ST. JOSEPH'S COLLEGE (AUTONOMOUS)

BENGALURU-27

DEPARTMENT OF MICROBIOLOGY

SYLLABUS FOR POSTGRADUATE COURSE

Re-accredited with 'A++' GRADE and 3.79/4 CGPA by NAAC
Recognised by UGC as College of Excellence

To be implemented from 2018 -19 Batch

SEMESTER	PAPER CODE AND TITLE	NO. OF TEACHING HOURS	NO. OF CREDITS	TOTAL MARKS
SEMESTER I				
THEORY				
Paper I	**MB 7118:** Microbial Diversity	60	04	100
Paper II	**MB 7218:** Cell Biology	60	04	100
Paper III	**MB 7318:** Microbial Genetics	60	04	100
Paper IV	**MB 7418:** Microbiological Techniques	60	04	100
PRACTICAL				
Paper I	**MB 7P$_1$:** Microbial Diversity and Cell Biology.	88	04	50
Paper II	**MB 7P$_2$:** Microbial Genetics & Microbiological Techniques	88	04	50
		TOTAL	**24**	**500**
SEMESTER II				
THEORY				
Paper I	**MB 8118:** Microbial Physiology	60	04	100
Paper II	**MB 8218:** Immunology	60	04	100
Paper III	**MB 8318:** Molecular biology	60	04	100
Paper IV	**MB 8418:** Food Microbiology	60	04	100
Paper V-A **(DE)**	**MBDE 8518:** Agricultural Microbiology	60	04	100
Paper V-B **(DE)**	**MBDE 8618:**Environmental Microbiology	60		
Note: Students can choose one of the departmental elective from Paper V-A or V-B				
PRACTICAL				
Paper I	**MB 8P$_1$:** Immunology and Microbial Physiology	88	04	50
Paper II	**MB 8P$_{2a}$:** Food & Agricultural Microbiology **MB 8P$_{2b}$:** Food & Environmental Microbiology	88	04	50
		TOTAL	**28**	**600**

SEMESTER	PAPER CODE AND TITLE	NO. OF TEACHING HOURS	NO. OF CREDITS	TOTAL MARKS
SEMESTER III				
THEORY				
Paper I	**MB 9118:** Recombinant DNA Technology.	60	04	100
Paper II	**MB 9218:** Medical Microbiology.	60	04	100
Paper III	**MB 9318:** Industrial Microbiology.	60	04	100
Paper IV	**MB 9418:** Biostatistics And Bioinformatics.	60	04	100
Paper V (OE)	**MBOE 9518:** Microbes and Us	30	02	35
	Industrial Visit	-	-	-
Note: Students choose open elective from other departments.				
PRACTICAL				
Paper I	**MB 9P$_1$:** RDT and Medical Microbiology.	88	04	50
Paper II	**MB 9P$_2$:** Industrial Microbiology.	88	04	50
		TOTAL	**26**	**600**
SEMESTER IV				
	MB 0418: Project Work	**360**	**12**	**300**
	IGNITORS/OUTREACH		**04**	
			16	
Total No. of Credits : 94				
KEY WORDS: DE – Departmental elective and OE – open elective				

DEPARTMENT OF MICROBIOLOGY

Semester	III
Paper Code	**MB9118**
Paper Title	**RECOMBINANT DNA TECHNOLOGY**
Number of teaching hrs per week	4 Hrs
Total number of teaching hrs per semester	60
Number of credits	04

Objective: This paper enables the students to understand the basic principles of recombinant DNA techniques, their usage and applications in designing transgenic organisms which is a need of the hour.

UNIT I

a. Introduction to genetic engineering **2**
b. Tools in genetic engineering:

DNA manupulative enzymes: **5**

Restriction endonucleases – Nomenclature, classification, enzyme catalysis and applications.

DNA Ligase - Types, enzyme catalysis and ligation strategies.

DNA modifying enzyme: Polynucleotidyl kinase, alkaline phosphatase and terminal nucleotidyltransferase. **1**

c. Cloning vectors: **12**

Plasmids (pBR322, pUC-8, pGEM3Z and Ti plasmid)

Bacteriophage (λ phage and M13 vectors)

Cosmids, phagemids, expression vectors, shuttle vectors, BACs and YACs, Excretion Vectors and Animal viral vectors (Adeno virus and retro virus).

