KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University,Established Under Section 3 of UGC Act, 1956)
(Accredited with A+ Grade by NAAC in the second cycle)
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KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

Ph.D. MICROBIOLOGY

Syllabus

(Effective from the Academic year 2023 – 2024 and onwards)

DEPARTMENT OF MICROBIOLOGY

2023- 2024

Research Programme Ph.D in Microbiology
(Effective from the academic year 2023-2024 onwards)

Research Programme – Ph.D. Microbiology

Programme Outcomes (PO)

a. Microbiology knowledge: Apply the knowledge of Microbiology, life sciences and allied subjects to the understanding of microbial life processes and related phenomena.

b. Problem analysis: Identify research problems, review research literature, and analyse complexities of microbial interactions in vitro and in vivo

c.Design/development of research solutions: Design processes/strategies that meet the specified needs with appropriate consideration for the public health and safety, along with societal and environmental considerations.

d. Conduct investigations of complex problems: Use research-based knowledge and appropriate research methodology including design of experiments, statistical analysis and interpretation of data, and synthesis of the information to provide valid experimental conclusions.

e. Modern tools usage: Create, select, and apply appropriate techniques, resources, and ICT tools for understanding of the subject. Apply reasoning obtained through the contextual knowledge to assess impact of microorganisms on the society, health, etc., and the relevant responsibilities with respect to professional commitments.

Programme Specific Outcomes (PSOs)

f.Environment and sustainability: Understand the impact of microorganisms in societal and environmental contexts, and understand the need for sustainable development.

g. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the work/research practice.

h.Project management and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. Demonstrate knowledge and understanding of Microbiology and management principles and apply these to one's own work, as a member and leader in a team.

i.Communication: Communicate effectively on complexities of microorganisms with the scientific community and with society at large, including comprehension, effective report writing and design documentation making effective presentations and give and receive clear instructions.

j.Life-long learning: Recognise the need for and inculcate the ability to engage in independent and life-long learning in the broadest context of microbiology.

Programme Educational Objectives (PEOs)

PEO-I: To design, analyze, conduct and interpret the experimental data for process/product development in all the life science field. To encourage the continue learning to update and to become an entrepreneur in a competitive world of technology.

PEO-II: To explain the function of microorganisms at the level of the cell, genome, gene, etc., and develop theoretical and practical knowledge in handling the microorganisms and using them as model organisms. Understand the classification and diversity of microorganisms and the resulting implications in relation to other life forms.

PEO-III: To use the concept of theories, research skills and recent technological tools in solving any technological issues independently.

PEO-IV: To understand the role of microorganisms and their applications in medical microbiology, fermentation, genetic engineering, agriculture, as well as environment related and other Life science field.

PEO-V: To impart knowledge of research methodology, including skill developments in scientific writing, data handling and processing, development of research ideas and planning / designing of research projects.

PEO-VI: To develop proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization and relate concepts to microbiology.

POs	a	b	c	d	e	f	g	h	i	j
PEOI	X		X		X					
PEO II		X	X			X				
PEO III			X	X						X
PEO IV					X	X	X			
PEO V								X	X	X
PEO VI		X		X						X

Research Programme Ph.D in Microbiology
(Effective from the academic year 2023-2024 onwards)

Course code	Name of the course	Instruction hours/ week	Credits	Maximum Marks (100)
23RMB101	Research Methodology and Pedagogy	4	4	100
23RMB201	Research and Publication Ethics	4	4	100
23RMB301	Industrial and Pharmaceutical Microbiology	4	4	100
23RMB302	Immunotechnology and Biotechnology			
23RMB303	Virology			
23RMB304	Medical Microbiology			
23RMB305	Environmental Microbiology and Sustainable Engineering			
23RMB306	Bioprocess Technology			
Program Total		**12**	**12**	**300**

Part I: Ph.D in Microbiology **2023-2024**

23RMB101 PAPER – I: RESEARCH METHODOLOGY AND PEDAGOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100 Total**: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To develop understanding of the basic framework of research process.
- To develop an understanding of various research designs and techniques.
- To identify various sources of information for literature review and data collection.
- To develop an understanding of the ethical dimensions of conducting applied research.
- Appreciate the components of scholarly writing and evaluate its quality
- Track their progress and know where they stand
- Know in advance how they'll be assessed

