



VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

MICROBIOLOGY

SYLLABUS

**Master of Science
(III Semester)**

**With effect from
2021-22**



VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Microbiology

Jnana Sagara, Ballari - 583105



Distribution of Courses/Papers in Postgraduate Programme I to IV Semester as per Choice Based Credit System (CBCS) Proposed for PG Programs

III – SEMESTER

With Practical

| Semester | Category | Subject code | Title of the Paper | Marks | | | Teaching hours/week | | | Credit | Duration of exams (Hrs) |
|-------------------------------------|------------|--|--|-------|-----|------------|---------------------|---|---|-----------|-------------------------|
| | | | | IA | SEE | Total | L | T | P | | |
| THIRD | DSC9 | 21MBL3C9L | Bioprocess engineering and Industrial Microbiology | 30 | 70 | 100 | 4 | - | - | 4 | 3 |
| | DSC10 | 21MBL3C10L | Medical Microbiology | 30 | 70 | 100 | 4 | - | - | 4 | 3 |
| | DSE1 | 21MBL3E1AL | A. Microbial Nanotechnology | 30 | 70 | 100 | 4 | - | - | 4 | 3 |
| | | 21MBL3E1BL | B. Chemical Microbiology | | | | | | | | |
| | | 21MBL3E1CL | C. Enzyme technology | | | | | | | | |
| | DSE2 | 21MBL3E2AL | A. Mushroom production and marketing | 30 | 70 | 100 | 4 | - | - | 4 | 3 |
| | | 21MBL3E2BL | B. Veterinary Microbiology | | | | | | | | |
| | | 21MBL3E2CL | C. Marine and extreme Microbiology | | | | | | | | |
| | GEC1 | 21MBL3G1AL | A. Pharmaceutical Microbiology | 20 | 30 | 50 | 2 | - | - | 2 | 1 |
| | | 21MBL3G1BL | B. Baking and Brewing | | | | | | | | |
| 21MBL3G1CL | | C. Virology and Covidology | | | | | | | | | |
| SEC3 | 21MBL3S3LP | Research Methodology | 20 | 30 | 50 | 1 | - | 2 | 2 | 1 | |
| DSC9P7 | 21MBL3C9P | Bioprocess engineering and Industrial Microbiology Lab | 20 | 30 | 50 | - | - | 4 | 2 | 4 | |
| DSC10P8 | 21MBL3C10P | Medical Microbiology Lab | 20 | 30 | 50 | - | - | 4 | 2 | 4 | |
| Total Marks for III Semester | | | | | | 600 | | | | 24 | |

Dept Name: Microbiology

Semester-III

DSC9: Bioprocess engineering and Industrial Microbiology

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|--|-------------------------------|
| Course Title: Bioprocess engineering and Industrial Microbiology | Course code: 21MBL3C9L |
| Total Contact Hours: 52 hours | Course Credits: 04 |
| Formative Assessment Marks: 30 | Duration of ESA/Exam: 3 hours |
| Summative Assessment Marks: 70 | |

Course Outcomes (CO's):

At the end of the course, students will be able to:

Course Outcomes (CO): After completion of this course student should able to

1. Understand the origin concept of fermentation, and strain development. Understand the construction and design of fermentor and the types of fermentors.
2. Get acquainted with preparation of culture media formulations for the production of metabolites and growth kinetics.
3. Production of purification of microbial products such as enzyme, organic acids, amino acids, antibiotics, alcoholic beverages.
4. Understand the concept of Bioprocess engineering.
5. Learn the basic component of bioprocess engineering includes Upstream and Downstream bioprocess.

DSC9: Bioprocess engineering and Industrial Microbiology

| Unit | Description | Hours |
|-------------|--|--------------|
| 1 | Introduction to fermentation technology. Construction and Design of a typical fermenter. Manual and automatic control systems. Design of sterilization process for batch and continuous fermentation. Types of fermenters- Tower, Jet, Loop, Airlift, Bubble, Column, Packed bed, | (10 Hrs) |

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| | <p>Fluidized bed.</p> <p>Types of Fermentations- Surface, Submerged, Solid State, Batch, Continuous, Dual and Fed batch fermentations.</p> | |
| 2 | <p>Media for industrial fermentations: Criteria, Media formulation, Media ingredients. Buffers, Precursors and Growth factors. Oxygen requirement, Chelaters and Antifoaming agents.</p> <p>Industrially important Microorganisms, Screening of metabolites. Phases of cell growth in batch culture. Monod model. Growth of filamentous organisms. Growth associated (primary) and non - growth associated (secondary) product formation Kinetics. Strain development- Mutation, Recombination and Protoplast fusion technique. Inoculum development for industrial fermentation.</p> | (12Hrs) |
| 3 | <p>Production and purification of few important microbial products: Enzymes (Amylase, Proteases), Organic acids (Citric acid and Vinegar), Amino acids (L-lysine and L-glutamic acid), Antibiotics (Penicillin and Streptomycin), Solvents (Ethyl alcohol, Acetone) Alcoholic beverages (Beer, Wine). Vitamins (Vitamin B₁₂).</p> | (8 Hrs) |
| 4 | <p>Bioprocess Engineering: Concept and Principles of Bioprocess Engineering. Upstream bioprocess: Major process variables. Optimization of process variables. Strategies for the enhanced production: Immobilization and Response surface methodology.</p> | (10 Hrs) |
| 5 | <p>Downstream bioprocess: Filtration-Micro, Cross-flow and Ultra, Centrifugation-High speed, Continuous and Ultra. Cell disruption. Precipitation, Coagulation and Flocculation. Solvent /Aqueous 2-phase extractions, Dialysis and Electrodialysis. Reverse osmosis. SDS-PAGE, Ion Exchange chromatography, HPLC and Gel Filtration, Drying and Crystallization.</p> | (12 Hrs) |

