S], pH and temperature, time of incubation, Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver-Burke plot, Haldane-Briggs relationship. Concept and significance of K_m and V_{max} . Concept of enzyme inhibition; types of enzyme inhibitors-reversible, competitive, non-competitive, uncompetitive and irreversible; significance and applications of enzyme inhibitors. Basics of enzyme turnover- Kinetics, measurement and rates of enzyme turnover.

Unit 3. Mechanism of enzyme action.

16 Hrs

Theories of mechanisms of enzyme action. Mechanism of action of lysozyme, chymotrypsin and ribonuclease. Monomeric, Oligomeric and multi-enzyme complex (PDH and fatty acid synthase), isozymes (Lactate dehydrogenase, creatine phosphokinase, alcohol dehydrogenase, alkaline phosphatase and isocitrate dehydragenase.) and Allosteric enzymes (Threonine dehydratase and aspartate transcarbomylase); covalently modulated enzymes (Glycogen phosphorylase) and Membrane bound enzymes (ATPase).

Unit 4. Enzyme techniques and their Applications

16 Hrs

Screening by plate assay methods, large scale production of enzymes, recovery of enzymes, enzyme purification methods - enzyme precipitation, separation by chromatography, enzyme reactors. Immobilized enzymes: Physical and chemical methods of immobilization, immobilization supports, kinetics of immobilized enzymes. Enzyme electrodes, Enzyme catalysis in a polar medium, entrapment of enzymes and its applications. **Application of enzymes:** Synthesis of chemicals using enzymes, food technology and medicine. Enzymes in diagnostic assays. immunoenzyme techniques. Commercial products of microbes: Antibiotics, biopolymers, biosensors, biopesticides, production of biofuels. Microbial toxins: Types, biochemical and molecular basis of toxin production, implications. Genetically engineered microbes, anti-HIV, anticancer, antifungal, anti-plasmodial, anti-inflammatory compounds.

Course outcomes:

- Acquire the knowledge of enzymes their properties and classification, Mechanism of action, Michaelis-Menten initial rate equation, methods for the determination of Km and Vmax.
- Analyses the mathematical derivations in understanding enzyme kinetics and different transformation and its application.
- Understand the concept of Enzyme Engineering and immobilization
- Learn about enzyme kinetics, effect of enzymes concentration, pH and temperature on kinetics of enzyme reactions, enzyme inhibition and activation, and Multi substrate enzyme kinetics.

Reference:

- 1. Felix Franks, 1993; Protein Biotechnology, Humana Press, New Jersey.
- 2. Stryer L, 1995; Biochemistry, Freeman and Company, New York.
- 3. Voet & Voet, 1995; Biochemistry, John Wiley & Sons, New York.
- 4. Nelson & Cox, 2000; Lehninger's Principles of Biochemistry, Elsevier Publ.
- 5. Harper, 1999; Biochemistry, McGraw Hill, New York.
- 6. Colowick S P and Kaplan N D, 1955; Methods in Enzymology. Vol. I. Academic Press.
- 7. Sualter C H, 1985; Practical Guide to Enzymology. John Wiley & Son.
- 8. Price & Steeves, Fundamentals of Enzymology
- 9. Kapler, Advances in Enzymology, Academic Press.
- 10. Harvey, W., Blanch, S.Clark. 2007 Biochemical Engineering, Marcel Dekker

Specialization: MB-3.4 (D) BIOINFORMATICS

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course objectives:

- The primary goal of this course is to uncover the basic tools and biological databases to the students and make them familiar with the same.
- At the end of this course students will be able to classify the molecular data in the respective data and file formats with machine learning approach.

UNIT-1- Introduction to Bioinformatics:

16 hrs

Definition, History and application of Bioinformatics, need of Bioinformatics, introduction to internet and its role in bioinformatics. Algorithms- Characteristics, design and analysis; complexity: Time and space, asymptotic notation, greedy algorithms, divide and conquer.