Cloning and expression in bacteria and yeast.

UNIT II

a. Basic principles of gene cloning strategies. **2**
b. Transformation techniques: $CaCl_2$ mediated Transformation, Micro projectile **5** Bombardment, Microinjections, Electroporation, Liposome mediated transfer, and Agrobacterium mediated transfer**.**

UNIT III

Genomic and cDNA library construction and their applications. **4**

UNIT IV

Analysis of gene and gene products: **8**

Direct methods – Selection by Complementation or Nonsense separation and marker inactivation techniques.

Indirect methods – Restriction enzyme cleavage pattern, Hybridization techniques (Colony and Plaque hybridization), Blotting techniques, Chromosome walking, Detection of specific protein by invitro translation techniques, Immunological methods, Protein synthesis in mini cells and Maxi cells.

UNIT V

a. PCR – Gene amplification, Primer designing, optimization, variation in the PCR,types of PCR. **4**

b. DNA sequencing – Maxam Gilbert's method, Sanger, Coulsen's method, automated sequencing, next generation sequencing. Applications of sequencing **3**

c. DNA finger printing and its applications **2**

d. DNA Microarrays – Types , features and their application in the study of gene expression **3**

e. Chemical synthesis of oligonucleotides: Phosphodiesters, Phosphotriester, Phosphitetriester approaches, enzymatic synthesis of DNA and applications of synthetic oligonucleotides. **3**

UNIT VI

a. Applications of gene cloning and Ethics in Genetic Engineering: **4**

Applications of gene cloning in Medicine (Gene therapy), Agriculture (Transgenic plants – Insecticide resistant and herbicide resistant).

b. Safety of recombinant DNA technology : **2**

Restriction and regulation for the release of GMOs into Environment. Ethical, Legal, Social and Environmental issues related to rDNA technology.

NOTE: 8 hours of self study assigned from the above units.

REFERENCES:

1. Brown, T.A. 2000, Gene Cloning, fourth edition, Chapman and Hall Publication, USA.
2. Lewin B., 2000, Genes VII, Oxford University Press, Oxford, U.K.
3. Old R.W. and Primrose S.B., 1996, Principles of Gene Manipulations, Blackwell Science Publications, London.
4. SandhyaMitra, 1996, Genetic Engineering, Mac Millar India Ltd., New Delhi.
5. Symonds N., A. Toussaint, P. Van De Putte, M.M. Howe, 1987, Phage Mu. Cold Spring harbor Laboratory.

6. Watson, J.D., N.H.Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner, 1998, Molecular Biology of the Gene, fourth edition, The Benjamin/Cummings Publishing Company Inc., Tokyo.
7. Winnaker E.L., 1987, From Gene to Clone: Introduction to Gene Technology, VCH Publications, Weinbem Federal Republic German.

BLUEPRINT

Code number: **MB 9118**
Title of the paper: Recombinant DNA technology

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter number
32	20	1
11	07	2
06	04	3
13	08	4
24	15	5
10	06	
96	**60**	Total
Maximum marks for the paper (Excluding bonus question) : **70**		

Semester	III
Paper Code	**MB 9218**
Paper Title	Medical Microbiology
Number of teaching hrs per week	4
Total number of teaching hrs per semester	60
Number of credits	4

Objective: Medical Microbiology seeks to empower students with knowledge and ability to promote human health.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 It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases and use their knowledge in clinical research.

UNIT I

Introduction to Normal human flora**.** **12**

Laboratory Management:- Safety in a microbiology laboratory.

Quality control in microbiology: - External and internal

Nosocomial infections: - Microbiology of hospital infections, common type of infections, diagnosis and control of infections, biomedical waste management quantity and types of biomedical waste and waste treatment.

Factors responsible for Microbial pathogenesis.

UNIT II

General characters, culture, antigenic structure, pathogenesis, laboratory diagnosis, epidemiology, treatment, management and control of important groups of pathogenic microorganisms **15**

BACTERIAL: *Staphylococci, Streptococci, Pneumococcus, Gonococci, Clostridia,Haemophillus, Vibrio,* Shigella, *Salmonella, M.tuberculosis, Pseudomonas, Leptospira, Treponema pallidum*

UNIT III

MEDICAL MYCOLOGY:

Classification of medically important fungi. **15**

Surface infections:-*Tinea versicolor,Tineanigra*and *.T. piedra*.