References:

1. Ali Cinar, S.J. Parulekar, et al., (2003) Batch Fermentation: Modelling, Monitoring, and Control. Marcel Dekker
2. Arnold D & J E. Davies, Atlas. RM 1999 Manual of Industrial Microbiology & Biotechnology 2nd Ed. Berry, D.R. (Ed) 1998 Physiology of Industrial fungi BSP, Oxford University.
3. Crueger & Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition
4. Casida, Industrial Microbiology
5. Demain, A.L Biology of Industrial Microorganisms 6. Diliello Methods in Food and Dairy Microbiology
7. Harold B. Reisman 1988 Economic Analysis of Fermentation Processes CRC Pr I Llc
8. Vogel A & L. Celeste Todaro 2005 Fermented and Biochemical Engineering Hand Book 2nd Standard Publishers Distribution New Delhi
9. Harvey, W., Blanch, S. Clark. 2007 Biochemical Engineering, Marcel Dekker
10. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. 2002. Industrial Microbiology: An Introduction. Blackwell Science.

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSC10: Medical Microbiology

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|--------------------------------------|-------------------------------|
| Course Title: : Medical Microbiology | Course code: 21MBL3C10L |
| Total Contact Hours: 52 hours | Course Credits: 04 |
| Formative Assessment Marks: 30 | Duration of ESA/Exam: 3 hours |
| Summative Assessment Marks: 70 | |

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the mechanism of microbial pathogenicity and pathogenesis of Microorganisms.
2. Learn the Systemic bacteriology which includes epidemiology, symptoms, diagnosis and treatment of diseases.
3. Learn the viral disease which includes epidemiology, symptoms, diagnosis and treatment of diseases.
4. Learn the fungal infections and human parasites which include epidemiology symptoms diagnosis and treatment of diseases.

DSC10: Medical Microbiology

| Unit | Description | Hours |
|-------------|--|-----------------|
| 1 | Microbial pathogenicity and pathogenesis: Attributes of pathogenicity and pathogenesis. Mechanism of disease process and prognosis. Host and microbial factors influencing susceptibility. Concept and types of microbial infections; Modes of transmission of pathogens, Portal of entry and exit; Types of infections. | (8 Hrs) |
| 2 | Systematic study of important pathogenic bacteria with reference to Epidemiology, aetiology, pathogenesis, symptoms, diagnosis, treatment; Enterobacteriaceae (<i>Salmonella, Vibrio cholerae E.coli</i>); <i>Mycobacterium</i> | (12 Hrs) |

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| | <i>tuberculosis, Streptococci, Clostridium tetani</i> and <i>Treponema palladium, Chlamydia, Mycoplasma and Rickettsia.</i> | |
| 3 | Systematic study of important pathogenic bacteria with reference to Epidemiology, aetiology, pathogenesis, symptoms, diagnosis, treatment of viral diseases caused by important viruses - Pox, Herpes, Adeno, Papovo, Picorna, retro, arbo, hepatitis, Rabies, Chikungunya, Ebola. | (12 Hrs) |
| 4 | Systematic study of important pathogenic bacteria with reference to Epidemiology, aetiology, pathogenesis, symptoms, diagnosis, treatment of fungal diseases - <i>Mycoses, Candidiasis, Mycetoma, Chromomycosis, Sporotrichosis, Cryptococcosis, Blastomycosis, Coccidiomycosis and Histoplasmosis.</i> | (10 Hrs) |
| 5 | Parasitology: Morphology, life cycle and pathogenesis of the human parasites. Intestinal protozoa, Urogenital protozoa, <i>Leishmania donovani, P. vivax, Toxoplasma gondii</i> , Helminths, Nematodes <i>Wuchereria</i> , Cestodes– <i>Taenia, Hymenolepis</i> , neurocysticercosis and hydatid disease. Trematodes blood flukes. | (10 Hrs) |
| References: 1. Topley and Wilson. Principles of bacteriology, Virology and Immunity. Edward 2. David Greenwood, Richard C and Slack B. Medical Microbiology. ELBS Churchill 3. Rajesh Bhatia R. Essentials of Medical Microbiology. Jayjee Brothers. 4. Kenneth jR. Medical Microbiology – Introduction to Infectious Disease. Prentice Hall 5. Joan Stokes, Rideway Wren and Sir Ashley Miles. Clinical Microbiology. Edward Arnold. 6. Douglas J and Slekh. Medical Bacteriology. Churchill Livingstone. 7. Bailey and Scotts. Diagnostic Microbiology. C.V. Mosby Company 8. Hoghl and Moffet. Clinical Microbiology. JB Lippincott Company | | |

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE1: Microbial nanotechnology

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|--|-------------------------------|
| Course Title: Microbial Nanotechnology | Course code: 21MBL3E1AL |
| Total Contact Hours: 52 hours | Course Credits: 04 |
| Formative Assessment Marks: 30 | Duration of ESA/Exam: 3 hours |
| Summative Assessment Marks: 70 | |

Course Outcomes (CO's): At the end of the course, students will be able to:

1. Understand the basics of nanotechnology.
2. They will know the different types of nanotechnology.
3. Understand green synthesis of nanoparticles by bacteria and plants.
4. Handle the instruments used in nanoparticles detection using x-ray diffract technology SEM, TEM, AFM spectroscopic technology.
5. Gain knowledge in applications of nanoparticles in agriculture smart environmental wastewater treatment and uses of nanoparticles in medicines.