UNIT-2- Biological Databases:-

16 hrs

Biological database and its importance with functioning, Types of Biological database, Introduction to NCBI, Sequence and structure database, Nucleic acid database (NCBI GENBANK, EMBL, DDBJ), Protein database(PIR, MIPS, SWISS-PROT, TrEMBL, NRL-3D, PRINTS, Pfam), specialized database, Genome database, Literature database(Pubmed and PMC). Database searching methods (Entrez).

UNIT-3-: Sequence analysis:

16 hrs

Need for sequence analysis, Pairwise alignment, dot plot, dynamic programming, global and local alignment algorithms, Detailed deviation of Needleman-Wunsch algorithm and Smith-Waterman algorithm, PAM and BLOSUM, BLAST and FASTA, Multiple sequence alignment types, Clustal, T-coffee, Multialign, Domain, Motifs Patterns, Sequence file format(Plain, GenBank, FASTA, GCG, MSF, Ig, EMBL)

UNIT-4:-Phylogenetic analysis:

16 hrs

Introduction, Taxonomy and Phylogeny, Types of Phylogenetics tree, clustering methods, distance-based and character-based methods, UPGMA, NJ, Maximum likelihood method, Parsimony, Bayesian inference, Searching for trees, Evaluating trees and data, Bootstrapping strategies, Phylogenetic software

Machine learning methods: Architecture of neural networks, Application of neural networks, Support Vector machines-introduction and applications, Hidden markov model, markov chain, application of HMM in sequence and structure analysis

References:

- 1. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
- 2. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
- 3. Baldi, P. and Brunak, S. 1998 Bioinformatics. The MIT Press.
- 4. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
- 5. Lesk, A.M. 2002 Introduction to Bioinformatics. Oxford University Press.
- 6. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2004 Bioinformatics: Concepts, Skills & Applications.CBS Publishers & Distributors, New Delhi.

- 7. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
- 8. Patterson, B.K., Techniques in Quantification and Localization of Gene Expression.
- 9. Mont, D.W., Bioinformatics: Sequence and Genome Analysis.
- 10. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.

Microbiology SEMESTER-III Elective: MB-3.5 (A) MICROBIAL GENETICS

Course Credits: 2

Total No. of Hours: 32

No. of Teaching Hours per Week: 2 Hrs

Course Objectives:

- Learn basic principles of heredity and inheritance of characterisites.
- Study genetic recombinations in microorganisms.

Unit-1 Genetics:

16 Hrs

Historical development; basic principles of heredity, Mendelian principles, laws of inheritance; experimental proof of genetic material

Bacterial recombination

General Princeples; bacterial plasmids, fertility factors Distance factors, Col plasmids, other types of plasmids; transposable elements; bacterial conjugation – F+ x F- mating, Hfr conjugation, F' conjugation mapping, recombination mapping; bacterial transformation –

mechanism; natural and artificial transformations; Transduction: generalized and specialized transduction; host restriction and modifications; mappings the genome.

Unit-2 Viral recombination:

16 Hrs

Phage phenotypes, phenotype mixing, mechanisms of replication in DNA and RNA viruses; recombination and mapping, circular map, lytic phages- T7 and T4 lysogenic phages I and P1 and Fx 173 and Their uses in microbial genetics.

Fungal recombination

Structural organization of fungal genome; Chromosomal genes, mitochondrial genes, plasmids and transposable elements, fungi as model organisms in genetics genome mapping in fungi.

Course outcomes:

- Understanding microbial genetics at molecular level.
- Comprehend different mechanisms of genetic change in microorganisms.