Cutaneous infections:-*Dermatophytes*.

Systemic:- Yeast – *Cryptococcus neoformans*

Yeast like fungi – *Candida sp*.

Filamentous fungi – *Aspergillus, Penicillium*

Dimorphic fungi – *Blastomyces dermatidis, Histoplasma capsulatum*

Parasitology: *Giardia, Plasmodium ,Entamoeba histolytica*,

Parasitic hooknoses:-*Toxoplasma, Taenia*.

UNIT IV

VIRUSES

DNA viruses – Herpes virus – HSV-1 and HSV-II, Hepatitis B virus. **12**
RNA viruses – Dengue, Chikungunya, Ebola, H1N1,HIV
Viral zoonoses – Japanese encephalitis, rabies,
OncogeneicViruses:-Properties of cells transformed by viruses, list of Oncogenic viruses, oncogenes and mechanism of viral oncogenesis.

UNIT V

Classification and mechanism of action of antimicrobial agents: bacteria, viruses, fungi and parasites). Methods of testing drug sensitivity. **AMR-TB, ESBLS** **6**

NOTE: 8 hours of self study assigned from the above units.

REFERENCES:

1. Ananthanarayanan and JeyaramPaniker C.K. Text Book of Microbiology, 8th edition Orient Longman, Chennai.
2. Chakraborty P., 1995 A Text Book of Microbiology, New Central Book Agency (P) Ltd., Calcutta.
3. Collee, J.G., A.G.Eraser, B.P. Marmion, A Simmons, 1996 Mackie and McCartney, Practical Medical Microbiology, fortieth edition, Churchill Lingstone.
4. Davis, B.D., R.Dulbecco, H.N. Eisen, H.S. Ginsberg 1990. Microbiology 4th edition Harper &Now publishers, Singapore.
5. Franklin T. J. and Snow G. A., (1975), Biochemistry of Antimicrobial Action, Chapman and Hall, London, 1-22 and 160- 174
6. Gale E. F., Cundliffe E., Reynolds P. E., Richmond M. H. and Waring M. J., (1972), The molecular basis of antibiotic action, John Wiley and Sons, London
7. Goldstein A., Aronow L., and Kalman S. M. (1969) Principles of Drug Action, The Basis of Pharmacology, Harper international edition New York 11.
8. Jawetz E, J.C. Melnic and E.A. Adelberg, 2001, Review of Medical Microbiology, Prentice Hall International Inc, USA.
9. Jawetz E, J.C. Melnic and E.A. Adelberg, Medical Microbiology, 24th edition, The McGraw- Hill companies.
10. Lorian V., (1986), Antibiotics in laboratory medicine, 2nd Ed, Williams & Wilkins Publication 5
11. Leslie collier, Balows A. and Sussman M. 2000 Topley& Wilson's Microbiology and Microbial infection vol. 1-5 Arnold Publishers, London.
12. Mandell, Dougles and Bennt's Principle and Practice of Infectious diseases 2000 vol. 1 &2 Churchill Livingstone.
13. Villanova, PA; NCCLS: 2002.National Committee for Clinical Laboratory Standards (now Clinical and Laboratory standards Institute, CLSI). Performance standards for antimicrobial susceptibility testing; 12th information supplement (M100-S1).
14. Villanova, PA: NCCLS, 1997.National Committee for Clinical Laboratory Standards (now Clinical and Laboratory Standards Institute, CLSI). Methods for dilution antimicrobial susceptibility testing for bacteria that grows aerobically. Approved Standards M7-A4.

BLUEPRINT

Code number: **MB 9218**
Title of the paper: Medical Microbiology

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter number
19	12	1
24	15	2
24	15	3
19	12	4
10	6	5
96		**Total**
Maximum marks for the paper (Excluding bonus question) - 70		

Semester	III
Paper Code	**MB 9318**
Paper Title	**INDUSTRIAL MICROBIOLOGY**
Number of teaching hrs per week	4
Total number of teaching hrs per semester	60
Number of credits	4

Objective: Industrial microbiology provides an understanding of the processes involved in the production of variety of biological products; including biopharmaceuticals, therapeutics, diagnostics, etc. with the help of microorganisms, the course discusses variety of aspects of fermentation ranging from the equipment utilised, types of microorganisms, genetic modifications of these organisms required, to standardization of the processes for a large scale production to subsequent downstream processing of the products. It also offers some practical experience of production at a laboratory scale.