DSE1.A:Microbial nanotechnology

| Unit | Description | Hours |
|------|--|-----------------|
| 1 | Introduction to Nanotechnology: Definition of nano, Scientific revolution-Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, carbon age, new form of carbon (CNT to Graphene), Types of nanostructure and properties of nano materials, Quantum Dots shell structures, metal oxides, semiconductors, composites. | (8 Hrs) |
| 2 | Applications of nanoparticles: nano biofertilizers and pesticides, nano-agriculture and microcapsule designs, DNA nano capsule. Assessing nanotechnology for enhanced food security in India. Nanoparticles based smart delivery systems. Applications of nanotechnology in seed science and detoxification of herbicide residues, in environmental remediation and water treatment, Nanoporous polymers and their applications in water purification, nanotoxicology. Use of nanoparticles in medicine. | (12 Hrs) |
| 3 | Synthesis of nanoparticles; approaches to synthesis, mechanisms involved in biogenic nanoparticle synthesis. Green synthesis of nanoparticles bacterial biosynthesis, fungal and yeast synthesis, plant and plant extracts for biosynthesis, waste mediated synthesis of nanoparticles. | (12 Hrs) |

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| 4 | Instruments used in nanoparticle detection: Characterization Techniques, X-ray diffraction, powder diffraction, lattice parameters, structure analyses, strain analyses, phase identification, particle size analyses using - Scherer`s formula - X-ray photoelectron spectroscopy (XPS) - Auger electron spectroscopy (AES). | (10 Hrs) |
| 5 | Instruments used in nanoparticle detection: Surface Imaging: Scanning Electron Microscope (SEM), Field Emission Scanning Electron Microscope (FESEM)-Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Transmission Electron Microscopy (TEM). Spectroscopic techniques: Infra-red spectroscopy (IR) Rotational & Vibrational UV-visible - Raman Spectroscopy- Photoluminescence (PL) – Cathodeluminescence (CL). | (10 Hrs) |

References:

1. Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.
2. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
3. Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.
4. Processing & properties of structural naonmaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge, UK 2005

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE1 B: Chemical Microbiology

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|--|-------------------------------|
| Course Title: : Chemical Microbiology | Course code: 21MBL3E1BL |
| Total Contact Hours: 52 hours | Course Credits: 04 |
| Formative Assessment Marks: 30 | Duration of ESA/Exam: 3 hours |
| Summative Assessment Marks: 70 | |

Course Outcomes (CO's): At the end of the course, students will be able to:

1. To understand the physiological process involved in microorganisms
2. To study the classification of microorganisms based on physical and nutritional adaptations. To study in detail about the growth phases of microorganisms.
3. To study the role of microorganisms in biogeochemical cycles.
4. To study the various applications of microorganisms in environment as well as industry by chemicals synthesised by microorganisms.

DSE1 B: Chemical Microbiology

| Unit | Description | Hours |
|-------------|---|-----------------|
| 1 | Microbial Physiology: Classification of Microorganisms based on physical and nutritional adaptations. Microbial growth and its phases. | (8 Hrs) |
| 2 | Microbial energy metabolism: Microbial photosynthesis, Biological Oxidation, Fermentation pathways. | (12 Hrs) |
| 3 | Biogeochemical cycles: Nitrogen cycle, Carbon cycle, Sulphur cycle, Phosphorus cycle and hydrological cycles. | (10 Hrs) |
| 4 | Concept of Biodegradation and Bioremediation and its Scope. Biodegradation of pesticides, Insecticides, plastic, detergents. Bioremediation of Iron, Copper, Manganese, Magnesium, Silver and Gold | (10 Hrs) |
| 5 | Chemicals synthesized by microorganisms – Antibiotics, other Secondary metabolites, Amino acids, Organic Acids, Vitamins, Preservatives, PGPRs, Peptides, Enzymes and Solvents, Single cell protein, Single cell oil, microbial pigments. | (12 Hrs) |

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| References: <ol style="list-style-type: none">1. Voet & Voet, 1995; Biochemistry, John Wiley & Sons, New York.2. Nelson & Cox, 2000; Lehninger's Principles of Biochemistry, Elsevier Publ.3. Freifelder D, 1982; Physical Biochemistry, Freeman & Co. New York.4. Harper, 1999; Biochemistry, McGraw Hill, New York.5. Brock T.D. Principles of Microbial Ecology. Prentice Hall Publ. Co. Philadelphia.6. Subba Rao. 2000. Soil Microbiology. 4th Ed. Oxford & IBH | | |

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE 1 C: Enzyme Technology

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|--|-------------------------------|
| Course Title: Enzyme Technology | Course code: 21MBL3E1CL |
| Total Contact Hours: 52 hours | Course Credits: 04 |
| Formative Assessment Marks: 30 | Duration of ESA/Exam: 3 hours |
| Summative Assessment Marks: 70 | |

Course Outcomes (CO's): At the end of the course, students will be able to:

1. To understand the physiological process involved in microorganisms
2. To study the classification of microorganisms based on physical and nutritional adaptations. To study in detail about the growth phases of microorganisms.
3. To study the role of microorganisms in biogeochemical cycles.
4. To study the various applications of microorganisms in environment as well as industry by chemicals synthesised by microorganisms.