Elective: MB-3.5 (B) DIAGNOSTIC MICROBIOLOGY

Course Credits: 2

Total No. of Hours: 32

No. of Teaching Hours per Week: 2 Hrs

Course objectives:

- Identify and adhere to established guidelines for working with potential pathogens to ensure biohazard safety
- Demonstrate steps of proper procedure for microbiological staining, and interpret results for use with identification of pathogens

16 Hrs

Unit-1 An overview of medical microbiology, significance of microbial diseases of humans. Laboratory safety measures and sample disposal

Medical Specimens: collection procedure and transport of body fluid specimens gastrointestinal specimens, genital specimens, respiratory specimens, urine specimens and wound specimens. specimen processing General methods, microscopy, culture methods and serology

16 Hrs

Unit-3 Laboratory diagnosis of important bacterial, viral, fangal and protozoal infections (Mycobacterium, Staphylococcus, Treponema, Salmonella, HIV, Hepatitis, Corona, Aspergillus Candida, Plasmodium) Antimicrobial drug testing procedures.

Course Outcome:

Understanding the process of sample handling for diagnostic purpose.

Comprehend methods involved with special reference to important diseases.



Davangere University

Shivagangotri, Davangere-577 007, Karnataka M.Sc. Microbiology (Academic Year 2024 onwards)

Semester scheme with Choice-Based Credit System (CBCS)

Course Structure

M. Sc Microbiology IV Semester

					Mark	S			
	Subject/Paper Code Code Title of the Paper	Title of the Paper	Instruction Hrs./week	Examination	Internal Assessment	Total Marks	Credits	duration (Hrs.)	
	THEORY PAPERS & PROJECT WORK/DISSERTATION								
	MB 4.1	Food and Dairy Microbiology	4	70	30	100	4	3	
	MB 4.2	Biotechnology	4	70	30	100	4	3	
	MB 4.3	Industrial microbiology and	4	70	30	100	4	3	
		Pharmaceutical microbiology		70	30	100	4	3	
SEMESTER-IV	MB 4.4	Project work/Dissertation	6	70	30	100	6	3	
[2000]	PRACTICAL PAPERS								
E	MB 4.5	Food and Dairy Microbiology	4	40	10	50	2	3	
E	MB 4.6	Biotechnology	4	40	10	50	2	3	
30	MB 4.7	Industrial microbiology and	4	40	10	50	2	3	
		Pharmaceutical microbiology	4,	40	10	20	Li	3	
		Study Tour/Field Visit	Study Tour/Field Visit			(Sing State State)			
	Mandato	ory Credits: Personality Development	2	EU 461 154	FEE 250 STA	ENW LONG INCO	2	20 to 64	
			32			550	26		

*Internal assessment: Theory: 2 Tests=10 marks; 1 Assignment-05 marks; 1 Seminar=05 marks; Attendance=10 marks

Practical: Record – 05 marks and Attendance – 05 marks

Project work/Dissertation Internal assessment: Work done presentation 20 marks;

Attendance/Viva:10 marks

CORE MB 4.1: FOOD AND DAIRY MICROBIOLOGY

Course Credits: 4

Total No. of Hours: 64

No. of Teaching Hours per Week: 4 Hrs

Course Objectives:

- A comprehensive understanding on the food contamination with microorganisms and spoilage.
- Understand the mechanism of food preservation and possible food-borne outbreak
- Perspectives on application of microorganisms at organized industrial sector and quality assurance
- Production of dairy products and quality assurance.

Unit-1 Microorganisms and food spoilage:

16 Hrs

Development and scope of food microbiology; food as substrate for microorganisms, ; Intrinsic and Extrinsic parameters affecting the growth of microorganisms in food (water activity, temperature, pH, O/R potential, accessory factors); important microorganisms in food (molds, yeasts and bacteria). Food contamination and spoilage:

Sources of food contamination. Principles of food spoilage; spoilage of cereals, sugar products, vegetables, fruits, meat and meat products, fish and other sea foods, poultry; spoilage of canned foods; conventional and modern methods for detection of spoilage and characterization.

