KAKATIYA UNIVERSITY

Department of Microbiology

Pre Ph. D Microbiology

Syllabus contents and Scheme of Examination

For the candidates admitted from the academic year 2023-2024

Paper	Paper Code	Title of Paper	Duration of Examination (Hrs)	Min Marks	Max. Marks
Paper I	General	Research Methodology in Microbiology	3	40	100
Paper II (A)	Special I	Microbial Technology	3	40	100
Paper II (B)	Special II	Agricultural and environmental Microbiology	3	40	100
Paper II (C)	Special III	Cell and Molecular Biology	3	40	100

Note:

Every student, who has been enrolled in Ph.D. Course, shall have to deliver two Departmental seminars on his/her Ph D topic. Seminar will be of about 45-minutes duration. The presentation will be followed by questions session by the audience. Every student shall be required to submit the synopsis of the topic of his/her seminar duly certified and forwarded by the supervisor to the Head & Chairperson BOS of the Department so that the same can be displayed on the notice board

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FACULTY OF SCIENCE
Microbiology
Pre Ph.D. EXAMINATION
Model Question Papers
Paper: I/II

Time: 3 Hrs Max. Marks: 100

Note; i .**Answer ALL questions**
ii. All questions carry equal marks

1. **Writ short notes on :** (ONE question is to be set from each unit)
Each question carries 4 marks **4 x 5 = 20**

a) **Question from Unit I**
b) **Question from Unit II**
c) **Question from Unit III**
d) **Question from Unit IV**

(TWO questions are to be set from each unit)
Each question carries 16 marks **4 x 20 = 80**

2. **From Unit I**
a)
or
b)

3. **From Unit II**
a)
or
b)

4. **From Unit III**
a)
or
b)

5 **From Unit IV**
a)
or
b)

15. Rastogi. Bioinformatics Basic skills and applications
16. Gibas C, Jambeek P., Developing bioinformatics in computer skills, 2001. Oreilly & associates inc. Shrott publishes.
17. Sundar Rao, P.S.S, Richard, J An Introduction to Bio statistics. A manual for students in health science practice. - Hall Pub.
18. Beier, F.K., Crespi, R.S. and Straus, T., Biotechnology and Patent protection, 1985, Oxford and IBH Publishing Co, ND.
19. Singh K, Intellectual Property rights on Biotechnology, BCIL, New Delhi
20. www.ipr-helpdesk.org/
21. www.patentoffice.nic.in/ipr/patent/patents.htm
22. www.bangalorebio.com/GovtInfo/ipr.htm
23. Davis, G.B. and C.A. Parker Writing the doctoral dissertation. Barrons Educational series,2nd edition,1997 ,160.
24. Duncary, P.Authoring a PhD, thesis: how to plan, draft, write and finish a doctoral dissertation, 2003. Macmillan, pp 256.
25. Martha Davis Scientific courses and presentations, , 2005. Academic press, Tokyo.pp.356
26. Robert A. Day How to write pub a scien COURSE 5thed, the Oryx Press, 88 West Port, CT06881, pp.275
27. Traylor, Fredric & Koch, Biosafety, 2002. Michigan sate University pub., USAContemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wardsworth Pub. Co. Belmont, California
28. Manual of patent practice and procedure. IPR India, 2005. Ministry of commerce and industry, New Delhi, pp.163.
29. John.A.Thomas Biotechnology and safety assessment, , 2004
30. Young, Tomme Genetically Modified Organisms: A Guide to Biosafety Tzotzos, George
31. Sue Carson, Dominique Robertson *Manipulation and Expression of Recombinant DNA*, 2nd Edition
32. Hegde M N A course book on Scientific and professional writing for Speech- language pathology 3 edition. An outline of scientific writing (for researchers with English as a foreign language) Jen Tsi Yang, World scientific pub.
33. Stephen EliasAn Patent, Copyright & Trademark: An Intellectual Property Desk Reference (Author), Richard Stim
34. Shiv Sahai Singh Law of Intellectual Property Rights
35. Indian Patent Law: Legal and Business Implications
36. Ajit Parulekar, Sarita D'Souza Bioethics and Biosafety in Biotechnology V Sree Krishna
37. WHO Laboratory manual 3rd edition 2004. Laboratory Biosafety and Biosecurity Guidance
38. Young, Tomme Genetically Modified Organisms: A Guide to Biosafety Tzotzos, George
39. Sue Carson, Dominique Robertson *Manipulation and Expression of Recombinant DNA*, 2nd Edition
40. Michae Alley 1st edition, 2003 The craft of scientific presentations critical steps to succeed and critical errors to avoid-