DSE 1 C: Enzyme Technology

| Unit | Description | Hours |
|-------------|---|--------------|
| 1 | Microbial Physiology: Classification of Microorganisms based on physical and nutritional adaptations. Microbial growth and its phases. | (8 Hrs) |
| 2 | Microbial energy metabolism: Microbial photosynthesis, Biological Oxidation, Fermentation pathways. | (12 Hrs) |
| 3 | Biogeochemical cycles: Nitrogen cycle, Carbon cycle, Sulphur cycle, Phosphorus cycle and hydrological cycles. | (10 Hrs) |
| 4 | Concept of Biodegradation and Bioleaching and its Scope. Biodegradation of pesticides, Insecticides, plastic, detergents. Bioleaching of Iron, Copper, Manganese, Magnesium, Silver and Gold. | (10 Hrs) |
| 5 | Chemicals synthesized by microorganisms – Antibiotics, other Secondary metabolites, Amino acids, Organic Acids, Vitamins, Preservatives, PGPRs, | (12 Hrs) |

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| | Peptides, Enzymes and Solvents, Single cell protein, Single cell oil, microbial pigments. | |
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References:

1. Nelson & Cox, 2000; Lehninger's Principles of Biochemistry, Elsevier Publ.
2. Freifelder D, 1982; Physical Biochemistry, Freeman & Co. New York.
3. Harper, 1999; Biochemistry, McGraw Hill, New York.
4. Brock T.D. Principles of Microbial Ecology. Prentice Hall Publ. Co. Philadelphia.
5. Subba Rao. 2000. Soil Microbiology. 4th Ed. Oxford & IBH

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE 2 A: Mushroom Production and Marketing

| | |
|---|-------------------------------|
| Course Title: : Mushroom Production and Marketing | Course code: 21MBL3E2AL |
| Total Contact Hours: 52 hours | Course Credits: 04 |
| Formative Assessment Marks: 30 | Duration of ESA/Exam: 3 hours |
| Summative Assessment Marks: 70 | |

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Identify edible types of mushroom
2. Gain the knowledge of cultivation of different types of edible mushrooms and spawn production
3. Gain knowledge about nutritive value, medical and therapeutic importance of mushrooms
4. Manage the diseases and pests of mushrooms
5. Learn a means of self-employment and income generation. Awareness about the marketing trends of Mushrooms.

DSE 2 A: Mushroom Production and Marketing

| Unit | Description | Hours |
|------|---|----------|
| 1 | Introduction to mushrooms Mushrooms Taxonomical rank, History and Scope of mushroom cultivation. Edible, medicinal and Poisonous Mushrooms, Vegetative characters. Identification of poisonous mushrooms. | (8 Hrs) |
| 2 | Common edible and medicinal mushrooms Distribution of mushroom; life cycle of mushroom of Button mushroom (<i>Agaricus bisporus</i>), Milky mushroom (<i>Calocybe indica</i>), Oyster mushroom (<i>Pleurotus sajorajju</i>) and paddy straw mushroom (<i>Volvariella volvcea</i>), <i>Cordyceps mushrooms</i> . | (12 Hrs) |

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| 3 | <p>Principles of mushroom cultivation</p> <p>Structure and construction of mushroom house. Sterilization of substrates. Spawn production, culture media preparation, production of pure culture, mother spawn, and multiplication of spawn. Composting technology, mushroom bed preparation, Spawning, spawn running, harvesting. Cultivation of oyster and paddy straw mushroom. Problems in cultivation, diseases, pests and nematodes, weed moulds and their management strategies.</p> | (10 Hrs) |
| 4 | <p>Health benefits of mushrooms and Post harvest technology</p> <p>Nutrient values of mushroom, protein, carbohydrate, fat, fibre, vitamins and amino acids contents, short and long term storage of mushroom, preparation of various dishes from mushroom. Medicinal value of mushroom, cultivation, extraction, isolation and identification of active principle from mushroom. Pharmacological and economic values of mushroom. Therapeutic aspects of mushrooms. Value added products of mushrooms.</p> <p>Preservation of mushrooms - freezing, dry freezing, drying, canning, quality assurance and entrepreneurship.</p> | (10 Hrs) |
| 5 | <p>Mushroom Marketing</p> <p>Status of mushroom cultivation in India. Genetic improvements in mushrooms, harvesting, packing and storage, problems in cultivation, diseases, pests and nematodes, weed moulds and their management strategies. Strategies of marketing, Mushroom marketing from door to door, farmer to big stores, hotels, Farmer to local market, distributor to farmer.</p> | 12 Hrs) |
| <p>References:</p> <ol style="list-style-type: none"> 1. Marimuthu, T. et al. (1991). Oster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore. 2. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi 3. Pandey R.K, S. K Ghosh, 1996. A Hand Book on Mushroom Cultivation. Emkey Publications. 4. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur. | | |

5. Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.
6. Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. PVT.LTD, New Delhi.
7. V.N. Pathak, Nagendra Yadav and Maneesha Gaur, Mushroom Production and Processing Technology/ Vedams Ebooks Pvt Ltd., New Delhi (2000)
8. Paul Stamets, J.S. and Chilton, J.S. 2004. Mushroom cultivation A practical guide to growing mushrooms at home, Agarikon Press.
9. Tewari and Pankaj Kapoor S.C. 1993. Mushroom cultivation. Mittal Publication. Delhi.
10. Marimuth et al., 1991. Oyster Mushrooms. Dept. of Plant pathology, TNAU, Coimbatore.
11. Nita Bahl. 1988. Hand book of Mushrooms, 2nd Edition, Vol I & II.
12. Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. 2nd ed., CRC press.