COURSE OUTCOME

1. Critically analyse research methodologies identified in existing literature.
2. Propose and distinguish appropriate research designs and methodologies to apply to a specific research project.
3. Develop a comprehensive research methodology for a research question.
4. Apply the understanding of feasibility and practicality of research methodology for a proposed project
5. Plan appropriate teaching strategies, materials and assessments
6. Learn from and make changes to curriculum to improve student learning

UNIT – I (Spectroscopy and Chromatography)

Spectroscopy: Principles and instrumentation and applications of UV-Visible light spectroscopy, UV- Visible absorption spectroscopy, Spectrofluorimeter, Atomic spectroscopy, IR spectroscopy, ES bound X ray spectroscopy, Red and blue shift, R and B bands various transition compounds, Vibrational spectroscopy, different vibrations, NMR spectroscopy and MALDI-TOF. Chromatographic techniques: Principles of column chromatography. Instrumentation of Low pressure liquid chromatography (LPLC), High performance liquid chromatography (HPLC) Fast protein liquid chromatography (FPLC), High performance Thin Layer Liquid Chromatography (HPTLC), Perfusion chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Affinity chromatography, Gas chromatography (GC – MS).

UNIT – II (Research design)

Research: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems. Research Designs – Features of good designs. Sampling design: Meaning – Concepts – Steps in sampling – Criteria for good sample design.

UNIT – III (Sample design and analysis)

Concepts of data base management brief idea of data types, data structures, searching, sorting, designing a data base, genomic, proteomic databases. Computer analysis of genetic sequences: general concepts of sequence analysis identification of functional sequences, homology, brief idea of BLAST, ENTREZ and PUBMED. Scaling measurements – Techniques – Types of scale**.** Correlation – Meaning and definition - Scatter diagram – Karl pearson's correlation coefficient. Rank correlation. Regression: Regression in two variables – Regression coefficient problems – uses of regression. Hypothesis testing – Errors in Hypothesis testing - large sample test (Z – test) single and two tailed test, Small sample test (t – test)-Single mean -Two mean - Paired t -test, F – test, Chi – square test –Single Variance-Goodness of fit, SPSS Software, Anova – one way and two way. – CRD, RBD Designs. RSM (Response Surface Methodology). Thesis report writing.

UNIT – IV (Computer Applications)

Spreadsheet tool - Introduction to spreadsheet application, features and functions, using formulas and functions, data storing, features for statistical data analysis, generating charts/ graph and other features. Tools used may be Microsoft Excel, Open office or similar tool. Presentation tool - Introduction to presentation tool, features and functions, creating presentation, customizing presentation, showing presentation. Tools used may be Microsoft Power Point, Open Office or similar tool. Web Search - Introduction to internet, use of internet and WWW, using search engine like Google, Yahoo etc, using advanced search techniques. Plagiarism software, Literature search, Endnote, Mendeley and its application.

UNIT – V (Pedagogical Methods in Higher Learning)

Historical Perspectives – Objectives and role of Higher Education – Learning and Learning Hierarchy –Information processing – Learning Events and Outcomes – Motivation. Education Evaluation: A Conceptual Framework – Methods of Evaluation – Self Evaluation and Student Evaluation in Higher Education – Question Banking – Diagnostic Testing and Remedial Teaching.

SUGGESTED READINGS

1. Boyer, R. 2006 Modern Experimental Biochemistry. 3rd Edition. Addision Wesley Longman. New Delhi.
2. Wilson, K and J. Walker 2006. Principles and techniques of biochemistry and molecular biology, 6th Low Price Edition, Cambridge University Press, India
3. David Friedfelder 2001. Physical Biochemistry. 5th Edition Oxford Publishers. New York.
4. Kothari, C. R. 2005. Research Methodology-Methods and Techniques, Wiley International Ltd, UK
5. S. Palanichamy and M. Manoharan 2001. Statistical methods for biologists, Palani Paramount Publications, Palani.
6. R. Rajaram, 2008. Basic Computer Science and Communication Engineering Second Edition. SCITECH Publication India Private Limited, Chennai, India.

