



SYLLABUS
FOR
Ph.D. COURSE WORK IN
MICROBIOLOGY

DEPARTMENT OF MICROBIOLOGY
VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANA SAGARA CAMPUS, VINAYAKANAGAR, CANTONMENT
BALLARI-583 105



**VIJAYANAGARA SRI KRISHNADEVARAYA
UNIVERSITY, BALLARI-583 105
(EFFECTIVE FROM THE ACADEMIC YEAR 2019-2020)**

**P.G. DEPARTMENT OF STUDIES AND RESEARCH IN
MICROBIOLOGY**

SYLLABUS FOR Ph.D. COURSEWORK

Sl. No	Name of the Course	Contact Hours per week	Maximum marks			Examination Hours
			Continuous assessment	Course-end examination	Total	
1	Course-I: Research Methodology	03	25	75	100	03
2	Course-II: Core subject (Microbiology)	03	25	75	100	03
3	Course-III: Field of Specialization (Recent Advances in Microbiology)	03	25	75	100	03
Total			75	225	300	
Viva-voce					50	

*The student should obtain a minimum of 55% marks in order to be declared successful at the Ph.D. course work examination.

COURSE-I: RESEARCH METHODOLOGY

52 Hrs

UNIT- I

10 Hrs

- Introduction to research; Definitions and characteristics of research; Types of research; Main components of any research work.
- Topic Selection: Learning Objectives; Problem identification; Criteria for prioritizing problems for research.
- Analysis and Statement of the problem: Learning Objectives; analyzing the problem; formulating the problem statement.
- Literature review: Uses of literature review; Source of information; Organization of information on index cards.
- Objectives: Learning Objectives; Definitions; Formulation of the research objectives.
- Research methodologies: Study population; Variables; Sampling; Sample size determination;
- Plan for data collection; Methods of data collection; Plan for data processing and analysis; Ethical considerations.
- Work Plan; Major components and outline of the different phases in a research process; Summary of the major components of a research proposal; Fieldwork; Writing a research report.

UNIT-II

08 Hrs

- Statistics: Probability & Sampling distribution; Estimation, Hypothesis testing & application; Correlation & regression analysis.
- Types of study designs/ Experiment design – Orthogonal array, ANOVA, interaction, Signal-to- Noise ratio.

UNIT-III

10 Hrs

- Spreadsheet tool: Introduction to spread-sheet applications, features & functions, using formulae & functions, data storing, features for statistical data analysis, generating
- Charts/graphs & other features. [*Tools: Microsoft Excel, Open office and similar or other advanced tools*]
- Presentation tool: Introduction to presentation tool, features & functions, creating presentations, customising presentation. [*Tools used: Microsoft Powerpoint, Open Office or any other tool*]
- Web Search: introduction to internet, Use of Internet & www, using search engines using advanced search tools. Thesis writing & Scientific editing tools.

UNIT-IV

08 Hrs

- Database browsing and Data retrieval; Searching of databases similar sequence; The NCBI; Publicly available tools; Resources at EBI; Resources on the web; Database mining tools.
- Sequence database and genome database; Data Structures and Databases; Databases such as GeneBank; EMBL; DDBJ; Swissprot; PIR; MIPS; TIGR; Hovergen; TAIR; PlasmODB; ECDC.
- Searching for sequence database like FASTA and Blast algorithm. Biological background for sequence analysis; Identification of protein sequence from DNA sequence.

UNIT-V

06 Hrs

- The gene bank sequence database, submitting DNA sequence to the databases and database searching.
- Sequence alignment, Pair wise alignment techniques, multiple sequence analysis; multiple sequence alignment.
- Flexible sequence similarity, searching with the FAST3 program package, Use of CLUSTAL W and CLUSTAL X for the multiple sequence alignment, Submitting DNA.
- Protein sequence to databases: Where and how to submit, SEQUIN, genome centre. Submitting aligned set of sequences, updates and internet resources, Phylogenetic analysis, Primer designing and DNA microarray or Biochips.