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE 2 B: Veterinary Microbiology

| | |
|---|-------------------------------|
| Course Title: : Veterinary Microbiology | Course code: :21MBL3E2BL |
| Total Contact Hours: 52 hours | Course Credits: 04 |
| Formative Assessment Marks: 30 | Duration of ESA/Exam: 3 hours |
| Summative Assessment Marks: 70 | |

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the mechanism of pathogenesis of Microorganisms.
2. Learn the Systemic bacteriology and virology which includes epidemiology symptoms diagnosis and treatment of diseases.
3. Learn the fungal disease which includes epidemiology symptoms diagnosis and treatment of diseases
4. Learn the human parasites which include epidemiology symptoms diagnosis and treatment of diseases.
5. To study the immunology i.e., antigen antibody reactions and detection tests and serology of pathogens.

DSE 2 B: Veterinary Microbiology

| Unit | Description | Hours |
|-------------|---|----------------|
| 1 | Veterinary microbiology Highlights of developmental history of Veterinary Microbiology. Scope of Veterinary Microbiology, Definitions: Infection, infectious disease, contagious disease, non-contagious disease etc. Types of infection– primary, secondary, cross, nosocomial, iatrogenic infection, localized infection, generalized infection, Bacteraemia, septicaemia, toxemia etc. Sources of infection-animal, human, insects, inanimate. Transmission of | (8 Hrs) |

| | | |
|---|--|-----------------|
| | infection– Modes of transmission, direct & indirect contact etc. Pathogenicity and Virulence Factors determining the ability of organism to produce disease, pathogenicity, virulence, invasiveness, toxigenicity: endotoxin and exotoxin. Resistance and susceptibility of Host factors- breed, species, individual factors- age, physiological & nutritional status, use of antibiotics or corticosteroids etc. Vector borne and zoonotic diseases | |
| 2 | Veterinary Bacteriology and Virology: Important Systemic bacterial diseases of animals: Epidemiology, aetiology, symptoms,pathogenesis, diagnosis and treatment of Anthrax, Brucellosis, Bordetella, Mastitis. Veterinary virology Important Systemic Viral diseases of animals: Epidemiology, aetiology, symptoms, pathogenesis, diagnosis and treatment of Foot and mouth disease, Blue tongue, Cow pox, Egg Drop Syndrome Virus, capri pox virus, goat and sheep pox, Lumpy Skin Virus Disease, Bovine Herpes Disease, Duck viral hepatitis, Rabies | (12 Hrs) |
| 3 | Important Systemic fungal diseases of animals: Epidemiology, aetiology, symptoms,pathogenesis, diagnosis and treatment of Aspergillosis, Coccidioides, Blastomyces, Histoplasma, Rhinosporidium, Mucor, Cryptococcus, Mycetoma, Sporothrix. | (10 Hrs) |
| 4 | Important Systemic parasitic diseases of animals: Epidemiology, aetiology, symptoms, pathogenesis, diagnosis and treatment of Giardia duodenalis, Anaplasmosis, Theileriosis, Schistosoma nasalis, Fasciolopsis, Leishmanosis, Ehrlichia, Acanthocephala. | (10 Hrs) |

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| 5 | <p>Immunology and serology</p> <p>Concepts in Veterinary and Medical Immunology. organs and cells of immune system. Types of immunity and immune response. Antigens, Antibodies, mechanism and theories of antibody production. Major histocompatibility complex, Complement system: Cytokines: Major types and functions.</p> <p>Antigen and antibody reactions, Agglutination, precipitation, haemagglutination, Complement fixation, neutralization, toxin and antitoxin reaction, immunofluorescence, ELISA.</p> <p>Hypersensitivity reactions, Autoimmunity and immunotolerance. Immunisation of animals. Biological: Role of conventional and modern vaccines in immunoprophylaxis, Adjuvants.</p> | (12 Hrs) |
|---|--|----------|

References:

1. Topley and Wilson. Principles of bacteriology, Virology and Immunity. Edward
2. David Greenwood, Richard C and Slack B. Medical Microbiology. ELBS Churchill
3. Rajesh Bhatia R. Essentials of Medical Microbiology. Jayjee Brothers.
4. Kenneth jR. Medical Microbiology – Introduction to Infectious Disease. Prentice Hall
5. joanstokes, Ridewaywren and Sir ashleymiles. Clinica Microbiology. Edward Arnold.
6. Dougias J and Slekh. Medical Bacteriology. Churchill Livingstone.
7. Bailey and Scotts. Diagnositic Microbiology. C.V. Mosry Company
8. Hoghl and Moffet. Clinical Microbiology. JB Lippincott Company

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
DSE 2 C: Marine and Extreme Microbiology

| | |
|---|-------------------------------|
| Course Title: : Marine and Extreme Microbiology | Course code: 21MBL3E2CL |
| Total Contact Hours: 52 hours | Course Credits: 04 |
| Formative Assessment Marks: 30 | Duration of ESA/Exam: 3 hours |
| Summative Assessment Marks: 70 | |

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To study the diversity of marine microorganisms and their evolution and interaction with other microbial community.
2. To study different ocean processes and its metabolism and the role of microorganisms in it.
3. To study the aspects of marine microbes in biofueling and pollution control
4. To study about extreme environment and microorganisms living in that environment.
5. To understand the physical and molecular adaptations of extremophiles and their applications.

