

*Placed at the meeting of  
Academic Council  
held on 26.03.2018*

**APPENDIX - BK**  
**MADURAI KAMARAJ UNIVERSITY**  
*(University with Potential for Excellence)*

**M.Sc. Microbiology (SEMESTER)**

**REVISED SYLLABUS**

*(Effect from June 2018 onwards)*

**SCHEME OF EXAMINATIONS AND REGULATIONS**

**1. Introduction of the program**

This two year Masters of Science course in Microbiology deals with the advanced study of microorganisms comprising Bacteria, Fungi, Protozoans, Algae and Virus; and its association with the environment, plants, animals and humans. Candidates undertaking this curriculum will understand the advanced concepts of Microbiology including the benefits and harmful role of microorganisms in the production of commercially important products and in various diseases respectively. Concepts of Biotechnology and concepts of food microbiology included in this curriculum will help them in the future to face various industries. Host pathogen interactions noticed in the plant and the animal system is also included in the syllabus at the in-depth level, which will make them understand about various diseases and its treatment.

**2. Eligibility for admission:**

A candidate with 55% total aggregate in B.Sc. in Microbiology / Bio-Chemistry / Botany / Zoology / Biotechnology / Agriculture / B.Tech. in Biotechnology or any other relevant life science degree is eligible.

A candidate with 55% total aggregate in B.Pharm. / B.V.Sc. / M.B.B.S may also be considered for admission.

However the candidate should have undergone Higher Secondary examination (10+2) conducted by the Board of Higher Secondary Education, Govt. of Tamil Nadu or any other examinations accepted as Equivalent thereto by the syndicates subject to such conditions

- a) Biology/Physics/Chemistry as subjects in the Higher Secondary education.
- b) Candidates should have secured at least 60% in the above subjects individually and as total aggregates

A relaxation of 10% marks in the aggregate shall be given to SC/ST/Physically Challenged candidates.

### **2.1. Duration of the programme**

The students will undergo the prescribed course of study for a period of not less than two academic years (four semesters)

The maximum duration for completion of the PG Programme shall not exceed eight semesters.

### **2.2. Medium of Instructions of the programme: English**

### **3. Objectives of the Programme**

- To provide value based education, with academic excellence and advanced research.
- To inculcate the advanced concepts of Microbiology including taxonomy, physiology, Immunology, biomolecular interactions, genomics, proteomics and rDNA technology.
- To impart the scope for the application of concepts learned in the subject.
- To introduce about the recent advances in the field of Microbiology and its importance in research.
- To raise skilled candidates with research caliber in the field of Microbiology

### **4. Outcome of the Programme**

The scope of this course is wide which enables the candidate to get placed in diagnostics, pharma, fermentation, dairy, food and medical arena. This course also involves individual project dissertation work which enables the candidate to carry out independent research and make them understand all the troubleshoot in various experiments.

### **5. Core subject papers**

General Micro Biology, Cell Biology & Biochemistry, Agricultural & Environmental Microbiology,
Immunology, Molecular biology & Microbial Genetics, Fermentation Technology,
Microbial Bioremediation, Genetic Engineering, Bioinformatics
Research Methodology, Project and Viva – voce

### **6. Subject elective papers**

Medical Microbiology  
Genomics & Proteomics

### **7. Non-subject elective papers**

Applied Microbiology

## 8. Unitization

Subject code	Title of the Paper	Weekly contact hours	No. of credits	Examination Hours	Marks		
					Int.	Ext.	Total
	<b>I Semester</b>						
MS01	General Micro Biology	6	6	3	25	75	100
MS02	Cell Biology & Biochemistry	6	6	3	25	75	100
MS03	Agricultural & Environmental Microbiology	6	6	3	25	75	100
MS04	Practical – I	6	3	6	40	60	100
ME01	Medical Microbiology (T&P)	6	4	3	25	75	100
	<b>Total</b>	<b>30</b>	<b>25</b>				<b>500</b>
	<b>II Semester</b>						
MS05	Immunology	6	6	3	25	75	100
MS06	Molecular biology & Microbial Genetics	6	6	3	25	75	100
MS07	Fermentation Technology	6	6	3	25	75	100
MS08	Practical – II	6	3	6	40	60	100
NME01	Applied Microbiology	6	4	3	25	75	100
	<b>Total</b>	<b>30</b>	<b>25</b>				<b>500</b>
	<b>III Semester</b>						
ME02	Genomics & Proteomics (T&P)	6	4	3	25	75	100
MS09	Microbial Bioremediation	6	6	3	25	75	100
MS10	Genetic Engineering	6	6	3	25	75	100
MS11	Bioinformatics	6	6	3	25	75	100
MS12	Practical – III	6	3	6	25	75	100

	<b>Total</b>	<b>30</b>	<b>25</b>				<b>500</b>
	<b>IV Semester</b>						
MS13	Research Methodology	5	5	3	25	75	100
MS14	Project and Viva – voce	25	10		20	80	100
	<b>Total</b>	<b>30</b>	<b>15</b>				<b>200</b>
	<b>Grand Total</b>		<b>90</b>				<b>1700</b>

### 9. Pattern of semester exam

#### THEORY QUESTION PAPER PATTERN

Time: 3 hours

Max Marks: 75

#### Section A: (10 x 1 =10 Marks) (Answer all the Question; 1 to 10)

Question No 1 to 10

1. Two questions from each unit.
2. Four choices in each question.
3. Answer all questions. Choose the right answer.

#### Section B: (5 x 7 = 35 marks)

Answer all questions - Either Or types

Answer not exceeding two pages.