Part I: Ph.D in Microbiology **2023-2024**

23RMB201 PAPER – II: RESEARCH AND PUBLICATION ETHICS 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100 Total**: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To understand the philosophy of science and ethics, research integrity and publication ethics.
- To identify research misconduct and predatory publications.
- To understand indexing and citation databases, open access publications, research metrics.
- To understand the usage of plagiarism tools.
- To learn about violation of publication ethics, authorship and contributor ship
- To learn about databases and Research metrics

COURSE OUTCOME

1. Provide students with knowledge, general competence, and analytical skills in Research Methodology and Publication Ethics
2. Equip themselves with ethical issues related to Research and Publication.
3. Build a strong foundation for future research work in a systematic manner by applying notions of Research Methodology.
4. Appraise research integrity
5. Utilize various indexing and citation databases and outline research metrics
6. Apply various tools for plagiarism check

UNIT I: Philosophy and Ethics

Introduction to Philosophy: Definition, nature and scope, concept, branches – Ethics: Definition, moral philosophy, nature of moral judgments and reaction.

UNIT II:Scientific Conduct

Ethics with respect to science and research – Intellectual honesty and research integrity – scientific misconduct: Falsification – Fabrication – Fabrication and Plagiarism (FFP) – Redundant publications: duplicate and overlapping publication-salami slicing - selective reporting and misrepresentation of date.

Unit III: Publication Ethics

Publication Ethics: Definition, introduction and importance- Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc. – Conflicts of interest – publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, type- violation of publication ethics, authorship and contributing and appeals- predatory publishers and journals.

Unit IV: Publication misconduct

Group discussions: Subject specific ethical issues, FFP, authorship – conflicts of interest-complaints and appeals: examples and fraud from India and abroad.

Unit V: Development of e-content &IPR

Database: indexing database- citation database: web of science, scopus, etc. Research Metrics: impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score – Metrics: h-index, g index, g index, I 10 index, altmetrics.

Unit VI: Development of e- content & IPR

Integrated Library Management System (ILMS): e-journals – e-books – e-shodhsindu –shodhganga – database – e-content development – Learning Management system (LMS) – e-PG– Pataskala – CEC (UG) SWAYAM – MOOCs – NPTEL – NMEICT. IPR: Patent – Copyrights- trademark – Geographical Indication.

SUGGESTED READINGS

1. Open access publishing
2. Open access publications and initiatives-SHERPA/RoMEO online resource to check polisher copyright & self -archiving policies-software tool to identify predatory publications developed by SPPU-Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Part III:Ph.D in Microbiology **2023-2024**

23RMB301 PAPER – III: INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To impart theoretical knowledge of role of microbes in industrial production of different biochemical /bio-molecules.
- The theory syllabus covers area such as design of bioreactors, media formulations and factors affecting the industrial production of bio-chemicals along with approaches that can be used for enhanced production.
- To understand the basics of pharmaceutical microbiology and important microorganism playing role pharmaceutically.
- To understand different products of microbial origin playing key role in pharmaceutical applications.
- To understand role of secondary metabolites in pharmaceutical industry.
- To understand good practices and regulation involved in utilizing microbial product for pharmaceutical application.

COURSE OUTCOMES

1. Learning of different fermentation techniques, bioreactor design, inoculum development for industrial fermentations, Microbial growth and product formation kinetics, media formulation and sterilization.
2. isolation, preservation and improvement of industrially important micro-organisms.
3. Understanding of different pathways followed in or by the microbes involved in production of these biochemicals. Method of manipulating these pathways to get desired yield.
4. Have well versed with the different microbial products used in pharmaceutical applications
5. Better understanding of good laboratory practices and regulations for utilizing microbial product in pharmaceutical applications.
6. Understanding of application of these bio-molecules in benefit of mankind.