B. **Biostatistics:** Applications in biology, sampling techniques-; Probability, normal, binomial and poisson distribution. Chi-Square test, test of goodness of fit, null hypothesis. Analysis of variance (ANOVA): Methods of ANOVA, one way and two way classifications, F-test, Correlation: Methods of studying the correlation, types of correlations. Regression: types of regression analysis, methods of studying regression and importance of regression. Importance of statistical software in data analysis (COSTAT and STATISTICA).

Unit – IV: Biophysical techniques

A. **Chromatography and electrophoresis techniques:** Preparation of buffers, principles of centrifugation and ultracentrifugation. Chromatography : paper, thin layer and column chromatography, ion exchangers, molecular sieves, affinity columns, Gas chromatography (GC) and High performance liquid chromatography (HPLC). Electrophoresis – Different methods of electrophoresis for proteins and nucleic acids. Identification of microorganisms – G+C content, RFLP, AFLP, 16S r-RNA and 18S r-RNA sequence analysis.

B. **Principle of biophysical methods:** Methods used for analysis of biopolymers X ray diffraction (XRD), fluorescence, UV, visible, IR, NMR and ESR spectroscopy and biological applications of mass spectrometry. Principle of radioactive isotopes, autoradiography southern, northern and western blotting techniques. Automatic analyzer for amino acids, protein sequencer, peptide synthesizer and nucleic acid synthesizer. Theory of lyophilization and its applications in biological systems.

Recommended Books

1. Woese,C.R.,Kandler,O. and M.L.Wheelis 1990 Towards a natural System of organisms: Proposal for the Domains Archea, Bacteria and Eucarya. *Proc. Nati, Acad, Sci.* ,87: 4576- 4570
2. Madigan,M.T.,J.M.Mrtinko and J.Parker 2000 Brock Biology of Microbiology IX Ed .Prentice Hall International, Inc.
3. Prescott, L.M., J.P Harley and D.AKlein, 2007 Microbiology VII Ed.Mc Grow Hill,
4. Davis R.Y. E.A. Adeberg and J.L. Ingram,1991 General Microbiology
5. Stainer General Microbiology, V Ed., Printice Hall of India Pvt,Ltd. New Delhi
6. Ronald M. Atlas 1997. Principles of Microbiology. II Ed. Mc Graw Hill Pub.
7. Alexopoulos CJ et al, Introductory Mycology 4th Edition
8. Cotterill, R.M J. 2002 Biophysics An Introduction, John Wilely and Sans England.
9. Nolting, B. 2006 Methods in Modern Biophysics II Ed. Springer, Germany.
10. Holme. D.J. and H. Peck. Analytical Biochemistry.
11. A.Upadhyay, K.Upadhyay and N. Nath 2006 Biophysical Chemistry, Principles and Techniques Himalaya Pub. House.
12. Slater, R.J. 1991 Radioisotopes in Biology. A practical Approch, IRL Press, Oxford.
13. Holler, F.J.,D.A.Skoog and S.R.Crouch, 2007 Principles of Instrumental Analysis IV ED.Thomson, Brooks/Cole Pub. US
14. Malhan . . N, P .K. Himalaya Publishing House. Bio statistics, Arora .P, Mani and Vijayaraj Bioinformatics for the beginners.

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Paper II (A): Microbial Technology

Unit –I

A. **Bioprocess technology:** Introduction to biotechnology and biochemical engineering, bioprocess techniques, biotechnology products. Raw materials used for Industrial fermentation and its processing. Industrially important strains – Isolation, screening and preservation, inoculum development – scale up of process, strain improvement methods; Types of fermentations-submerged and solid state fermentations, scale up of bioprocess.