Unit-2 Food preservation and Food borne infections:

16 hrs.

a) Principles and methods of food preservation- Physical (temperature, irradiation, drying, canning, processing for heat treatment - D, Z and F values) Chemical (Organic acids, food additives. Class I and Class II preservatives), Biopreservation (Lactic acid bacteria), Food Packaging- Types of packaging materials, properties and benefits, Modified atmosphere packaging (MAP)...

b) Food-borne infections and intoxication:

Bacterial- Brucella, Bacillus, Clostridium, Escherichia, Listeria; Food intoxication- Botulism, Staphylococcal toxin. Mycotoxins (aflatoxins, patulins, ATA, ochratoxins, fuminosins, Trichothecenes, Deoxynivalenol, Zearalenone, ergot alkaloids); food borne outbreaks (laboratory testing procedures and preventive measures) (Detection of food-borne microorganisms: Culture and Microscopic analysis, molecular (PCR) and Immunological methods (Radioimmuno assay and ELISA); Molds, Algae, Protozoa, Viruses, Biosensors in food industry.

Unit-3 Food Biotechnology:

16 Hrs

Fermented foods:

SCP- Nutritional & therapeutic importance (production), QUORN and SCO and their commercial production. Fermented Vegetables (Sauerkraut, olives, cucumbers), Meat (sausages), Beverage (cocoa and coffee); Bread, Idli, Soy sauce; fermentation by molds, application of microbial enzymes in food industry (Protease, Lipases)

Algal biotechnology (importance and mass production/limitations); mushroom technology; fungal foods; microbial production of flavours, biocolours, enzymes for food processing, sweeteners, food wastes, genetically modified foods; current trends in manufactured foods; consumer acceptance and market forces.

Food sanitation and control:

GHPs, Sanitation in manufacture and retail trade; food control agencies and their regulation, hazard analysis and critical control points (HACCP); GMP, plant sanitation – employees' health standard, quality assurance/control. Recent trends and developments of food technologies in India. Food Parks. Recent concerns on food safety; Genomics and proteomics of food borne microorganisms; predictive

microbiology.

Indian, Federal and ISO systems for food safety; Organic food; food quarantine

Unit- 4 Dairy Microbiology:

16 hrs

Biochemical composition of milk, microbial flora of milk, sources of milk contamination, Pathogenic (human, zoonotic) microorganisms in milk; Pasteurization, sterilization of milk and UHT. Types of microorganisms in chilled and refrigerated milk supplies; psychrophiles, mesophiles and thermophiles and their role in milk spoilage; Quality maintenance in dairy industry (plant, equipment, barn); quality control tests for milk; microbiological grading, market milk (bulk) production and public health.

<u>Microbiology of dairy industry:</u> properties starter cultures: starter selection, lactic and non-lactic starter cultures; pure and mixed starter cultures;; starter –production, maintenance, and preservation; assessment of quality of starter cultures; Defects associated with starter cultures and control; production of flavour components by starter cultures.

Whey: dairy effluent treatment.

<u>Dairy product</u>: Production of Cream, curd, butter, ice-cream, milk powder, khoa, peda, yoghurt, acidophilus milk, condensed milk, kefir, koumiss, srikhand, cultured butter milk, cheese (Cheddar, Camembert, Roquefort) and other fermented milk products.

Course Outcome:

- Thorough knowledge on food borne pathogens, fermented food products and role of microorganisms in dairy industry.
- Trained on Food intoxication and diagnosis
- Industrial applications on fermented foods
- Obtain the competency in all the food and milk analysis techniques, culture maintenance and fermented food production and the skilled ward to take up the profession for food quality assurance.

REFERENCES

- 1. Adams M. R. and Moss M. O. (2007). Food Microbiology 3rd Edition. Royal Society of Chemistry.UK.
- 2. Ahmed E.Y. and Carlstrom C. (2003). Food Microbiology: A Laboratory Manual, John Wiley and Sons, Inc. New Jeresy
- 3. Bhunia A. K. (2008). Food-borne Microbial Pathogens- Mechanisms and Pathogenesis, Food Science text Series, Springer International, New York, USA
- 4. Deak T. and Beuchat L. R. (1996). Hand Book of Food Spoilage Yeasts, CRC Press, New York.
- 5. Doyle M. P. and Beuchat L. R. (2007). Food Microbiology- Fundamentals. Frontiers, ASM Press.
- 6. Frazier W.C. and Westhoff C.D. 2008 Food Microbiology. Tata McGraw Hill Publishing Company Limited, New Delhi, India.
- 7. Garbutt J. (1997). Essentials of Food Microbiology, Armold- International Students edition, London.
- 8. Marriott N. G. and Gravani R. B. (2006). Principles of Food Sanitation, Food Science text Series, Springer International, New York, USA.
- 9. Thomas J, Karl M, Kniel, Kalmia E (2017), Food Microbiology: An Introduction, American Society of (ASM).
- 10. Jay JM, Loessner MJ and Golden DA (2006), Modern Food Microbiology, Food science Text book series. Springer