UNIT – I

History and chronological development of industrial microbiology. Industrially important strains –Isolation and preservation. Inoculum development for various fermentation processes. Strain development – mutation, recombinant DNA technology and protoplast fusion

UNIT – II

Fermentation – Submerged fermentation: batch, fed batch and continuous fermentation and solid state fermentation. Types of fermenters (Tower, cylindroconical and airlift) – batch fermentation – continuous fermentation. Fermentor design – body construction – mass transfer – oxygen transfer – effect of viscosity, Aeration, Agitation, pH – scale-up process.

UNIT – III

Production of beverages: beer and wine, Production of industrially important alcohols and Concept of ethanol production from different sources, Vitamin: B12 and riboflavin, Antibiotics: penicillin and streptomycin, Production of enzymes: amylase and proteases. Free cell immobilization and enzyme immobilization techniques. Production of probiotic and Single cell protein – baker's yeast, spirulina, red algae. Downstream process – intracellular and extracellular product separation. Liquid extraction, precipitation, floatation and filtration: Micro filtration and Ultra filtration.

UNIT – IV

Chemotherapeutic agents; Antimicrobial agents, sulfa drugs, antibiotics- pencillin and cephalosporin; classification of antibiotics; antibiotics from prokaryotes; mode and action of antibiotics, origin of drug resistance, mechanism action of drug resistance. Clinical uses of antimicrobial drugs, Microbial spoilage and preservation of pharmaceutical products, Sterilization of pharmaceutical products, Applications of microorganism in the pharmaceutical sciences.

UNIT – V

Role of precursors and steering agents in production of antibiotics, vitamins and enzymes. Antiseptics- disinfectants - preparation, standardization. Quality control of Pharmaceutical products – Injectables, IV fluids and pyrogen testing.

SUGGESTED READINGS

1.Patel, A.H. 2003. Industrial microbiology, Macmillan India Ltd. New Delhi
2.Prescott and Dunn's 1983. Industrial microbiology, CBS Publishers, New Delhi
3.Stanbury, P.T. and A. Whitaker 2005. Principles of Fermentation Technology, Pergamon Press, NY
4.Atlas R.N and R. Bartha 2007. Microbial Ecology-Fundamental and Applications.4th Edition. Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi
5.Michael J Waites 2007. Industrial microbiology, Blackwell publishing.UK
6.Mansi, E.M.T. and C.F.A. Bryce 2000. Fermentation Microbiology and Biotechnology, Taylor and Francis, New York.
7.Shuler, M.L. and F. Kargi 2005. Bioprocess engineering basic concepts. Pearson Education, New Delhi.
8.Hugo, W.B. and A.D. Russell 2007. Pharmaceutical Microbiology, 7th Edition, Blackwell Science Ltd, Oxford.

Part III:Ph.D in Microbiology **2023-2024**

23RMB302 PAPER – III: IMMUNOTECHNOLOGY AND BIOTECHNOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE

- To provide overview of immune system, antigen antibody structure and interactions.
- To develop understanding of innate and adaptive immunity along with major cells and molecules involved.
- To integrate immunology with health and enrich the knowledge for autoimmune disorders, hypersensitivity reaction.
- The objective of the course is to make student understand about the structure and function of biologically important molecules.
- Students will learn about DNA, RNA and the molecular events that govern cell functions.
- To develop understanding of gene transfer in transgenic animals, transgenic plants and gene cloning

COURSE OUTCOMES

1. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity
2. Develop understanding about immune system, antigen antibody interactions.
3. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
4. Describe the structure and function of DNA and RNA in a cell.
5. Elucidate central cell biological processes and how they are regulated
6. Understand how genetic engineering forms the foundation of modern biotechnology.

UNIT – I

Cells and Organs of immune system, T / B cell – maturation, activation – receptor, Cytokines – structure and functions, Antigen – Structure and chemical make-up, Immunoglobulin – structure – Organization and expression of Immunoglobulin genes, Purification of antigens and immunoglobulins., MHC – structure and functions, HLA tissue typing.