UNIT- I

Concepts and scope of fermentation technology **1**

UNIT-II

a. Basic design and function of a fermenter. **7**
b. Types of fermenters: stirred tank fermenters, tubular fermenters, tower fermenters, air-lift fermenters, membrane bioreactors, photo bioreactors, disposable fermenters, fluidized bed fermenters.
c. Solid state fermenters: tray fermenters, drum fermenters.

UNIT-III

a. Media sterilization, sterilization of fermenter, sterilization of air supply. **11**
b. Aseptic inoculation methods, sampling methods, monitoring and control devices.
c. Fermentation media: media formulations, sources of carbon, nitrogen, vitamins and minerals.
d. Role of buffers, precursors, inhibitors, inducers and antifoam agents.
e. Development of inoculum for bacterial, fungal and actinomycetes.
f. Substrate for solid state fermentation
g. Power requirement, Oxygen transfer kinetics, Concepts of Newtonian and non Newtonian fluids, plastic fluids, apparent viscosities

UNIT-IV

Microbial growth kinetics: Batch, Continuous and Fed Batch culture. **6**

UNIT-V

a. Isolation, preservation and improvement of industrial microorganisms: **11**
Isolation methods, screening methods, preservation techniques, strain improvement,

protoplast fusion, parasexual cycle and recombinant DNA techniques.
b. Immobilization of enzymes and cells: methods, advantages and applications

UNIT-VI

a. Scale up of fermentation process: parameters used in scale up and problems associated with scale up. **8**
b. Downstream processing: objectives and criteria, foam separation, precipitation methods, filtration devices and filter aids.
c. Industrial scale centrifugation and cell disruption methods, liquid-liquid extraction, solvent recovery, chromatography, microfiltration, ultrafiltration, drying devices, crystallization and whole broth processing.

UNIT VII

MICROBIAL TECHNOLOGY

a. Production of: alcohol-beer and ethanol; Organic acids- citric acid; Amino acids- glutamic acid; Antibiotics- penicillin; Vitamins- Vitamin B12; Enzymes- protease; Biopolymers-: xanthan gum **16**
b. Production of recombinant proteins- human insulin, interferon; Recombinant vaccine production - Hepatitis B vaccine; melanin biosynthesis in *E.coli*; Chymosinproduction in *E.coli* and yeast.

NOTE: 8 hours of self study assigned from the above units.

REFERENCES:

1. Casida, J.F. (1968). Industrial Microbiology. Wiley Eastern Ltd.
2. Cruger, W. and Crueger, A. (2000). Second Edition, Biotechnology: A Text Book of Industrial microbiology.,Panima Publishing Corporation, New Delhi.
3. Flickinger, M.C. and Drew, S.W. (1999). Encyclopedia of Bioprocess Technology, Biocatalysts and Bioseparation. Vol. V., John Wiley and Sons Publications.
4. Pepper, H.J. and Pearman, D. (1979). Microbial Technology.Vol.I Academic Press, New York.
5. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1995). Second Edition, Principles of Fermentation Technology. Aditya Book (P) Ltd., New Delhi.

BLUEPRINT

Code number: **MB 9318**
Title of the paper: **Industrial Microbiology**

Total marks for which the questions are to be asked (including bonus questions)	Number of Hrs	Chapter number
1	1	UNIT I
11	7	UNIT II
18	11	UNIT III
10	6	UNIT IV
18	11	UNIT V
13	8	UNIT VI
25	16	UNIT VII
TOTAL - 96	**60**	
Maximum marks for the paper (Excluding bonus question)= 70		

Semester	III
Paper Code	**MB 9418**
Paper Title	**Biostatistics and Bioinformatics**
Number of teaching hrs per week	4
Total number of teaching hrs per semester	60
Number of credits	4

BIOSTATISTICS

UNIT I

Samples and Population, Variables in Biology **10**
Sampling methods. Probability and non probability methods.
Frequency distribution
Graphic presentation of data-histogram, frequency curve and ogives
Measures of Central tendency – mean, median and mode
Measures of dispersion – range, mean deviation, standard deviation, standard error, variance.