Microbiology SEMESTER-IV CORE MB 4.2: BIOTECHNOLOGY

Course Credits: 4

Total No. of Hours: 64 No. of Teaching Hours per Week: 4 Hrs

Course objectives:

- Recapitulate the previous knowledge of cell biology and to establish thorough understanding of various cell structure and function at molecular level.
- Provide a thorough understanding of the various molecular biology concepts in study of biotechnology and to study the different tools and techniques used to study the biology of cell at molecular level.
- Acquire in-depth knowledge of the molecular events involved in cell division which
 includes mitosis, meiosis, cell cycle and its regulation. Including. To provide wider and
 global perspective of cell cycle regulation and cancer, with an ability to discriminate,
 evaluate, analyse and synthesise existing and new knowledge, and integration of the same
 for enhancement of knowledge.
- To provide sufficient hands-on learning experience related to the area of specialization with a focus on research orientation

Unit-I

Introduction to Biotechnology & Microbial biotechnology:

16 Hrs

Concept, Definitions of biotechnology; developmental milestones of biotechnology; scope of biotechnology; modern trends. Microbial synthesis of commercial products- protein pharmaceuticals (Interferons; Human Growth harmone) Restriction endonucleases, small biological molecules (amino acids, indigo) antibiotics; bioplastics (PHB, PHA), biopolymer (dextran, alginate, xanthan, pullulan), microbial enzymes, microbial metabolites – organs acids, amino acids, manipulation of gene expression in prokaryotes, heterologous protein production on eukaryotic cells; yeast cloning.

Unit-II

Plant Biotechnology & Animal Biotechnology:

16Hrs

Transgenic plants: principle, production method and development of pest and disease resistant plnats; tolerance to abiotic stress; genetic manipulation of flower pigmentation; nutritional improvement; modification of plant products, edible vaccines, anti-sense RNA technology.

Cloning strategies, embryo stem cell technology homologous recombination and transgenesis; Methods and applications of transgenic animals; mammalian cell culture; human somatic cell gene therapy – ex vivo gene therapy antisense therapy; methods and applications; brief account of genetic diseases in humans, DNA in forensic science.

Unit-III

Environmental Biotechnology & Biosensors:

16Hrs

Waste water and sewage treatment; landfall technologies, bioremediation —microbial degradation of xenobiotics; genetic engineering of biodegradative pathways; Biomass utilization- cellulose and starch; production of biofuels; Microbes in metal biotechnology; solid waste management.

Brief account of Amperometric, Potentiometric, Conductometric, Thermometric, Piezoelectric, Optical, whole cell Biosensors, immunesensors.

Unit-IV

Patenting in Biotechnology, Biosafety and Bioethics:

16 Hrs

Regulation recombinant DNA technology; patenting biotechnology inventions; patenting organisms, patenting indifferent counties; patenting and fundamental research; intellectual property rights. Definitions of biosafety and bioethics; levels of biosafety; hazardous materials used in biotechnology; good laboratory practices and good manufacturing practices; bioethics in resource management, ethical issues of genetically modified organisms, ethical aspects of cloning and transplantations; social implications of biotechnological research.