UNIT – II

Antigens - Antibody reactions, In *vitro methods* – Agglutination – Passive and reverse passive agglutination, Precipitation – reactions in gels – Immuno diffusion – Counter immuno electrophoresis, Complement fixation test, Immunofluorescence, ELISA, RIA, Immuno electron microscopy, Forensic serology.

UNIT – III

Introduction to genetic engineering, Restriction enzymes – types and nomenclature - classification – and uses, Cloning Vectors – types of vectors, pBR, pUC vectors, Phage vectors and Expression Vectors Prokaryotic hosts: *E. coli*, Eukaryotic hosts: Yeast cell. Gene cloning - construction of cDNA and genomic libraries - selection and screening method of recombinants - Screening of recombinants for Site directed Mutagenesis by SSCP, heteroduplex analysis.

UNIT – IV

Isolation of DNA and RNA – Handling and quantification of nucleic acids, radiolabelling and non radiolabelling of nucleic acids, Gel electrophoresis - Blotting techniques, Hybridization and heteroduplex analysis, Molecular diagnostics of genetic disease using PCR / OLA, RT PCR, Inverse PCR, Nested PCR, Multiplex PCR, Expression cassette PCR, Real time PCR. Applications – gene cloning, DNA sequencing, genome mapping DNA diagnostic system in forensic sciences.

UNIT – V

Genetic engineering of plants and animals: Gene transfer techniques into plant and animal cell. Plants as tool for recombinant protein production; Development and use of transgenic animals; transgenic mice – methodology and applications. Ethical issues of gene cloning.

SUGGESTED READINGS

1.Richard A. Goldsby, Thomas J.Kindt. Barbara A. Osborne 2000. Kuby Immunology. 5th Edition.
W.H. Freeman and Company, New York.

2.Frank C. Hay and Olwyn M.R. Westwood 2002. Practical Immunology. 4th Edition, Blackwell
Science Ltd. Oxford.

3.Roitt, I.M. Brostaff, J.J. and D.K. Male 2000. Immunology. 6th Edition. C.V. Mosby Publishers. St.
Louis.

4.Winnacker, E.L. 2003. From genes to clones. Introduction to Gene Technology.1st Edition VCH.
Weinhein.

5.Brown, T.A. 2006. Gene Cloning and DNA analysis; An Introduction. 5th Edition. Blackwell
Publishing, UK

6. Glick, B.K and J.J. Pasternak 2003. Molecular Biotechnology.Principles and applications of recombinant DNA. 3rd Edition. ASM Press, Washington.

Part III:Ph.D in Microbiology **2023-2024**

23RMB303 **PAPER – III: VIROLOGY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE

- Knowledge on history, general characters of viruses and how viruses are classified on basis of architecture and genetic material.
- Discerning the plant and animal viruses and their replication strategies inside the host and also methods used in cultivation and detection of viruses.
- Comprehend the bacteriophages and other phages and their application.
- Knowledge on some common plant and animal diseases caused by different viruses, viruses transmission and control.
- Knowledge on viral infection diagnosis and control.
- Introduce a concept of biosafety against infection or genetic modification.

COURSE OUTCOMES

1. Recognize characters of different types of viruses.
2. Understand how viruses can be used as biotechnological tools, as cloning vectors and for gene transfer.
3. Understand the architecture of viruses and their genomes.
4. Theoretical knowledge on techniques employed for culturing and detection of plant and animal viruses.
5. Comprehend the intricate interaction between viruses and host immune cells and pathogenesis of virus-induced diseases, the detection and the treatment.
6. Identify the role of the Biosafety Professional in Biomedical Research Laboratories.

UNIT -I

History of Virology, Brief outline of virology: discovery of virus, General properties of viruses, Classification of viruses, Preservation of viruses, & Cultivation of viruses.

UNIT -II

Viruses & Human diseases: DNA viruses: Pox virus, Herpes virus, adenovirus. Papova virus, Hepadna virus, Pathogenesis & Laboratory diagnosis.

UNIT -III

Viruses & Human diseases: RNA viruses: Orthomyxo viruses, Paramyxo viruses, Influenzae and other arthropod born viruses, Retroviridae. Emerging Viral infection – SARS-CoV, Bird flu and Nipha Virus.