UNIT-VI

10 Hrs

- Ethical Issues: Ethical, legal, social and scientific issues in Biological Research. A brief idea about the funding agencies such as DST, DBT, ICMR, CSIR and UGC. Role of IPR in Research and Development.
- Introduction to Intellectual Property :Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies
- Patent filing procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting –disclosure/non-disclosure; Financial assistance for patenting -introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies

REFERENCES:

1. Montgomery, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India)
2. Montgomery, Douglas C. & Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India)
3. Kothari C.K. (2004) 2/e, Research Methodology – Methods and Techniques (New Age International, New Delhi)
4. Krishnswamy, K.N., Shivkumar, Appa Iyer and Mathiranjana M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
5. The Complete reference Office Xp- Stephan L. Nelson, Gajula Kelly (TMH)
7. Basic Computer Science and Communication Engineering – R. Rajaram (SCITECH).
8. Design of Experiments: Statistical Principles of Research Design and Analysis, by Robert O. Kuehl Brooks/Cole.
9. Study and Communication Skills for the Biosciences by Stuart Johnson and Jon Scott, Oxford University Press.
10. Write and Publish a Scientific Paper by Robert A. Day Oryx Press Scientific Easy when you know how by Jennifer Peat BMJ Books.
11. Research Projects and Research Proposals A Guide for Scientists Seeking Funding by Paul G. Chapin Cambridge University Press.
12. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.
13. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007.
14. Bhate and Pongashe, Patent, Bhate Prakashan, Pune Ponkhshe S. (1988) Management of Intellectual Property, Bhate and Ponkhshe Prakasham, Pune

COURSE-II: CORE SUBJECT: MICROBIOLOGY

52 Hrs

UNIT –I:

08Hrs

- Chromatographic techniques, TLC, HPLC, FPLC, GC, FT-IR, GCMS, ion exchange, UV, Mass, NMR.
- Centrifugation techniques, SDS-PAGE, 2D electrophoreses, Iso electric focusing, PFGE, MALDI-TOF.
- Microscopes- Fluorescent, SEM, TEM, AFM, PCR, Real-time PCR. Circular dichroism spectroscopy, DLS, flow cytometry.

UNIT –II:

08 Hrs

- Separation, Purification and Characterization of proteins, X-ray diffraction, Crystallography.
- Enzyme kinetics, molecular modeling and structural elucidation of enzymes, enzyme stability;
- Advances in nucleic acid sequencing and hybridization. DNA-Microarray, PCR, DNA fingerprinting, R-DNA technology and antisense RNA techniques.

UNIT –III:

08 Hrs

- Advances in the study of microbial diversity in extreme environments.
- Modern techniques for collection, molecular approaches in assaying microbial diversity of different biomes.
- Exploitation of microorganisms for human welfare.
- Study of human micro biome.

UNIT –IV:

10 Hrs

- Complement fixation, structure and classes of antibodies, genetic basis of antibody diversity. MHC I and II: structure and antigen presentation.
- T and B lymphocytes activation and role in humoral and cell mediated immunity.
- Vaccines live and attenuated, killed multi-subunit and DNA vaccines.
- Hypersensitivity and auto immune diseases. ELISA, RIA, Hybridoma Technology.

UNIT –V:**10 Hrs**

- Agriculture important microorganisms and their exploitation for biofertilizer, biopesticides, production of green manure, compost and vermicompost.
- Advances in the detection and controlling of microbial diseases in plants and production of value added pathogens and pest resistances crops, transgenic plants.
- Advances in the isolation of microbes from different environments and their exploitation for extraction of precious metals from low grade ores, bioremediation of xenobiotics; use of super bugs or consortia in environment cleaning-waste water treatment, solid waste management, oil spills, bioremediation of underground water, phytoremediation.

UNIT –VI:**08 Hrs**

- Improvement of industrially important microbial strains advances in fermentation technology.
- Recent advance in designing of fermentors and bioreactors.
- Upstream and downstream processes.
- Immobilization techniques, Response surface methodology, biochips.