B. **Bioreactors:** Bioreactors in bioprocessing of cells and enzymes, biosensors in bioprocessing, multi interacting microbial bio-processing, variables in bioprocessing. Type of fermenters, design and operation of fermenters, criteria for selection of a reactor, recent advances in yeast bioprocessing.

Unit-II

A. **Microbial engineering:** Medium optimization and sterilization, Basic concepts in media formulation – standardization of growth limiting nutrients in designed medium – Media for cell growth and product formation. Media optimization.

B. **Stoichiometry of bioreaction and energetics of microbial growth**, yield coefficients, Growth stoichiometry and elemental balances, productivity and their correlation with the stoichiometry. Immobilization and cell culture – cell immobilization, enzyme immobilization. Bioinstrumentation and computer control of fermentation processes.

Unit-III

A. **Bioseparation Technology:** Importance of downstream processing (DSP) in biotechnology, characteristics of products, criteria for selection of bio-separation techniques. Principles of precipitation, solid- liquid separation; filtration; sedimentation and centrifugation.

B. **Evaporation:** Theory of evaporation, multiple effects of evaporation, efficiency of evaporators, evaporation equipment. Crystallization: principles of crystallization, crystallization equipment and its applications in bioprocessing. Drying methods, principles of drying, types of industrial dryers, membrane separation processes: chromatographic and electrophoretic separation methods.

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Unit-IV

A. **Extraction:** Liquid-liquid extraction; extraction process and principles, batch and continuous extraction, co-current and counter current extraction processes. Various cell disruption methods, cell disruption for intracellular products, cell disruption equipment. Applications in bio-processing.

B. **Industrial production** of biopesticides, biofertilizers, biopolymers, biosurfactants, vaccines. Engineering and social considerations for the production of r-DNA products; safety, good laboratory and manufacturing practices. Fermentation economics - market potential, some effects of maintenances; legislation on production of antibiotics and recombinant proteins.

Recommended Books

1. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
2. Stanbury P.F, Ehitaker H, Hall S.J (1997) Priciples of Fermentation Technology., Aditya Books (P) Ltd.
3. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers
4. Patel, A.H. Industrial microbiology
5. Peppler & Pearlman .Microbial Technology Vol I & Vol II .
6. Prescott & Dunn, Industrial microbiology,
7. Prescott & Dunn's Fundamentals of Applied Microbiology (2nd edition)
8. Shuler,M.L., AND F.Kargi Bioprocess engineering, Prentice Hall of India
9. Stanbury, P.F. Whitaker.A and S.S 1995 Principle of Fermentation Technology 2nd Edition
10. Tampion & Tampion Immobilized cells: Principles and Application
11. Thoma Industrial Microbiology
12. Walker, G.M. 1998 Yeast physiology and Biotechnology Wiley
13. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd. 2001.

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Paper II (B): Agricultural and Environmental Microbiology

Unit I

A. **Disease resistance in plants** – Mechanism of resistance, biochemical basis of resistance, systemic and localized acquired resistance, PR proteins, gene-to-gene resistance (horizontal and vertical). Polycyclic and monocyclic diseases, implications of epidemiological concepts for disease management and disease forecasting. Management and storage of agricultural products; post-harvest diseases- prevention and control.

B. **Biological control of crop pests and diseases** - The Integrated Pest Management (IPM). Biotechnological approaches in IPM. IPM in major crops. Methods of gene transfer in plants, Bt-genes and the resistance in insects. Molecular diagnostics of plant diseases; Achievements and recent developments in genetic engineering in agriculture.

Unit II

A. **Biofertilizers**: *Rhizobium, Azospirillum*, *Azotobacter*, Cyanobacteria, Mycorrhizae and Actinorrhiza - Screening and selection, commercial production, quality control and performance of biofertilizers. Production improvement processes (strain improvement); Biofertilizer for sustainable agriculture.

B. **Microorganisms as biopesticides** - Structure and characteristics of the following: *Trichoderma, Beauveria, Metarrhizium, Nomuraea, Bacillus thuringiensis* and NPVs - Applications, advantages and limitations of biopesticides. Mode of action, Biopesticides in seed treatment and soil amendments. Principles and mechanism of biological control; Role of biopesticides in sustainable (organic) agriculture.