UNIT - IV

Virus – Host interaction, immunity to viral diseases. Antiviral agents and Viral Vaccines. Immunization Schedules. Animal virus- Adeno virus, Retro virus, Orthomyxo virus, Parvo virus and Corona Virus.

UNIT -V

Virology methods: Cultivation and purification of viruses, *In vitro* and in ovo system for virus growth, estimation of yields, methods for purification of viruses with special emphasis on ultracentrifugation. Epidemiology and Laboratory diagnosis of viruses: Electron microscopy, molecular and serodiagnosis of viral infections, PCR; Sequencing & genotyping.

SUGGESTED READINGS

1.Medical Virology – Morag C, and Timby M.C. X Edition (1994) Churchill Livingstone, London.

2.Introduction to Modern Virology – Dimmock N.J. Primrose SB. IV Edition (1994). Blackwell Scientific Publications, Oxford.

3.Virology – Contrat H.F. Kimball PC and Levy JA. IIIrd Edition. (1994). Prentice Hall, Englewood cliff, New Jersy.

4.Principles of Bacteriology, Virology and Immunology – Topley & Wilson's (1995). Edward Arnold,London.

5.Virology -3rd Edition 1996, Fiels DN (Edn.) Lippincott – Raven.

6.Principles of Virology -2nd Edition 2004, SJ Flint Edn. ASM Press.

7.Clinical Virology -2nd Edition 2002, Doughlas D Richman (Edn.) ASM Press.

8.Essentials of Diagnostic Virology – 2000, Gregory A Storch, Churchill Livingstone.

9.Principles of Molecular Virology, 1997. 2nd ed. A.Cann. Academic Press.

10.David Greenwood, Richard C.B, Slack, John Forest Peuthere (1992). "Medical Microbiology". 14thEnd. ELBS with Churchill Livingstone.

Part III:Ph.D in Microbiology **2023-2024**

23RMB304 **PAPER – III: MEDICAL MICROBIOLOGY** **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE

- Introduction to basic principles and then applies clinical relevance of many etiological agents responsible for global infectious diseases.
- The infectious disease cycle of the pathogens enables to solve the epidemics.
- The territory covered by infections and the immune response
- Focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career and able to establish the medical laboratory.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora

COURSE OUTCOMES

1. Knowledge of most common medically important organism and the infections they cause.
2. Different approaches, techniques and tools used to identify pathogens and control them.
3. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response to infection
4. Application of molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobial agents
5. Diagnostic approaches for microbial pathogens
6. Developing efficient vaccines and new drugs.

UNIT – I

Laboratory precaution and guidelines – collection – transportation – handling and examination of pathological specimens (Blood, Urine, Stool and sputum) – methods of isolation, identification and interpretation of pathogenic organisms – Antibiotic susceptibility testing. Infections – types – methods – Infectious disease cycle. Quality control in microbiology lab and automation in medical microbiology.

UNIT – II

Gram positive organisms: Morphology, cultural characteristics, antigenic property, pathogenecity, laboratory diagnosis and Treatment. *Staphylococcus* sp., *Streptococcus* sp., *Bacillus* sp.,*Corynebacterium* sp., *Clostridium* sp. and *Mycobacterium* sp.

UNIT – III

Gram negative organisms: Morphology, cultural characteristics, antigenic property, pathogenecity, laboratory diagnosis and Treatment. *E.coli, Klebsiella* sp., *Proteus* sp., *Pseudomona*s sp., *Vibrio* sp., *Salmonella* sp., *Shigella* sp., *Treponema* sp., *Neisseria* sp. and *Haemophilus* sp. MDR, XDR and PDR.

UNIT – IV

Superficial mycosis - *Pityriasis versicolor, Tinea nigra, piedra.* Cutaneous mycosis Dermatophytes. Systemic mycosis - Coccidiomycosis - Blastomycosis – Histoplasmosis. Opportunistic mycosis, Candidosis, Aspergillosis, Zygomycosis. Subcutaneous mycosis – Sporotrichosis, Chromoblastomycosis and Mycetoma.

