

M.Phil., Microbiology 2020-2021

<i>Sem</i>	<i>Course Code</i>	<i>Course</i>	<i>Course Title</i>	<i>Hours / Week</i>	<i>Credit</i>	<i>Internal Marks</i>	<i>External Marks</i>	<i>Marks</i>
I	20MPMB1CC1	Core I	Research Methodology	4*	4	25	75	100
	20MPMB1CC2	Core II	Advances in Microbiology	4*	4	25	75	100
	20MPMB1CC3	Core III	Teaching and Learning Skills	4*	4	25	75	100
	20MPMB1CC4	Core IV	Research Topic in Microbiology (Guide Paper)	4*	4	25	75	100
	*One hour library for each course							
TOTAL				16	16	100	300	400
II	20MPMB2PD		Dissertation##	-	8	-	-	200
	GRAND TOTAL				-	24	-	-

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPMB1CC1	Core – I	RESEARCH METHODOLOGY	4	4	100	25	75

Course Outcomes:

1. Describe the basic concepts of Research Methodology.
2. Identify the formats of publications in Research journals.
3. Explore the knowledge of Impact factor and Plagiarism.
4. Summarize the different types of microscopes, spectroscopic and chromatographic Techniques.
5. Acquire the knowledge of bioinformatics tools and Data analysis.

UNIT I

12 hours

Basic Concepts: Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; #Hypotheses of Research Purposes# - Research Design - Survey Research - Case Study Research. Sources of Data: Primary Data, Secondary Data, Procedure Questionnaire - Sampling Merits and Demerits.

UNIT II

12 hours

Writing Research Proposal: Developing an outline Preamble, the problem, specific aims, background and significance, hypothesis to be tested, study design, setup, measurement procedures, and analysis of data, #displaying preliminary data in tables, graphs and charts#. Report Writing- Prewriting considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals. Research proposal Grant- definition, structure, budget allocation, specific aims, background and significance. #Hierarchy of funding agencies in India and their operations

UNIT III

12 hours

Research Reports: Structure and Components of Research Report, editing and evaluation of final draft, evaluating the final draft, Good Research Report, observation and research report. Pictures and Graphs. H-index, i10 index, Impact factor, Plagiarism. Title and abstract for a given text - Choosing and indexing key words from a given paper- Writing the paper based on a given set of instructions to authors.

UNIT IV

12 hours

Biomolecule analysis: Basic Principles and application of Confocal, Fluorescent and Electron Microscopes. Spectrophotometer - principles and application UV-Vis, XRD, FT-IR and NMR Centrifugation-Preparative, Analytical and Density gradient centrifugation. Chromatographic Techniques-Theory and application of GC-MS Chromatography and HPLC. Electrophoretic Techniques: Theory and Application of SDS PAGE, #MALDI-TOF and Pulse Field gel electrophoresis (PFGE) #. Gel documentation and molecular weight analysis.

UNIT V

12 hours

Bioinformatics and Biostatistics: Genbank: Genbank flat file format-ASN.1, GCG, FASTA, EMBL, NBRF, PIR, SWISSPROT sequence formats, PDB format - NCBI, EMBL, DDBJ, UniGene, SGD, EMI Genomes. protein databases-PIR, SWISSPROT, TrEMBL, Prosite, PRINTS #Structural databases-PDB, SCOP and CATH#.

Biostatistics: Definition, Types of biological data, #Representation of biological data#. Measurement of central tendency; Measurement of dispersion; Data analysis – Student's t-test, Chi-square test, F-test, ANOVA, Correlation and Regression, Probability.

..... # **Self study portion**

Text Books:

T.B-1 Arunima Kumari, An Introduction to Research Methodology, Agrotech Publishing Academy, Udaipur, 2008.

T.B-2 N.Gurumani, Research Methodology for Biological Sciences, MJP Publishers, 2006.

T.B-3 Keith Wilson and John Walker, Practical Biochemistry - principles and techniques, Cambridge Press, New York, 1994.