UNIT II

Probability – addition and multiplication rules. Hayes theorem **10**
Probability distribution binomial, poison and normal.
Student "t" distribution.
Point estimation and interval estimation.
Estimating the population mean, known and unknown.
Wilcoxon signed Rank test
Null and alternate hypothesis
Two tailed and one tailed test
Chi-square test – test of independence, goodness of fit and homogeneity
Statistics related to Epidemiology

UNIT III

Correlation – definition, types and measurements of correlation. **10**
Regression analysis – equation, estimation of unknown value from known value.
ANOVA – one way and two way classification – Least significance difference (LSD)
Randomization – different ways of randomization – randomized blocks – latin squares.
Randomized blocks versus latin square.
Problems biologically based.
Software packages used in analyzing results. Graph pad prism , 2 way

REFERENCES:

1. Baxevanis, A.D., and Ouellette, B.F.F., 2001, Bioinformatics A Practical Guide to the Analysis of Genes and Proteins, Wiley – Interscience Publication, New York.
2. Bhaskararao, T 2001 Methods of Biostatics Paras publications, Hyderabad.
3. Gibas, C., and Jambeck, P., 2001, An Introduction to Software tools to Biological Applications Developing Bioinformatics Computer Skills, Shroff Publishers & Distributors Pvt. Ltd., Mumbai.
4. Gupta, S.P., 1987, Statistical Methods (sulton Chand and Sons Publishers, New Delhi).
5. Khan I.A and Khanum A. 1994 Fundamentals of Biostatics (UkaazPublcation, New Delhi).
6. Rashidi, H.H., and Buchler, L.K. 2000, Bioinformation Basics. Applications in Biological Science and Medicine, CRC Press, USA.
7. Reza Hoshmand, A. 1988, Statistical Methods for Agricultural Sciences (Timber Press, Oregon)
8. Schefler W.C. 1980 Statistics for the Biological Sciences (Addison – Wesley Publishing Company, New York).
9. Sokal, R.R. and Rohif F.J. 1987 Introduction to biostatistics (W.H. Freeman and Company, New York)

BIOINFORMATICS

UNIT I

Databases: Introduction to data bases-Relational databases- Oracle, SQL, Database generation, Sequence databases- Resources- Human Genome Project (HGP), Microbial genomes, structural databases- protein data Bank (PDB), Organization of databases, Navigation through databases **8**

UNIT II

Principles behind computational analysis, Sequence analysis, sequence alignment and phylogenetic analysis with reference to nucleic acids, identification of ORF'S, sequence analysis, sequence alignment, phylogenetic analysis with reference to proteins **7**

UNIT III

8

Protein Sequence Analysis - Introduction - Sequence Data Banks - Wbrf – Pir – Swissport - Databases, Data Mining - Algorithms Of Proteomics And Its Applications – Protein Expression Profilling - Protein - Protein Interaction - Protein Modifications. Automation - Nucleic Acid Data Bank – Embl Nucleotide Sequence Data Bank - Aids Virus Sequence Data Bank - Rna Data BanK.

UNIT IV

7

Tools For Data Bank - Pairwise Alignment - Needleman And WuschAlgorighm – Smith Waterman - Multiple Alignment - Clustral - Pras - Blast - Fast, Algorithms To Analyse Sequence Data - Pdb, Cambridge Structure Data Base (Lsd), 2d Electrophoresis, Ief, Hplc, Protein Digestion Technique, Mass Spectrometry, Maldi, Tof, Peptides, Mass Finger, Printing, Protein**.**

REFERENCES:

1. Bioinformatics 1998, baxavanis.
2. Bioinformatics 2000. Higgins & Taylor, OUP
3. Introduction to Bioinformatics-2002. Dhananjaya, www.sd.bio.com.series
4. Nucleic acid research, 2001. Jan. Genome Database issue
5. Taxali, R.K. 1991. dBase III Plus-Made Simple (Tata Mc-Graw-Hill Publishing Company Ltd., New Delhi).
6. Taxali, R.K., 2000, PC Software for Windows Made Simple (Tata McGraw-Hill Publishing Company Ltd., New Delhi).
7. Zar J.H. 1996. Biostatical Analysis (Prentice-Hall International, USA).