DSE 2 C: Marine and Extreme Microbiology

| Unit | Description | Hours |
|------|---|-----------------|
| 1 | Marine microorganisms and its interactions Marine microbial Diversity and evolution of bacteria, archaea, fungi, protists, and viruses and their importance in marine processes. Impacts of rising CO ₂ levels on microbial community structure and ocean processes. Methods in Marine Microbiology. Metabolic Diversity and Ecophysiology. Microbial Symbioses of Marine Animals. Microbial Diseases of Marine Organisms. Marine Microbes as Agents of Human Disease. | (8 Hrs) |
| 2 | Role of Microbes in Ocean Processes, Carbon Cycling, Nitrogen, | (12 Hrs) |

| | | |
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| | Sulfur, Iron, Phosphorus and Silicon Cycling | |
| 3 | Microbial Aspects of Marine Biofouling, Biodeterioration, and Pollution Marine Microbial Biotechnology. | (10 Hrs) |
| 4 | Extreme environments and extremophiles: Extreme environments, Extremophiles and its characteristics, Microorganisms in extreme environment (Temperature, pH, Pressure, Salinity, Sugar Concentration, Humidity, Rocks, Extreme Radiation, Heavy metals). | (10 Hrs) |
| 5 | Extremophiles Adaptations and applications: Physiological adaptations and Molecular adaptations of various extremophiles. Applications of extremophiles in food industry, fermentation industry, pharmaceuticals, Biomining, Bioremediation, Polymer industry. | 12 Hrs) |
| References: | | |
| 1. <u>Colin B. Munn</u> Marine Microbiology Ecology & Applications 3rd Edition. ISBN 9780367183561 Published December 23, 2019 by CRC Press 436 Pages 153 Color & 15 B/W Illustrations | | |
| 2. <u>A Textbook on Marine Microbiology by Dr. P. F. Steffi (Author), Mrs. R. Rajeswari Anburaj (Author)</u> | | |
| 3. <u>Microbes in Extreme Environments (Special Publications of the Society for General Microbiology) December 1997 by R.A. Herbert (Editor), Geoffrey Codd (Editor)</u> | | |

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
GEC 1 A: Pharmaceutical Microbiology

| | |
|---|------------------------------|
| Course Title: : Pharmaceutical Microbiology | Course code21MBL3G1AL |
| Total Contact Hours: 30 hours | Course Credits: 02 |
| Formative Assessment Marks: 20 | Duration of ESA/Exam: 1 Hour |
| Summative Assessment Marks: 30 | |

Course Outcomes (CO's):At the end of the course, students will be able to:

1. Know the significance and production of pharmaceuticals, biological in production of therapeutic enzymes, cytokines.
2. Know the significance and production of antibiotics and vaccines.
3. Know the quality assurance and validation and know the designing layout for microbiology laboratory. Learn the concept related to patents novelty, utility, anticipation, patent application, PCT and implications, Role of a country patent office.

GEC 1 A: Pharmaceutical Microbiology

| Unit | Description | Hours |
|------|--|----------|
| 1 | Biopharmaceuticals. Concepts of pharmaceuticals, biologics and biopharmaceuticals, sources of biopharmaceuticals, biopharmaceuticals in production and research, monoclonal antibodies cytokines, haemopoietic growth factors, hormones, blood products, therapeutic enzymes (Asparaginase, Streptokinase, beta lactamases). | (10 Hrs) |
| 2 | Chemotherapy, Antibiotics and antibiogram, antibiotic policy NCCLS and WHO guidelines, vaccines, new vaccine production methods (DNA vaccines, synthetic, peptide vaccines, multivalent subunit vaccines, edible vaccines and their trials), Case studies. | (10 Hrs) |
| 3 | Quality Assurance and Validation. Regulatory aspects of QC, QA, and QM. GMP, GLP and CMP in Pharma Industry. ISO, WHO, USFDA certification. Microbial Limit test of Pharma products. Sterility testing, pyrogen testing and LAL test of Sterile Pharma products. Sterilization- heat, D- value, Z- value and survival curve, radioactive, gaseous and filtration. Chemical and | (10 Hrs) |

| | | |
|---|--|--|
| | biological indicators. Designing layout for microbiology laboratory. | |
| <p>References:</p> <ol style="list-style-type: none"> 1. Pharmaceutical Microbiology- Edited by W. B. Hugo & A.R. Russel Sixth Edition. Blackwell Scientific Publications. 2. Lippincott's illustrative Reviews: Pharmacology Edition: 02 Maryjnyck by Lippincott's review Publisher 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., KoKate C.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. Academic Press New York. 7. Pharmaceutical Biotechnology by S. P. Vyas & V.K. Dixit. CBS publishers & distributors, NewDelhi 8. Quniolinone antimicrobial agents- Edited by David C. Hooper, John S. Wolfson. ASM Washington DC. 9. Quality control in the Pharmaceutical industry - Edited by Murray S. Cooper Vol. 2, Academic Press New York. | | |

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
GEC 1 B: Baking and Brewing

| | |
|------------------------------------|------------------------------|
| Course Title: : Baking and Brewing | Course code21MBL3G1BL |
| Total Contact Hours: 30 hours | Course Credits: 02 |
| Formative Assessment Marks: 20 | Duration of ESA/Exam: 1 Hour |
| Summative Assessment Marks: 30 | |

Course Outcomes (CO's): At the end of the course, students will be able to:

1. To understand the concept and importance of baking and brewing in fermentation process.
2. Gain knowledge on microorganisms involved in baking and brewing processes.
3. To learn the production of baking products, their ingredients and importance