T.B-4 David W Mount, "Bioinformatics: Sequence and Genome Analysis", 2nd Edition, CBS Publishers, 2004

T.B-5 A. Irfan , Khan and Atiya Khanum. Fundamental of Biostatistics, Ukaaz publishers, India,1994.

UNIT I Chapter II Section 2.1-2.8 **T.B-1**

UNIT II Chapter 4,5 & 6 **T.B- 2**

UNIT III Chapter 7 **T.B- 2**

UNIT IV Chapter 2,6,7,10 & 11 **T.B- 3**

UNIT V Chapter 13,15 &16 **T.B- 4&5**

Books for Reference:

1. C.R.Kothari, Research Methodology, Wiley Eastern Ltd., New Delhi, 1988.
L.R.Patki, L.Bhalchandra and I.H. Jeevaji, An introduction to microtechniques, S. Chand and Company Ltd., New Delhi, 1989.
2. S.R.Pennington and M.J. Dunn. "Proteomics from Protein Sequence to Function", Viva Books Ltd, 2002.
3. J.M.Wrigglesworth, Biochemical research technique - a practical introduction. John Wiley, New York,1984.
4. N.T. J. Bailey, Statistical Methods in Biology, English Univ. Press, 2010.

Web Reference:

1. <https://www.academia.edu> › Basic_Concepts_of_Research_Methodology
2. <https://www.scribbr.com> › Knowledge Base › Starting the research process
3. <https://www.slideshare.net> › vikasindian001 › research-report-ppt
4. <https://en.wikipedia.org> › wiki › Biomolecule
5. <https://www.slideshare.net> › biinoida › bioinformatics

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes :

Semester	Code	Title of the Paper					Hours	Credits		
I	20MPMB1CC1	RESEARCH METHODOLOGY					4	4		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓	✓		✓	
CO2	✓	✓		✓		✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓		✓	✓	✓	✓
CO4			✓			✓				✓
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓
Number of Matches= 35, Relationship : HIGH										

Prepared by:

1. DR. N. Packialakshmi

Checked by

1. Dr.P.Sivalingam
2. Dr.A.Khaleel Ahamed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPMB1CC2	Core – II	ADVANCES IN MICROBIOLOGY	4	4	100	25	75

Course outcomes

1. Acquire the knowledge and skill in sustainable microbial technologies.
2. Describe the depth of theoretical knowledge in vaccine development.
3. Examine the mechanisms of antibiotics common in human use.
4. Gain the comprehensive knowledge in gene manipulation.
5. Acquire specific knowledge of microbial-derived enzymes and their industrial applications.

UNIT I

12 Hours

Strategies in Bioconversion: Utilization of farm wastes and residues in agriculture – Microorganisms as a source of nutritive protein– SCP and Mushroom. Bioconversion of lignocelluloses into protein – rich food and feed. Composting of organic wastes, Production of biogas#. Bioengineering approaches to the bioremediation of compostable wastes- Microbial characteristics of composting process, Compost systems - Batch and continuous. #Approaches to Bioremediation. Environmental pollutants.

UNIT II

12 Hours

Vaccines Preparation and chemotherapeutic drugs: Vaccines; Vector vaccines; Naked DNA Vaccines; Biosynthetic and Chemically Synthesized vaccines; Subunit vaccine; Anti Idiotypic vaccines; Combination vaccines , Polynucleotide as vaccines . Preparation of Hepatitis B vaccine and Tissue Culture derived rabies vaccine and AIDS vaccine#. #Properties and mode of action of Antibacterial drugs: Sulpha drugs, Penicillins, Cephalosporins, Streptomycin, Tetracyclines, Chloramphenicol.

UNIT III

12 Hours

Genetic Engineering of Bacteria and Fungi: Methods for the genetic manipulation of Bacilli- gene expression. Genetic engineering of *Streptomyces* – methods of gene manipulation – gene expression –use of *Streptomyces* as a host for excretion of heterologous products. # Genetic Engineering of Filamentous fungi for industrial application - antibiotics and enzymes.