UNIT – V

Protozoan infections - *Entamoeba histolytica, Plasmodium vivax, Plasmodium falciparum, Giardia intestinalis, Trichomonas vaginalis, Taenia solium*. Trematodes - *Fasciola hepatica, Schistosoma haematobium*, Nematodes - *Trichuris trichiura, Ascaris lumbricoides*, and *Wuchereria Bancrofti*.

SUGGESTED READINGS

1.Ananthanarayanan, R. and C.K.J. Panicker, 2005. Text Book of Microbiology 7th Edition. Orient Longman, New Delhi.

2.Brook,G.F., J. S. Butel, A. Stephen and Morse, 2003. Medical Microbiology, 22nd Edition. Mc Graw Hill.

3. Chakraborty, P., 2003. A Text book of Microbiology. 2nd Edition. New Central Book Agency (P) Ltd., Calcutta.

4. Chander, J., 2002. A Text book of Medical Mycology. Interprint Mehta Publishers, New Delhi.

5.Chatterjee, K.D., 1980. Parasitology in relation to medicine. 12th Edition, Chatterjee Medical Publishers, Calcutta.

6.Chunin, J., 2000. Parasitology. New York Publishers, London.

7.Dismukes, W.E., P.G. Pappas and D. Sobel, 2003. Clinical Mycology. Oxford University Press, UK.

8.Jawetz, E., J.L. Melnic and E.A. Adelberg, 2001. Review of Medical Microbiology. 22nd Edition. Lange Medical Publishers. New York.

9. Mehrotra, R.S. and K.R. Aneja, 2007. Introduction to Mycology. New Age International Ltd. New Delhi.

10. Panjarathinam, R., 2007.Text book of Medical Parasitology, 2nd Edition. Orient Longman Publishers. New Delhi.

Part III:Ph.D in Microbiology **2023-2024**

23RMB305 PAPER – III: ENVIRONMENTAL MICROBIOLOGY AND SUSTAINABLE ENGINEERING **4H – 4C**

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

- To create the responsiveness about environmental issues among students.
- To improve the practice of concern towards the environment.
- To encourage community to involve themselves in environment upgrading.
- To create awareness among the students to know about various renewable and non-renewable resources of the region enables environmentally literate citizens (by knowing the environmental acts, rights, rules, legislation, etc.)
- To make appropriate judgments and decisions for the protection and skills associated with improvement of the earth.

COURSE OUTCOME:

1. Understand core concepts and methods from environmental sciences and their application to solve environmental issues.
2. Understand core concepts about various pollution, its impact in environment and effective solutions to be practiced.
3. Comprehend the importance Environmental management standards in India.
4. Understand the international oddity of environmental problems and mode of facing them.
5. Apply systems concepts and practices to execute green and sustainable engineering.

Unit I Introduction to Sustainability

Sustainability needs and concept, Challenges, Environmental acts and protocols, Global, Regional and local environmental issues, Natural resources and their pollution, Carbon credits, zero waste concept, Life cycle analysis, Environmental impact and assessment studies, sustainable habitat and green buildings, green, materials, energy, conventional and renewable resources, Technology and sustainable development, Industrial Ecology.

Unit II Diverse Pollutions

Air pollution, effects of air pollution; Water pollution-sources, Sustainable waste water treatment, Solid waste- sources impacts of solid waste, zero waste concept, 3R concept- Global environmental issues- Resource degradation, climate change, Global Warming, Ozone layer depletion, Regional and local environmental issues, Carbon credits and carbon trading, Carbon foot print.

Unit III Environmental standards

Environmental management standards, ISO 14000 series, Life cycle Analysis (LCA)-Scope and Goal, Bio-mimicking, Environmental impact Assessment (EIA)-Procedures of EIA in India.

Unit IV Green Construction

Basic concepts of sustainable habitat, green buildings, green material for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings, Sustainable cities, Sustainable transport. Microbial induced carbonate precipitation (MICP), Bio cementation.