Unit III

A. **Bio-monitoring of aquatic environment**, Biological indicators, Biosensors, and genosensors. Role of organic pollution in water quality, algal blooms, pollution indices (Odum, Nygaard, Palmer, Margalef, Kothe), Concepts of C-BOD, N-BOD and COD, Oxygen sag curve. General characteristics of industrial waste-water coming from sugar and paper and pulp industries.

B. **Water Microbiology:** Disinfection of drinking water physico-chemical methods (UV, ultra sounds, chlorination and ozonation); Coliform test of potable water, MPN. Primary treatment of wastewater; treatment of industrial effluent by aerobic treatment methods. Methods of anaerobic treatment of sludge. Biotechnological approaches for recovery of useful products from sewage and industrial wastes, Water- borne risks to human health.

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reporter genes, DNA microarrays, DNA foot printing, DNA finger printing, chromosomal walking, jumping. Single strand conformation polymorphism, restriction fragment length polymorphism (RFLP),amplified ribosomal DNA restriction analysis (ARDRA),automated ribosomal spacer analysis (ARISA)

B. **PCR technology**, different versions of PCR and their applications. Metagenomics - principle, methodology, applications. Model organisms in research and their contributions-phages, bacteria, yeast, *Neurospora crassa*, *Caenorhabditis elegans, Drosophila*, mice, *Arabidopsis.*

Recommended Books

1. Voet Donald and Voet J.G. 3rd Edition, Biochemistry, John Wiley and sons INC
2. White.D. 2000 The Physiology and Biochemistry of Prokaryotes- Oxford University press
3. Lehninger A.L.Cox and Nelson-2006, 4th Edition, Principles of Biochemistry-CBS Publishers and Distribution Pvt. Ltd.
4. Brown, T.A. 1999 Gene Cloning. 3rd Edition. Chapman and hall Publications, USA.
5. Chirikjian, J.G. 1995 Biotechnology-theory and Techniques, Vol-II, Jones and Burtlett Publishers.
6. Glick, B.R and Pasternak, J.J. 1998 Molecular Biotechnology-Principles and Applications of Recombinant DNA, ASM Press, Washington D.C.
7. Lewin, B. 2008 Genes IX. Oxford University press, Oxford.
8. Winnacker, E.L. 1987 From Genes to Clones: Introduction to gene technology. V.C.H Publications, Federal Republic of Germany.
9. Molecular Biology of Cell. Albert *et al*., 4th Edition Garland Publishing Inc.
10. Maloy, S.R., Cronan, J.R. Freifelder, D. 1994 Microbial Genetics, Jones and Bartlett Publishers.
11. Snyder, L. and Champness, W. 1997 Molecular genetics of Bacteria. ASM press USA.
12. Old, R.W. and Primrose, S.B. 1994 Principles of Gene Manipulation, Blackwell Science Publication.
13. Ram Reddy S, Venkateshwarlu K and Krishna Reddy V. 2007. A text Book of Molecular Biotechnology. Himalaya Publishers, Hyderabad.
14. Pavan Kumar P, Kishore N and Ram Reddy S (2009) *In* A Text book of Biotechnology Ed.Chauhan AK and A. Varma. IK International Publishing House Pvt. Ltd.
15. Kirk, J.L., Beaudette, L.A., Hart, M., Moutoglis, P., Klironomos, J.N., Lee, H. and Trevors,J.T. (2004). Methods of studying soil microbial diversity. J Microbiol. Methods, 58: 1669-1688

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Paper-II(C): Cell and Molecular Biology

Unit-I

A. **Cell organization:** Biology of prokaryotic and eukaryotic cells. Structure, function and biosynthesis of cell walls and cell membranes. Intracellular transport of small molecules, cell communications, quorum sensing, signal molecules and signal systems. The mechanism of cell division and cell cycle-check points.

B. **Structural and functional diversity of proteins**. Protein isolation, chromatographic separations, electrophoresis, ultracentrifugation, protein sequencing methods, protein folding, structure prediction, protein engineering.