UNIT IV

12 Hours

Application of Microbes in Food industry: Starter cultures and their biochemical activities. # Production and application of Bakers Yeast, Bread, Cheese, Yoghurt and Soy sauce fermentation by Moulds. Fermented vegetables – Sauerkraut. Fermented Meat – Sausages Fermented beverages: Vinegar, Beer and wine. Application of microbial enzymes in food industry. Genetically engineered foods#.

UNIT V

12 Hours

Application of Enzymes and immunological method: Immobilization of Microbial enzymes- Properties, Methods, membrane confinement and their analytical, therapeutic and industrial applications. Biomedical application of immobilized enzyme. #Microbial enzymes in textile, leather, wood industries, detergents and clinical diagnostics#. Applications of immunological methods in bacteriology, virology, mycology, protozoology.

#..... # Self study portion Text Books

T.B -1 C.F. Forster and D.A. John Wase, Environmental Biotechnology. Edited by Ellis Horwood Ltd. Publication, 2008.

T.B -2 L. M. Prescott, John P. Harley and A. Donald Klein, Microbiology, 8th edn McGraw Hill Publishing company Ltd, 2011.

T.B -3 N.S. Subba Rao, Advances in agricultural microbiology. Oxford and LBH

publishing Co, 1982.

T.B -4 A.M Atlas and R. Bartha. Microbial ecology. Fundamentals and applications. An imprint of Addison Wesley Longmann Inc, 1998.

UNIT I Chapter 40 & 41 **T. B -2**

UNIT II Chapter 8 **T. B -1**

UNIT III Chapter 3 **T. B -3**

UNIT IV Chapter 11 **T. B -4**

UNIT V Chapter 5, 8 & 9 **T. B -1**

2. R.W. Old and S.B. Primrose, Principles of gene manipulation-An introduction to genetic engineering. 5th edition. Blackwell scientific publications. London, 1995.

Books for Reference

1. B.William Jakoby. Methods in Enzymology: Enzyme purification and related techniques. Edited by Academic Press, New York, 1988.

2. J. Soli Arceivala. Waste water treatment for pollution control. 2nd edition. Tata McGraw Hill publishing company Ltd, 1998.

3. San Diego. Biodegradation and Bioremediation. Academic Press, 2009.

4. G. Gregory, Vaccines: New generation Immunological Adjuvants. Series A: LifeSciences, 1995.

Web references

1. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/bioconversion>
2. https://www.who.int/vaccine_safety/initiative/tech_support/Vaccine-safety-E-course-manual.pdf
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5672523/>
4. https://www.researchgate.net/publication/47680774_Genetic_Manipulation_of_Streptomyces_Species
5. <http://www.fao.org/3/mg309e/mg309e.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes :

Semester	Code	Title of the Paper					Hours	Credits		
I	20MPMB1CC2	ADVANCES IN MICROBIOLOGY					4	4		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓		✓		✓	✓	✓	✓	✓	✓
CO3		✓	✓	✓	✓	✓				
CO4	✓		✓				✓			✓
CO5	✓	✓		✓	✓	✓	✓	✓	✓	✓
Number of Matches= 35, Relationship : HIGH										

Prepared by:

1. DR. P.Sivalingam

Checked by

1. Dr.N.Packialakshmi
2. Dr.A.Khaleel Ahamed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPMB1CC3	Core – III	TEACHING AND LEARNING SKILLS	4	4	100	25	75

Course Outcomes:

1. Acquire the knowledge on importance of computer and its application.
2. Examine how to use instructional technology effectively in a classroom.
3. Enable to have good communication in English
4. Develop the skills of ICT and apply them in Teaching Learning context and Research.
5. Identify the skills on behavioral technology and pedagogy of teaching.

UNIT I

12 Hours

Computer Application Skills: Internet –meaning – importance-types of networking-LAN, WAN, MAN-internet- website and webpage's, internet connectively – Browsing the internet-Browsing software-URL addresses, search engines, exploring websites and downloading materials from websites, power point-creating a presentation – #slide preparation-popular websites for data collection in Microbiology#, MS Excel – Statistical packages - SPSS.