Unit V Microbiome in Sustainability

Green Engineering, Microbiome of Green Design (building materials), Sustainable urbanisation, industrialization and poverty reduction, social and technological changes, industrial process: material selection, pollution prevention, Industrial ecology, industrial symbiosis.

REFERENCES:

1. Allen, D.T, and Shonnard D.R., Sustainability Engineering; concepts Design and case studies. Prentice Hall. 2002
2. Bradley, A.S: Adebayo,A.O. Maria, P. Engineering application in sustainable Design and development ,Cengage learning. 2015T.
3. Environmental Impact Assessment Guidelines, Notification of government of India,2006.
4. Mackenthun, K.M, Basic concepts in Environmental management, Lewis Publication London 2019.
5. ECBC Code, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications – Rating Systems, TERI Publications- GRIHA Rating system. 2007
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional. 2010
7. Twidell,J.W. and Weir, A.D, Renewable Energy Resources, English language Book Society (ELBS). 2015

Part III:Ph.D in Microbiology **2023-2024**

23RMB306 PAPER – III: BIOPROCESS TECHNOLOGY 4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** External: **100** Total: **100**
End Semester Exam: 3 Hours

COURSE OBJECTIVE:

- To study the historical development of bio process technology
- To design and construction of fermentor
- To learn about the controlled parameters in fermentation process
- To evaluate the kinetics and thermodynamics of enzymatic process
- To study the stoichiometry and energetics of cell growth and product formation
- To evaluate the kinetics and mechanism of microbial growth

COURSE OUTCOME:

1. To prepare a research plan for his/her fermentation research project.
2. To develop skills to train others in the area of bioprocess engineering.
3. To develop entrepreneur skills for applications in biotechnology based industries.
4. To apply different biotechnological methods used in the recombinant protein production
5. in fermentation processes and in protein purification.
6. Understanding of different pathways followed in or by the microbes involved in production of these bio- chemicals.

UNIT I Introduction to fermentation technology

Interaction between biochemical engineering; Microbiology and Biochemistry; Introduction to fermentation processes; Microbial culture; Screening and selection for fermentation processes; Preservation and improvement of industrially important microorganisms; Inoculum production for bacterial and fungal processes.

UNIT II Raw material and media formulation for fermentation process:

Fermentation media; Natural media; synthetic media. Sources of Carbon; Nitrogen and vitamins; antifoams and optimization. Significance of upstream processing.

UNIT III Types of Fermentation and Process parameters

Solid Substrate fermentation and submerged fermentation: ; Process parameters measurement of temperature; pressure and pH; dissolved Oxygen; foam etc. Strain improvement by mutation and screening of improved cultures; random and strategic screening methods; strategies of strain improvement for primary; secondary metabolites with relevant examples; Preservation of cultures after strain improvement programme.

UNIT IV Design and construction of a Fermentors

Body construction; construction material; Aeration and agitation systems; Stirrer glands and bearings; Baffles; Valves and steam traps; Pressure-control valves; computer applications in fermentation technology; specialized bioreactors; membrane bioreactors; tower bioreactors; fluidized bed bioreactors; Immobilized system and packed bed reactors and Photobioreactors.

UNIT V Downstream Processing

Biomass separation by centrifugation; filtration; flocculation and other methods; Cell disintegration: Physical; chemical and enzymatic methods; Separation of solid and liquid phases; isolation and purification techniques for proteins and other products based on different physico-chemical properties.

SUGGESTED READINGS

1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. Principles of Fermentation Technology. (2016) Butterworth-Heinemann Press. UK.
2. H. J. Peppler, D. Perlman. Microbial Technology: Fermentation Technology. (2014). Academic Press.
3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. (2006). CRC Press, USA.
4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. (2013). Springer Press, Germany.
5. John E. Smith. Biotechnology. (2009). Cambridge University Press.UK.
6. Celeste M. Todaro, Henry C. Vogel. Fermentation and Biochemical Engineering Handbook. (2014). William Andrew Press. Norwich, NY.
7. G. Lancini, R. Lorenzetti. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. (2014). Springer publications, Germany.