GEC 1 B: Baking and Brewing

| Unit | Description | Hours |
|-------------|--|-----------------|
| 1 | Fermentation, Milestones in fermentation, baking and brewing, reaction mechanisms of baking and brewing. Microorganisms involved in baking and brewing. Bakers yeast, its biology and production. Brewers yeast -top yeast, bottom yeast and its production. | (10 Hrs) |
| 2 | Baking and baked products: Intro to Yeast Breads, Advanced Yeast Breads, Naturally Leavened Breads (Sourdough), Ingredients and preparation of baked products.Bread, Buns hamburgers, hot dog buns sweet rolls English muffins, bagels, pret gels, croissants, Danish pastries, raised doughnut, crackers, cakes, pies, cookies. | (10 Hrs) |
| 3 | Brewing: Ingredients for brewing, role of cereals in fermentation, steps involved in brewing process, malting, milling, mashing, lautering, boiling, fermenting, conditioning, filtering and packaging. Cereal based Beverages: Beer, types of Beers, Production of Beer, Brewed coffee, Vinegar, Whiskey, | (10 Hrs) |

| | | |
|--|---|--|
| | Bourbon whiskey, Sake, Gin, Vodka, Kishik, Tarhana, Raabdi. | |
|--|---|--|

References:

1. [Carmen Schott](#), Brewing and Baking With Wild Yeasts: Adventures in Traditional Fermentation, 30 September 2014.
2. [Edward Ralph Moritz](#) A Text-Book of the Science of Brewing , 10 October 2018
3. Temitayo Ogunmora, Brewing Book for beginners
https://www.academia.edu/7122879/Brewing_Book_for_beginners.
4. Maratha sweetwarts Baking Handbook
5. Osslen, Professional Baking.
6. LABENSKY/LABENSKY_A_TEXTBOOK_OF_BAKING_AND_PASTRY_FUNDAMENTALS 4TH EDITION.

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology

Semester-III

GEC 1 C: Virology and Covidology

| | |
|---|------------------------------|
| Course Title: : Virology and Covidology | Course code21MBL3G1CL |
| Total Contact Hours: 30 hours | Course Credits: 02 |
| Formative Assessment Marks: 20 | Duration of ESA/Exam: 1 Hour |
| Summative Assessment Marks: 30 | |

Course Outcomes (CO's): At the end of the course, students will be able to:

1. Understand the classification of virus and their arrangements.
2. Knowledge on properties of virus, sub viral particles, replication of virus.
3. Learn the virus cultivation using chick embryo, plaque assay.

GEC 1 C: Virology and Covidology

| Unit | Description | Hours |
|------|---|----------|
| 1 | Virology, Classification of viruses- ICTV and Baltimore system of classification, properties of viruses. ultrastructure of viruses - capsids and their arrangements. Sub-viral particles, bacteriophages. Replication of viruses | (10 Hrs) |
| 2 | Virology techniques: Cultivation of viruses using cell lines, chick embryo, plaque assay method. Detection of viruses by PCR, RTPCR, Neutralisation assay, ELISA, Haemagglutination inhibition assay, Complement fixation, indirect fluorescent antibody assay. | (10 Hrs) |
| 3 | Covidology: General structure of Coronavirus, classification of coronavirus, COVID-19, epidemiology, pathogenesis, symptoms, Diagnosis, treatment. Mutations in Corona virus and its impact on society and economy. | (10 Hrs) |

References:

1. Principles of virology by Jane Flint, Vincont R. pub. 2020
2. Medical microbiology by Patric R. Murry pub. 2020
3. DNA Tumor viruses – Virology, Pathogenesis and Vaccines By Sally Roberks
4. Covid, 6th edition by Bernd Sebastian Kamps, Christian Hofmann Pub 2021
5. Covidians and Covidology by yasser negm kindle edition published: 2020

Date

Course Coordinator

Subject Committee Chairperson

Dept Name: Microbiology
Semester-III
SEC 3 : Research Methodology

| | |
|--------------------------------------|------------------------------|
| Course Title: : Research Methodology | Course code: 21MBL3S3LP |
| Total Contact Hours: 30 hours | Course Credits: 02 |
| Formative Assessment Marks: 20 | Duration of ESA/Exam: 1 Hour |
| Summative Assessment Marks: 30 | |

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To understand the basic concepts and fundamentals of research.
2. To gain knowledge on different search engines to collect information
3. To understand the concept of bioethics in research

SEC 3: Research Methodology

| Unit | Description | Hours |
|-------------|--|----------------|
| 1 | Introduction to Research: Aims, Objectives and principles; Fundamentals research Vs Applied research with examples: Qualitative vs Quantitative research: theoretical research vs experimental research with examples: Selection of a research problem and sources of literature – journals. Conferences, books. Types of sources: literature survey engines – scopus, web of science, google scholar, PubMed, NCBI, Scihub, etc. Science citation index. Citations, h-index, i 10 index, impact factor. Bioethics : Introduction to bioethics ,principles of bioethics,biotechnology and social responsibility, public acceptance issues in microbiology and biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics. | (10Hrs) |
| 2 | Methods of Data Collection: Data collection methods- Framing a hypothesis, designing controlled experiments, choosing the sample size, sampling bias, | (10Hrs) |