UNIT II

12 Hours

Communication and Interaction: The theory of communication-communication cycle-Types of communication, communication and language, communication in the class room, #Lecture and Lecture demonstration as communication#. Interaction methods –Interaction analysis, observation schedule and record. Bale's interaction process categories – Flander's system of interaction analysis – #verbal interaction category system#. Reciprocal category system – Equivalent talk categories.

UNIT III

12 Hours

Education Skill: Psychology – Definition-Nature- Meaning of educational Psychology – Definition – Nature – Scope. Teaching and learning – meaning – characteristics – effective teaching – concept of learning – #comparison between teaching and learning#. Mental health – Frustration – concept of adjustment – Defense mechanism – #Mental hygiene#.

UNIT IV

12 Hours

Uses of Teaching Strategies: Group methods of instruction – lecture – demonstration – seminars – workshops – case analysis – panel discussion – team teaching - individual approaches – Teleconferencing – #Video conferencing# – Description – Advantages – Micro teaching – Characteristics of Micro teaching – Teaching skills – Programmed Instruction – ICT enabled teaching – #Language Laboratory#.

UNIT V

12 Hours

Educational Technology: Educational technology – definition – objectives – teaching technology – characteristics of teaching technology –behavioral technology – pedagogy of teaching – General advantage of using teaching aids – Broad classification of teaching aids – #Hardware and software in teaching aids#. Instructional media – media attribution – multimedia and instructional development – #Multimedia centre# – uses and abuses of multimedia.

..... # **Self study portion**

Text Books:

T.B-1 S.K. Kochhar, Methods and Techniques of Teaching, Sterling Publisher Pvt. Ltd. Publications New Delhi, 2004.

T.B-2 P.Sambasiva Rao and D. Bhaskar Rao, Techniques of Teaching Psychology, 2006.

T.B-3 K.Samath, A. Panner selvam and S.Santhanam. Introduction to Educational Technology, 4th ed., Sterling Publisher Pvt. Ltd, 2000.

UNIT I Chapter 9,13 & 14 **T.B-3**

UNIT II Chapter 3 **T.B- 3**

UNIT III Chapter 1 & 2 **T.B- 2**

UNIT IV Chapter 6 **T.B- 2**

UNIT V Chapter 7-9 & 12 **T.B- 1**

Books for Reference:

1. R.A.Sharma, Educational technology and management models media and methods. R. Lall Book Depot. Meerut, UP, 2007.
2. T.M.Srinivasan, Use of Computers and Multimedia in Education –Aavisakar Publication, Jaipur, 2002.
3. M.Vanaja, Educational technology –Neel Kamal Publication Pvt. Ltd. Hyderabad, 2004.
4. Zikr–ur Rahman, Modern teaching methods and techniques — Anmol Publication Pvt. Ltd. New Delhi,2006.
5. S.Robinson, Fundamentals of Education Psychology, 2nd ed - Ane Books Pvt. Ltd, 2008.

Web Reference:

1. https://en.wikipedia.org/wiki/Learning_management_system.
2. <https://www.slideshare.net/Vijirayar/communication-and-interaction->
3. <https://www.slideshare.net/maheshjajulwar/life-skill-education-50942560>.
4. <https://www.slideshare.net/joselinesantos3/selection-and-use-of-teaching>.
5. https://en.wikipedia.org/wiki/Educational_technology.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes :

Semester	Code	Title of the Paper					Hours	Credits		
I	20MPMB1CC3	TEACHING AND LEARNING SKILLS					4	4		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓		✓	✓	✓			✓
CO2	✓		✓	✓	✓				✓	
CO3		✓					✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches= 35, Relationship : HIGH										

Prepared by:

1. DR. N. Packialakshmi

Checked by

1. Dr.P.Sivalingam
2. Dr.A.Khaleel Ahamed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPMB1CC4	Core – IV	PHARMACOLOGY	4	4	100	25	75

Course Outcomes:

1. Describe the concepts of Pharmacology.
2. Identify the sterilization process in Pharmaceutical products.
3. Acquire the knowledge on t Chemotherapeutic agents.
4. Explain the process of upstream and downstream processing.
5. Examine the knowledge and skill on pharmacophore modeling.