Unit-II

A. **Metabolic pathways**, experimental approaches to study the metabolism, regulation and control of glycolysis, citric acid cycle, ATP synthesis. Regulation of fatty acid metabolism, energy metabolism – interrelationship between carbohydrate, protein and lipid metabolisms. Aerobic, anaerobic and fermentative metabolisms in microorganisms.

B. **Secondary metabolism:** significance of secondary metabolism in microorganisms-significance, biosynthetic pathways of secondary metabolites- non-ribosomal peptides, β-lactam, polyketides, isoprenoids etc.

Unit-III

A. **Diversity of genomes in prokaryotes and eukaryotes.** Methods of DNA sequencing, molecular aspects of recombination in bacteria, regulation of gene expression. Mutations: Physical and chemical mutagens, mutation screening techniques, Site directed mutagenesis, genetic tools- transposons and plasmids, retroviruses and retroposons.

B. **Global regulatory mechanisms**-catabolite sensitive operons. Lac and Tryptophan operons, regulation of nitrogen assimilation, virulence genes, heat-shock proteins, ribosome and t-RNA synthesis, microarray and proteomic analysis of regulatory networks.

Unit-IV

A. **Tools and techniques used in molecular biology**-restriction enzymes, cloning-vectors, ligation, transformation, selection of recombinants-blue and white selection, blotting techniques. Fluorescent *in-situ* hybridization (FISH), whole cell *in situ* hybridization,

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Unit IV

A. **Microbial remediation and biodegradation of solid-wastes** - Disposal of domestic and municipal, solid-wastes. Role of microorganisms in the recycling of waste materials; Immobilization of microbial cells/enzymes and their use in various processes. Degradation of lignocellulosic waste, hemicellulose and chitin; Bio-composting, Biogas and biodesulpherization in environmental management.

B. **Microbial technology and Environment-Bioremediation:** degradation of xenobiotics and genetic engineering of biodegradative pathways. Biomarkers (DNA damage, strategies for biomarker use and evaluation). Synthesis of commercial products using microbial systems: Biopolymers- xanthan gum and PHA's (Bioplastics). Genetically modified microbes in the environment. Biosensors and biochips.

Recommended Books:

1. Text Book of Environmental Microbiology – Pradipta K. Mohapatra
2. Soil Biotechnology – Lynch J.M.
3. Plant disease resistance – Vander Plank
4. Microbial Ecology – Atlas & Batra
5. Environmental Biotechnology – Gilbert S.Omen
6. Anaerobic Treatment of Sewage – Michael S. Switzenbaury
7. Environmental Microbiology – Ralph Mitchell
8. Biodeterioration of non – aromatic compounds – Spani J.C.
9. Biological Control of Plant Pathogens The Plant Health Instructor, Pal, K. K. and B. McSpadden Gardener, 2006.
10. Molecular diagnosis of plant disease, AI/n. Rev. Phytopathol. 1988. 26:409-32.
11. Chemistry of Water & Microbiology – N.F. Voznaya
12. Microbial Technology – Microbial Processes – 2nd Edition, Peppler Periman
13. Systemic Acquired Resistance, W.E. Durrant and X. Dong, Annual Review of Phytopathology, 2004. 42:185–209.
14. Integrated pest management, semiochemicals and microbial pest-control agents in Latin American agriculture - Luis C. Rodrıguez, Hermann M. Niemeyer.
15. Waste Water Treatment - Metcalf & Eddy
16. Plant pathology- Agrios, G.N. 4th edition Academic press, San Diego.
17. Plant pathology and plant pathogens- Lucas, J.A., 3rd edition. Blackwell Science, Oxford.
18. Diseases of crop plants in India – Rangaswami G, 3rd edition. Prentice Hall of India, New Delhi.
19. Plant diseases management - Singh, R.S, Oxford & IBH, New Delhi.
20. Disease Management, Encyclopedia of Plant Pathology – O.C. Maloy and T.D.Murray, Wiley, New York, Maloy, 1993, 351-356.
21. Pathogenesis–related proteins in plants – S.K. Datta, Subbaratnam Muthukrishnan, CRC Press Editor.
22. Principles of Plant Disease Management- Jacobsen, B., Academic Press, New York, 2001.
23. Plant Pathology- Mehrotra R.S., Tata McGraw-Hill Limited

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