Course Outcome

- Explain the physiological processes that occur during plant growth and development and describe the methodology involved in plant tissue culture and plant transgenics
- Discuss issues related to plant nutrition, quality improvement, environmental adaptation, transgenic crops and their use in agriculture
- CO-3 Elucidate the significance of transgenic plants as bioreactors for the production of enzymes, plant bodies, edible vaccines and therapeutic protein
- CO-4 Address bioethical and biosafety issues related to plant transgenics

References:

- 1. Bengochea T and Doods JH (2012) Plant Protoplasts: A Biotechnological Tool for Plant Improvement. Chapman and Hall. London.
- 2. Gamborg OL and GC Phillips (2013) Plant Cell, Tissue and organ culture. Narosa Publishing House, New Delhi.
- 3. Razdan MK (2003) An Introduction to Plant Tissue Culture, Oxfsord & IBH Pub. Co, Pvt., Ltd., New Delhi
- 4. Bhojwani SS and Razdan MK (2003) Plant Tissue Culture: Theory and Practice, a revised edition. Elsevier Publication.
- 5. Reinert J and Bajaj YPS (2013) Applied and Fundamental aspects of Plant Cell, Tissue and organ Culture. Springer Verlag, Berlin.
- 6. Freshney RI (2005) Culture of Animal Cells, 5th Edn, Wiley-Liss.
- 7. Spier RE and Griffiths JB (1988) Animal Cell Biotechnology, Academic Press.
- 8. Clynes (1998) Animal Cell Culture Techniques, 1st Edn, Springer
- 9. Channarayappa (2006) Molecular Biotechnology: Principles and Practices. University Press (India) Pvt. Ltd., Worldwide CRC Press.
- 10. Channarayappa (2010) Cell Biology: Universities Press (India) Pvt Ltd.
- 11. John RW, Masters, (2000) Animal Cell Culture: Practical Approach, 3rdEdn, Oxford.
- 12. Murray Moo-Young (1989) Animal Biotechnology, Pergamon Press, Oxford.
- 13. Doyle A, Hay R, and Kirsop BE (1990) Living Resources for Biotechnology, Animal cells, Cambridge University Press

Microbiology SEMESTER-IV PAPER: MB 4.3 INDUSTRIAL AND PHARMACEUTICALMICROBIOLOGY

Course Credits: 4 Total No. of Hours: 64
No. of Teaching Hours per Week: 4 Hrs

Course objectives:

- Understand the basics of Industrial and pharmaceutical microbiology.
- Highlight different products of microbial origin in industrial/pharmaceutical applications.
- Recognize secondary metabolites and nanoparticles in pharmaceutical industry.
- Understand good manufacturing practices and regulation of pharmaceutical needs.

Unit 1. Industrial microbiology:

16 hrs

- a) Scope of industrial microbiology: History and developments in industrial microbiology, isolation of industrially important microbial strains, components of fermentation, media (crude and synthetic media), methods of preservation and maintenance of industrially important strains and strain improvement. Raw materials: molasses, corn-steep-liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates.
- b) Fermenters and Fermentations: Types of fermentation processes Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch and continuous fermentations, Components of a typical fermenter, Types of fermenter- laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters pH, temperature, dissolved oxygen, foaming and aeration, response surface methodology,

Unit 2 Microbial products and down-stream processing:

16 hrs

- a) Metabolites: industrially important enzyme amylase, protease, lipase, Organic acids- Citric, acetic, lactic acid, Amino acids Glutamic acid, L lysine Solvent: Acetone, ethyl alcohol Production of wine, beer, home brewing, whisky, fortified beverages.

 Secondary metabolites: Antibiotics: Streptomycin, penicillin, synthetic and semi-synthetic penicillins.
- b) Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray-drying, Enzyme immobilization: Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).

Unit 3. Nanotechnology

16 hrs

History and recent developments - sources of Nanoparticles - Use of Microorganisms and their metabolites in preparation of Nanoparticles, Nanotechnology in Bioprocess development.