| | | |
|---|---|---------|
| | importance of independent replicates, conducting an experiment, maintaining a lab- note book to record observations: identifying experimental errors. Case-studies on well designed experiments vs. poorly designed experiments. Correlations vs. causation. Good laboratory practices. Safety practices in laboratories; introduction to chemdraw, chemsketch and other basic softwares. | |
| 3 | Data presentation and writing: Technical presentation, technical writing, formatting citations; MS Excel for plotting the data (pie chart, plots, bar charts). Analysis using software tools: Decriptive Statistics: mean, standard deviation, variance, plotting data and understanding error-bars, curve fitting: correlation and regression. Distributions: normal distribution, Gaussian distribution, Skewed distributions. Inferential statistics: hypothesis testing and understanding p-value. Parametric tests: students t-test, ANOVA. Tests to analyse categorical data: chi-square test. | (10Hrs) |
| References: <ol style="list-style-type: none"> 1. C.R. Kothari, Research Methodology: Methods and Techniques, II Ed. New Age International Publishers, (20009) 2. Shanthibhushan Mishra, Shashi Alok, Handbook of Research Methodology, I Ed, 2017, Educreation Publishers. 3. Basic statistical Tools in research and Data Analysis 4. Introduction to statistical methods with MATLAB. | | |

Date

Course Coordinator

Subject Committee Chairperson

DSC 9P7 : Bioprocess engineering and industrial microbiology Lab

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|--|-------------------------------|
| Course Title: Bioprocess engineering and industrial microbiology Lab | Course code:21MBL3C9P |
| Total Contact Hours:30 Hours | Course Credits: 02 |
| Internal Assessment Marks: 20 Marks | Duration of ESA/Exam: 4 Hours |
| Semester End Examination Marks: 30 Marks | |

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Study the fermentation antibiotic penicillin, citric acid production.
2. To learn the isolation and screening of various industrially important microorganisms and production industrially important microbial products.
3. Understand the production of vitamins and alpha amylase.
4. Do Preparation of wine, and immobilized cells.

DSC 9P7 : Bioprocess engineering and industrial microbiology Lab

List of Experiments

1. Study of Fermentor and On-line measurement of a fermentation process.
2. Isolation of industrially important microorganisms for microbial processes.
3. Batch fermentation of Citric acid production, recovery and estimation of citric acid.
4. Antibiotic fermentation and estimation of penicillin.
5. Preparation of wine and estimation of alcohol by specific gravity method.
6. Alcoholic fermentation and determination of total acidity and non-reducing sugars
7. Production of Pectinase from *Aspergillus niger* by using Wheat bran, Coffee pulp using small scale fermentor and its assay.
8. Production of α - Amylase using *A. oryzae*, *Bacillus licheniformis* using Wheat bran in small scale solid state fermentation and its assay
9. Preparation of banana juice using Pectinase.
10. Immobilization of yeast cells by calcium alginate gel entrapment and assay for enzymes Invertase.
11. Preparation of immobilized cells of *B. licheniformis* for the use in the production of alpha amylase.

References:

1. Demain, A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology and Biotechnology IInd Edition. ASM Press, Washington.
2. Maheshwari, D.K., Dubey, R.C. and Saravanamtu, R. 2010. Industrial Exploitation of
3. Microorganisms. I.K. International Publishing House. New Delhi.
4. Nduka Okafor 2010. Modern Industrial Microbiology and Biotechnology ASM Publisher
5. Nupur Mathur Anuradha 2007. Industrial Microbiology A Laboratory Manual.
6. Peppler, H.J. and Perlman, D. 2005. Microbial Technology: Fermentation Technology Second Edition Volume 1. Elsevier India Private Limited.
7. Peppler, H.J. and Perlman, D. 2005. Microbial Technology: Fermentation Technology Second Edition Volume 2. Elsevier India Private Limited.
8. Richard H Baltz, Julian E Davies and Arnold L Demain 2010. Manual of Industrial Microbiology and Biotechnology 3e ASM Publisher

Date

Course Coordinator

Subject Committee Chairperson

DSC 10P8 : Medical Microbiology Lab

| | |
|--|-------------------------------|
| Course Title: Medical Microbiology Lab | Course code:21MBL3C10P |
| Total Contact Hours:30 Hours | Course Credits: 02 |
| Internal Assessment Marks: 20 Marks | Duration of ESA/Exam: 4 Hours |
| Semester End Examination Marks: 30 Marks | |

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Study the antibiotic sensitivity test, and study of cancer cells.
2. Perform preparation of culture media and to perform presumptive identification of pathogens using colony morphology on selective/differential/ selective differential enrichment media.
3. Determination of Drug susceptibility testing by various methods.
4. Study the Bacteriological examinations of urine, blood, Pus samples from Hospitals.

DSC 10P8 : Medical Microbiology Lab

List of Experiments

Study of commensal flora of mouth and human body.

2. Bacteriological examination of Urine, Blood, Pus Samples from Hospitals.
3. Detection of thyphoid by widal test
4. Detection of malarial parasite from human blood sample.
5. Study antibiotic sensitivity test by using paper disc as well as agar cup plate method.
6. Study of cancer cells and visit to cancer research institute.
7. Anaerobic culture method for anaerobes of clinical importance.
8. Presumptive identification of pathogens using colony morphology on selective/differential/ selective-differential/ Enrichment media. Isolation and characterization of clinical significant species of Staphylococcus, Streptococcus, enterobacteriaceae,
9. Determinations of MIC for selected antibiotics (Kirby-Bauer method, T test, Checker board method).

10. Conventional and rapid methods for isolation and identification of pathogenic bacteria, fungi.

References:

1. Mohamed A Daw. Medical microbiology laboratory manual second edition 2009. ISBN: 978-9959-53-052-3.

2. R Panjarathinam. Practical Medical Microbiology, Published by Jaypee Brothers Medical Publishers

Date

Course Coordinator

Subject Committee Chairperson