UNIT I

12 Hours

Concepts of Pharmacology : Introduction: definition, historical perspective, branches and scope of the subject of pharmacology. #Nature and sources of Drugs#, Drug nomenclature and dosage forms, three routes of drugs administration, advantages and disadvantages of different routes.

UNIT II

12 Hours

Sterilization of Pharmaceutical Products: Physical methods-Thermal methods, Radiation methods and Filtration methods. Chemical methods- Gaseous method. #Pharmaceutical importance of sterilization#, Pharmaceutical in process control.

UNIT III

12 Hours

Pharmacology of Chemotherapeutic Agents: Introduction and basic principles of chemotherapy of infection, #infestation and neoplastic diseases# and concepts of resistance to chemotherapeutic agents, Sulfonamides, Quinolones, Aminoglycosides, Tetracycline and chloramphenicol.

UNIT IV

12 Hours

Upstream and Downstream processing: Upstream processing-Batch, fed-batch and continuous processing. Downstream processing –Biomass-product separation, product purification, concentration stability, #FDA approval product licence#, marketing and sales.

UNIT V

12 Hours

Drug designing: Current drug designing process, role of protein structure in modern pharma drugs, structure based drug design, protein therapeutics, cytokines, #Receptors based drug design#, docking, search algorithms and scoring functions, pharmacophore modeling.

..... # **Self study portion**

Text Books:

T.B-1 Kar Ashutosh, “Pharmaceutical Microbiology”, New age international Ltd, New Delhi, 2007

T.B-2 W.B. Hugo and A.D.Russell, “Pharmaceutical Microbiology”, 7th Edition, Blackwell science Ltd, Oxford, UK, 2007

T.B-3 S.P. Vyas and V.K Dixit, Pharmaceutical Biotechnology. CBS Publishers and distributors, New Delhi, 2010.

UNIT I Chapter I Section 1.2.1–1.2.9. **T.B-1**

UNIT II Chapter VII Section 7.1-7.5. **T.B- 1**

UNIT III Chapter VIII-XIV. **T.B- 2**

UNIT IV Chapter XXI **T.B- 2**

Books for Reference:

1. R.Ananthanarayanan and C.K.J. Panikar, Text Book of Microbiology, 6th Edition, Orient Longman, 2000.
2. L.E.Casida, Industrial Microbiology. Wiley Eastern Limited, New Delhi, 1997.
3. C.K.Kokatae , A.P. Purohit and S.B.Gokhale, Pharmacognosy, 31st Edition. Nirali Prakashan, 2008.
- 4.H.P.Rang, M.M. Dale and P.K.Moore, Pharmacology, 5th Edition. Churchill, Livingstone, 2004.

Web Reference:

1. <https://www.slideshare.net/nirjhoraslam/basic-concept-of-microbiology>.
2. <https://www.slideshare.net/saivivekkosaraju/sterilization-methods-3240>.
3. https://www.amboss.com/knowledge/Chemotherapeutic_agents.
4. <https://en.wikipedia.org/wiki/Bioprocess>.
5. <https://www.pharmatutor.org/articles/drug-designing-review>.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes :

Semester	Code	Title of the Paper					Hours	Credits		
I	20MPMB1CC4	PHARMACOLOGY					4	4		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓			✓			✓	✓
CO2	✓			✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓		✓		✓	✓	✓	✓
CO5		✓	✓	✓	✓	✓		✓		✓
Number of Matches= 36, Relationship : HIGH										

Prepared by:

1. DR. N. Packialakshmi

Checked by

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Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20MPMB1CC4	Core – IV	MICROBIAL NANOTECHNOLOGY	4	4	100	25	75

Course Outcomes:

On successful completion of this course students are able to

1. Describe the Microbial characteristics and growth kinetics.
2. Examine the basic concepts of nanotechnology.
3. Acquire the knowledge about the applications of nanotechnology in biomedical science.
4. Analyse the concepts and characterization of of nanoparticles .
5. Identify the environmental, social and economic issues encountered in nanotechnology.