Microbial Nanotechnology: Production and characterization of nanoparticles from bacteria, actinomycetes, fungi, Nanocomposites, Nano-Enzymes, Micro-Algal nanomaterials. applications of microbial nanoparticles.

a) Industrial/pharmaceutical regulations: Good laboratory practices, Good Manufacturing Procedures. Process validation, ISO standards, Regulatory aspects of QC, QA, and cGMP in Pharma Industry. ISO, USFDA Guidelines and certification. Microbial limit test of Pharma products. Sterility testing, Sterility assurance-pyrogen testing and LAL tests of Sterile Pharma

products. Determination of D- value, Z-value, survival curve, radioactive, gaseous and filtration. Chemical and biological indicators. Designing layout for microbiology laboratory and its audits in industries.

Unit 4: Pharmaceutical microbiology

16 hrs.

Concepts of pharmaceuticals, biologics and biopharmaceuticals, sources, production, research trends. Cytokines, haematopoetic growth factors, hormones, clotting factors, blood products, therapeutic enzymes (Asparaginase, Streptokinase, beta lactamases), bacterial and viral vaccines, New vaccine production (DNA vaccines, synthetic, peptide vaccines, multivalent subunit vaccines, edible vaccines and their trials). Market case studies.

Spoilage of pharmaceutical products, Microbial production contamination and spoilage of pharmaceuticals products (sterile injectable, ophthalmic preparations and implements) and their sterilization.

FDA, govt. Significance of IP, BP and USP, Patenting of drugs and biological products.

Course Outcomes:

- Appreciate how microbiology is applied in manufacture of industrial products
- Understanding sources for microorganisms of industrial importance from the environment
- Comprehend the techniques and the underlying principles in down stream processing
- Understand the beneficial role of microorganisms in fermented foods and in food processing andthe microbiology of different types of fermented food products – dairy, pickles, Legume and cereal based food products

Reference

- 1. Pharmaceutical Microbiology- Edited by W. B. Hugo & A.R. Russel Sixth Edition.Blackwell Scientific Publications.
- 2. Lippincott's illustrative Reviews: Pharmacology Edition: 02 Maryjnycck by Lippincott's reviewPublisher Pheladelphia 1997.
- 3. Principles of medicinal chemistry Vol. 1 by Kadam S.S., Mahadik K.R., Bothra K.G.Edition: 18, Nirali Publication.
- 4. Pharmacognosy by Gokhle S.D., KoKateC.K.. Edition: 18, Nirali Publication.
- 5. Biotechnology Expanding Horizon by B.D. Singh ., First Edition, Kalyani Publication, Delhi.
- 6. Analytical Microbiology- Edited by Fredrick Kavanagh volume I &II. AcademicPress New York.
 - Pharmaceutical Biotechnology by S. P. Vyas & V.K. Dixit. CBS publishers & distributors, New Delhi.
- 7. Stanbury PF, Whitaker A and Hall SJ.(2006). Principles of Fermentation Technology.2nd edition, Elsevier Science Ltd.
- 8. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology.1st edition.Bios Scientific Publishers Limited. USA
- 9. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001). Industrial Microbiology: AnIntroduction.1st edition. Wiley Blackwell
- 10. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2ndedition. Panima Publishing Co. New Delhi.

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Question paper pattern for M.Sc. Microbiology

___semester M.Sc. Examination January/February 2025

MICROBIOLOGY

(2024-25 new syllabus CBCS)

Time 70	ime 3 hrs. Max			
Note:	All the parts are compulsory.			
		Part- A		
1.	Answer any five of the following:	(Five to be answered out of 7)	5x2=10	
	a.			
	b.			
	c.			
	d.			
	e.			
	f.			
	g.			
	£ ⁷	Part- B		
Write	e short notes on any four of the follo	wing: (4 to be answered out of 6)	4x5=20	
2.				
3.				
4.				
5.				
6.				
7.				
		Part- C	4-10-40	
8.	Answer any four of the following: (4 to be answered out of 6)	4x10=40	
9.				
10.				
11.				
12.				
13.				

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Registrar
Davangere University
Shivagangotri, Davangere