REFERENCES:

1. Mantel, Mathews and Mickee (1985). An introduction to genetic engineering in plants. Blackwell Publishers.
2. Manual of Environmental Microbiology, 3rd Edition 2007, Editors: Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, Linda D. Stetzenbach, ASM PressTitle: Manual of Environmental Microbiology, 3rd Edition
3. Methods for General and Molecular Microbiology, 3rd Edition, 2007 , Editors: C. A. Reddy, Terry J. Beveridge, John A. Breznak, George Marzluf, Thomas M. Schmidt, Loren R. Snyder, ASM Press.
4. Joanne Willey and Linda Sherwood and Christopher J. Woolverton (2017) Prescott's Microbiology10th Edition.
5. Michel J Pelzer, E.C.S.Chan, Noel. R Krieg, Microbiology Tata Macgraw hill 5th Edition 1993
6. Goldsby RA, Kindt TK, Osborne BA and Kuby J (2003) *Immunology*, 5th Edition, W.H. Freeman and Company, New York.

COURSE-III: RECENT ADVANCES IN MICROBIOLOGY

52 Hrs

UNIT– I

12 Hrs

- Isolation, identification and characterization of novel microorganisms from various diversified environments. Recent advances in Bacterial Taxonomy, a phylogenetic backbone and taxonomic framework for prokaryotic systems, Computer taxonomy, 16srRNA fingerprinting and lipid profile by GLC.
- Bioremediation of the polluted spheres; recent advances in the treatment of liquids, solids and hazardous wastes.
- Use of microbes in the energy production, plastic degradation, metals and minerals recovery.
- Microbial diversity in the extreme environments and their exploitation for the human welfares.
- Bioactive molecules such as anti fungal, anti bacterial, antiviral, anti cancer, anti-inflammatory, anti wound, anti whitening molecules of microorganism.
- Plant pathogen interactions, secondary metabolites, PGPRS by rhizosphere microbes, Bio fertilizers and Bio pesticides.
- Stress and signaling, Heat stress and Heat shock proteins. Quorum sensing, biofilms, biosensors.

UNIT– II

10 Hrs

- Principles and procedures used in Genetic engineering.
- Enzymes: DNA polymerase, restriction endonucleases, topoisomerase I and DNA ligase, reverse transcriptase, kinase, alkaline phosphatase, nuclease, RNase H.
- Vectors: plasmids (Ti/Ri), Cosmids, bacteriophage, M13 vectors, BAC, YAC and synthetic plasmids.
- DNA sequencing dideoxy chain termination and Sanger's +/- method.
- *Agrobacterium* mediated genetic transformation and Plant tissue culture: Cell and callus culture, anther culture. Genetically modified organisms and plants.
- Metagenomics.

UNIT –III

08 Hrs

- Epidemiology, transmission, prevention and control measures of emerging and re-emerging communicable diseases.
- Methods of collection, transportation, and processing of clinical samples.
- Isolation, characterization and preservation of pathogenic microorganisms.
- Antimicrobial agents and their applications.

- Recent trends in multi-drug resistance and its consequences. Antibiotic policy-CLSI and WHO guidelines; conventional and molecular methods for screening of drug resistance pathogens.
- Recent advances in the serological, molecular and biological methods in diagnostics. Production of polyclonal and monoclonal antibodies and their applications.
- Types of antigen antibody reactions and their applications in diagnosis of diseases. Immunotherapy, vaccine production, immunization schedules.

UNIT -IV

08 Hrs

- Industrially important microorganisms. Strain development, Inoculum development for industrial fermentation. Media for industrial fermentations, Construction and Design of a typical fermentor.
- Sterilization of media and fermentors - Design of sterilization process for batch and continuous fermentation.
- Major process variables of upstream bioprocess engineering. Optimization of process variables. Strategies for the enhanced production. Development in various methods for the recovery of products.
- Production and purification of 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 and butanol). Vitamins B₁₂, Antitumours and Anticholesterol agent.