UNIT I

12 Hours

Microbial Characteristics- Microbial life: Prokaryotes, Eukaryotes, Archeas & Protozoa- Structure of microbial cell: Spore, cell wall, flagella, cell membrane, capsule, pilli- Characteristics of aerobes, anaerobes, cyanobacteria, actinomycetes. Nutrition, Metabolism, Growth media, propagation, Cell counting, Growth kinetics, Yield constants, #Growth- Synchronous growth #.

UNIT II

12 Hours

Introduction to nanotechnology: Historical perspectives, Opportunities and challenges of nanotechnology. Structural and functional principles of nanotechnology, #Characteristics and applications of quantum dots and fullernes#. Magnetic nano particles, Nano biosensors, Synthesis of Gold, Silver, Titania and Nano arrays.

UNIT III

12 Hours

Microbial nanotechnology: Microbial synthesis of Nanoparticles. Nanotechnology in human disease control. *In vitro* diagnosis. Medical applications of nanoparticles and nanosystems. Role of nanotechnology in Cancer treatment. Nano drug delivery - Biosynthesis of nanodrug delivery vehicles. #Conventional drug delivery and targeted drug delivery#.

UNIT IV

12 Hours

Characterization of nanoparticles: UV-Vis spectroscopy, Electron Microscopy – High-resolution transmission electron microscopy (HRTEM), Scanning electron microscope (SEM), Atomic Force Microscope (AFM), Energy Dispersive X-Ray spectroscopy (EDS), #X-ray diffraction (XRD) #.

UNIT V

12 Hours

Implications of nanotechnology: Health and safety implications from nanoparticles: Health issues- Environmental issues- Need for regulation- Societal implications: Possible military applications- Potential benefits and risks for developing countries- Intellectual property issues- Criticism of Nanotechnology- #Studies on the implications of Nanotechnology#.

..... # **Self study portion**

Text Books:

T.B-1 L. M. Prescott, J. P. Harley and D. A. Klein. Microbiology, 8th edition, McGraw Hill Publishing company Ltd, 2011.

T.B-2 K. K Jain Taylor and Francis, Nanobiotechnology Molecular Diagnostics: Current Techniques and Applications (Horizon Bioscience), 1st edition, Taylor & Francis Publication, 2006.

UNIT I Chapter I-III **T.B-1**

UNIT II Chapter I, III & IV **T.B-3**

UNIT III Chapter IV&V **T.B-2**

UNIT IV Chapter VIII **T.B-2**

UNIT V Chapter X & XI **T.B-3**

Books for Reference:

1. D. S. Goodsell, Bionanotechnology, John Wiley & Sons, 2004.
2. Bernd Rehm, Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures, Horizon Scientific Press. 2006.
3. D. E. Reisner and J. D. Bronzino, Bionanotechnology: Global Prospects, CRC Press, 2008.
4. E. Papazoglou and A. Parthasarathy, Bionanotechnology, Morgan & Claypool Publishers. 2007.
5. R. Brooker and E.Boysen, Nanotechnology. Wiley Publishing Inc., India, 2006.

Web reference:

- 1.<http://www.nap.edu/catalog/11907.html>
- 2.<https://www.elsevier.com/books/nanotechnology/ramsden/978-0-08-096447-8>
- 3.https://www.kth.se/social/upload/54062f97f2765416cecdfd74/HT14-IM2655_Lecture%201.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes :

Semester	Code	Title of the Paper					Hours	Credits		
I	20MPMB1CC4	MICROBIAL NANOTECHNOLOGY					4	4		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓		✓	✓	✓		✓	
CO2	✓		✓				✓	✓	✓	
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓			✓		✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓
Number of Matches= 38, Relationship : HIGH										

Prepared by:

1. Dr. N. Reehana

Checked by

1. Dr.P.Sivalingam
2. Dr.A.Khaleel Ahamed