BLUEPRINT

Code number: **MB9418**
Title of the paper: **Biostatistics and Bioinformatics**

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter number
16	10	1 Biostatistics
16	10	2
16	10	3
13	8	1 Bioinformatics
11	7	2
13	8	3
11	7	4
96	60	Total
Maximum marks for the paper (Excluding bonus question) -70		

Semester	III
Paper Code	**MB 9518**
Paper Title	**Microbes and US**
Number of teaching hrs per week	2
Total number of teaching hrs per semester	30
Number of credits	2

Learning outcomes:

Microbes are tiny organisms, too tiny to see without a microscope, yet they are abundant on Earth. They live everywhere: in air, soil, rock, and water. Some live happily in searing heat, while others thrive in freezing cold. Some **microbes** need oxygen to live, but others do not. Though microscopic, one can't overemphasize the importance of microbiology. Society benefits from microorganisms in many ways. They are necessary for the production of bread, cheese, beer, antibiotics, vaccines, vitamins, enzymes, and many other important products. Indeed, modern biotechnology rests upon a microbiological foundation. In contrary to those microorganisms also have harmed humans, animals, plants and so on, and disrupted society over the millennia. Microbial diseases undoubtedly played a major role.

This elective draws our relationship closer to microbes. This relationship involves not only the beneficial effects but also familiarize us with the harmful effects of certain microorganisms. Here we will bring to you the ways microbes affect our lives by causing diseases. We will also try and learn the measures to be taken to prevent the spread of microbial diseases and if affected to treat them. We will also examine the use of microbes in commercial and industrial applications to produce food, chemicals and drugs, to treat sewage, control pests and clean up pollutants.

UNIT I

1. **MICROBIAL DIVERSITY** **2**
   Introduction to microbial biodiversity: distribution, abundance, ecological niche and types.

2. **THE HUMAN MICROBIOME** **2**
   Human Microbiota, Gut Microflora, Maintaining and replenishing the Gut Microflora.

UNIT II

3. **IMMUNITY**
   Overview of innate and adaptive immunity **3**

4. **INFECTIOUS DISEASE & PREVENTION**

a. Definition of infection and disease. **1**

b. **Classification of infections:** localized, generalized, endemic, epidemic, sporadic and pandemic. Classification of diseases as communicable and non-communicable with examples. **2**
c. **Sources of infection:** Air, humans, animals, insects, soil, water and food. **3**
d. **Methods of transmission of infection:** Contact, inhalation, ingestion. **2**
inoculation ,insects, congenital, iatrogenic and laboratory infections.
e. **Causes, prevention and treatment of infections /disease**: **5**
f. HIV, Tuberculosis, Malaria, Candidiasis and **1 recent outbreak**
g. Sterilization and Disinfection **1**
h. Vaccines and Immunization schedule **2**
i. Chemotherapy - Use and abuse **2**

5. MICROBIAL PRODUCTS: **5**
a. Microbiology of fermented milk products (acidophilus milk and yoghurt),
b. Microbiology of bread making and wine preparation
c. Insulin.
d. Compost.

REFERENCES:

1. Robert S. Burlage, Ronald Atlas, David Stahl, Gill Geesey, Gary Sayler, 1998. Techniques in Microbial Ecology, Oxford University Press. N.Y.
2. Atlas and Bartha; Microbial Ecology.
3. Nester *et al,* 2004, Microbiology a human perspective, Mac Graw Hill Higher education.
4. Prescott, Harley &Klein's,(2008), Microbiology, Mac Graw Hill Higher education.
5. Stalley, Jerome, Microbial life 2nd edition (2007), Sinauer Associates inc, Massachusetts.
6. Casida, J.F. 1968. Industrial Microbiology, Wiley Eastern Ltd., New Delhi.
7. Cruger, W. and Crueger, A. 2000. Biotechnology: A Text Book of Industrial Microbiology, Second Edition, Panima Publishing Corporation, New Delhi.