UNIT- V

06 Hrs

- Recent advancements in food and dairy microbiology.
- Fermentation of bread, beer and wine, yogurt, cheese, sauce, pickles, fermented sausages.
- Food safety is a major focus of food microbiology.
- Prebiotics and Probiotics, bacteriocins and phage therapy,
- Microbial biopolymers (Alginate and Cellulose).
- Food infection and food poisoning, Detection of food borne pathogens.

UNIT- VI

08 Hrs

- Natural and artificial synthesis of nanoparticles in microorganisms.
- Types of nanoparticles with special reference to gold and silver nanoparticles.
- Different methods of nanoparticles synthesis: physical, chemical and microbial sources. Functionalization of nanoparticles for biological applications.
- Biological Methods, Properties and Characterizations, Applications of nano materials in biosystems. Proteins - Lipids - RNA and DNA, Protein Targeting. Small Molecule/Nanomaterial, Protein Interactions.
- Nanomaterial Cell interactions, Nanomaterials and Diagnostics/Drug Delivery and Therapeutics.
- Nanotoxicity studies.

REFERENCES:

1. Jeffrey C Pommerville, 2011, Fundamentals of Microbiology, Bartlett Series.
2. Roger Y. Stanier, 1987, General Microbiology, MacMillan Publ.
3. Lammart JM, 2006; Techniques in Microbiology – a student handbook, amzon.com.
4. Madigan MT et al, 2008; Brock – Biology of Microorganisms, amzon.com.
5. Atlas RM, 1995; Principles of Microbiology, Mosby Yearbook Missouri
6. Pelczar, Chan & Kreig, 1982; Microbiology, McGraw Hill Book Co, New York
7. Microbial Technology: Pepler Microbiology and technology of fermented foods
W. Hutkins. Blackwell publishing.
8. Doyte MP, Loory RB & Thomas JM; Food Microbiology, ASM Pres, Washington
DC.
9. Jay JM, Modern; Food Microbiology, Chapman & Hall, New York.
10. Joshi VK & Pandey Ashok; Biotechnology of Food Fermentation, Asia tech,
Publishers.
11. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004



VIJAYANAGARA SRI RISHNADEVARAYA UNIVERSITY, BALLARI
DEPARTMENT OF P.G. STUDIES AND RESEARCH IN MICROBIOLOGY

Ph.D. Coursework Examination

Course-I: Research Methodology

Time: 3 Hours

Max. Marks: 75

SECTION-A

Answer in one or two sentence (Compulsory): (5x2=10)

- 1.
- 2.
- 3.
- 4.
- 5.

SECTION-B

Answer any **Five** of the following: (5x5=25)

- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.

SECTION-C

Answer any **Four** of the following: (4x10=40)

- 13.
- 14.
- 15.
- 16.
- 17.
- 18.



VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI
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Ph.D. Coursework Examination
Course-II: Microbiology

Time: 3 Hours

Max. Marks: 75

SECTION-A

Answer in one or two sentence (Compulsory):

(5x2=10)

- 1.
- 2.
- 3.
- 4.
- 5.

SECTION-B

Answer any **Five** of the following:

(5x5=25)

- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.

SECTION-C

Answer any **Four** of the following:

(4x10=40)

- 13.
- 14.
- 15.
- 16.
- 17.
- 18.



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DEPARTMENT OF P.G. STUDIES AND RESEARCH IN MICROBIOLOGY

Ph.D. Coursework Examination

Course-III: Recent Advances in Microbiology

Time: 3 Hours

Max. Marks: 75

SECTION-A

Answer in one or two sentence (Compulsory):

(5x2=10)

- 1.
- 2.
- 3.
- 4.
- 5.

SECTION-B

Answer any **Five** of the following:

(5x5=25)

- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.

SECTION-C

Answer any **Four** of the following:

(4x10=40)

- 13.
- 14.
- 15.
- 16.
- 17.
- 18.