BLUEPRINT

Code number: **MB9518**
Title of the paper: Microbes and Us

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter number
03	02	1
03	02	2
05	03	3
29	18	4
08	05	5
48	**30**	**Total**
Maximum marks for the paper (Excluding bonus question) -35		

PRACTICALS

MB $9P_1$: MOLECULAR BIOLOGY, RECOMBINANT DNA TECHNOLOGY AND MEDICAL MICROBIOLOGY

Total: 120 Hours

2. Collection and processing of clinical samples for microbiological examination
3. Antimicrobial susceptibility tests.
4. Differential Staining techniques: AFB, Leishman's, Giemsa, Capsule, granules spores.
5. Isolation and culture of medically important Anaerobes.
6. $CaCl_2$ mediated gene transfer.
7. Isolation of plasmid DNA by column chromatography.
8. Restriction digestion of isolated DNA (single and double digestion).
9. DNA ligation
10. DNA amplification by PCR.
11. Gene elution.
12. Expression of cloned genes in *E.coli.*
13. Purification of proteins by affinity chromatography.
14. Southern blotting
15. Western blotting

REFERENCES:

1. Ausubel, F.M., 1997, Short Protcols in Molecular Biology, second edition, John Wiley & Sons Harvard Medical School.
2. Ausubel, F.M., Roger Brent, Robert E. Kingston, David A Moore, Seidman J.G., John A.Smith, Kelvin Stunho, 1992, third edition, Sheet Protocols in Molecular Biology, John Wilsey& Sons Inc., New York.
3. Bailey and Scott Diagnostic Microbiology .
4. Berger, S.I., R. Kimmel, 1987, Guide to Molecular Closing Techniques, academic Press Inc., New York.
5. Brown T.A. 1998, Lab – Molecular Biology Lab FAX – II Gene Analysis, second edition, Academic Press, UK.
6. Brown, T.A. 1998, Molecular Biology lab Fax II Gene Analysis, Academic Press, London.
7. Glover D.M. and B.D. Hames, 1995, DNA Cloning – A Practical Approach, Vol. – 4, IRC Press.
8. K.R.Aneja 2003,FouthEdition,Experiments in Microbiology ,Plant Pathology and Biotechnology.New age International (P) Ltd.
9. Rajamanekam.C Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
10. Sambrook, J., E.F. Fit sch, Maniatis, T., 1989, Molecular Cloning.. A Lab Manual Vol. III., second edition CSH Press, Cold Spring Harbour.
11. Sambrook, J., Fritsch, E.F., and Maniatis, T., 1989 second edition, Molecular Cloning 1, 2, 3 – A Laboratory Manual, Cold Spring Laboratory Press USA.

PRACTICALS
MB9P$_2$: INDUSTRIAL MICROBIOLOGY

Total: 120 Hours

1. Screening and isolation of industrially important microorganisms (Enzyme - protease, and antibiotic - Penicillin) and their preservation.
2. Production of protease (SSF) and its estimation.
3. Production of antibiotic (SSF) and its assay.
4. Production and estimation of wine using different substrates by *Saccharomyces cerevisiae.*
5. Batch production and estimation of citric acid.
6. Immobilization of cells by alginate method.
7. Sterility testing of pharmaceutical products.
8. Preparation of protoplast from bacteria and its fusion.
9. Clarification of banana juice using pectinase.
10. Demonstration of fermentation by using yeast.
11. Acetic acid oxidation(vinegar production) by *Acetobacter*.
12. Industrial visit.

REFERENCES:

1. K.R.Aneja 2003,Fouth Edition,Experiments in Microbiology ,Plant Pathology and Biotechnology.New age International (P) Ltd
2. Manual of Industrial Microbiology and Biotechnology, Demain et al., Wiley
3. Biochemical Engineering and Biotechnology Handbook, Atkinson, Grove' Dictionaries
4. James G.Cappuccino and Natalie Sherman 2013 Seventh Edition. Microbiology a Laboratory Manual Pearson.
5. Microbiological Examination Methods of Food and Water: A Laboratory Manual, by Neusely da Silva, Marta Hirotomi Taniwaki, Valéria Christina Junqueira, Neliane Silveira, Maristela da Silva de Nascimento , Renato AbeilarRomeiro Gomes.

SEMESTER IV

MB 0418: PROJECT WORK

Total: 360 hours
Credits: 12