(One question from each unit)

#### Question Nos.

- 11a or 11b
- 12a or 12b
- 13a or 13b
- 14a or 14b
- 15a or 15b

#### Section C: (3 x 10 = 30 marks)

Answers not exceeding four pages

Answers any **THREE** out of Five (one question from each unit)

Question Nos.- 16-20

## PRACTICAL QUESTION PAPER PATTERN

Time: 6 Hours

Maximum Marks (University Exam) - 60

One Major Experiment	= 20 marks
One Minor Experiment	= 10 marks
Two spotters	= 05 marks
Record Book	= 05 marks
Viva Voce	= 20 marks

### Project evaluation: (MAX 100 Marks)

#### **External Maximum Mark (80 Marks)**

Dissertation work	= 60 marks
Presentation and viva	= 20 marks

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80 Marks  
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The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examinations. The practical examinations for UG course should be conducted at the end of the every semester.

### 10. Scheme for Internal Assessment

#### For Theory papers

- a) Two internal tests of 15 marks each: Average = 15 marks
- b) Group discussion/ Seminar/ Quiz = 05 marks
- c) Two assignments: 5 marks each: Average = 05 marks

#### For Practical papers

- a) Two internal tests of 25 marks each: average = 25 marks
- b) Observation book = 10 marks
- c) One assignment = 05 marks
- d) Internal Marks for the project (decided by the guide)= 20 marks

### 11. External Exam

Refer point 9.

## 12. Question paper pattern

Refer point 9.

## 13. Scheme for evaluation

### 14. Passing minimum

To get a pass, should fulfill the following conditions:

#### A) Theory:

1. 50% of the aggregate (External + Internal).
2. No separate pass minimum of internal
3. 38 marks out of 75 is the pass minimum for the External.

#### B) Practicals:

1. 50% of the aggregate (External + Internal)
2. No separate pass minimum for the internal
3. 30 marks out of 60 is the pass minimum for the External.

#### C) Project:

1. 50% of the aggregate (project evaluation + Viva-voce)
2. No separate pass minimum for the viva-voce
3. 40 marks out of 80 is the pass minimum for the project evaluation

### 14.1 Classification

S. No	Range of CCPA	Class
1	50 & above but below 60	II
2	60 & Above	I

## 15. Model questions

### Section A

Answer all questions (10X1=10)

1. According to Pasteur statements which one of the following is true

- a. Living organisms discriminate between stereoisomers
- b. Fermentation is a aerobic process

c. Living organisms doesn't discriminate between stereoisomers

d. Both a and b.

**2. Who demonstrated that open tubes of broth remained free of bacteria when air was free of dust.**

a. Abbc Spallanzani

b. John Tyndall

c. Francisco Redi

d. Pasteur

**3. In electron microscope, what material is used as an objective lense?**

a. Magnetic coils

b. Superfine glass

c. Aluminium foils

d. Electrons

**4. Meosomes are also known as**

a. Mitochondria

b. Endoplasmic reticulum

c. Plasmids

d. Chondroids

**5. Term vaccine was coined by**

a. Robert Koch

b. Pasteur

c. Needham

d. None of these

**6. The mode of reproduction which occurs in mycoplasma is**

a. Budding

b. Bursting

c. Binary fission

d. Binary fusion

**7. The bacterial pili mainly contain**

a. Carbohydrates

b. Lipids

c. Proteins

d. Minerals

8. **Sulphur oxidizing bacteria is**

- a. Alcaligenes
- b. Pseudomonas
- c. Thiobacillus
- d. None of these

9. **beta haemolytic bacteria is**

- a. Streptococcus pyogenes
- b. Str. pneumoniae
- c. Str. viridans
- d. Str. Faecalis

10. **Batch fermentation is also called**

- a. Closed system
- b. Open system
- c. Fed-Batch system
- d. Sub-merger system

**Section B:**

**Answer all questions (5 x 7 = 35 marks)**

11a. Write the contributions of Pasteur and Beijerinck.

Or

11b. Explain briefly the structure and functions of bacterial cell wall.

12a. Briefly explain the concept of containment facility.

Or

12b. Write a commonly used method for isolation of pure culture of bacterium.

13a. Distinguish between continuous and synchronous cultures.

or

13b. Distinguish between bacteria and mycoplasmas.

14a. Give a brief account of slime molds.

or

14b. Briefly explain the morphological features protozoa.

15a. Write a brief note on bioluminescence

or

15b. Explain Calvin cycle



## Section C

**Answer any three questions.(3X 10= 30)**

16. Give detail note on Bergy's system of bacterial classification
17. Discuss about early era of microbiology and major Scientist contributions
18. Explain about fungal classification
19. Describe the process of sporulation in *Bacillus*
20. Explain the microbes which live in extreme environments with suitable examples

### **16. Teaching methodology**

### **17. & 18. Text book & Reference books**

- 1) Prescott, Harley and Klein. 2006, Microbiology 6/e. The McGraw-Hill Companies.
- 2) Pelezar, M.J., Chan. E.C.S. and Kreig. N.R. 1993. Microbiology, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- 3) Schlegel. H.G. 1993. General Microbiology. Cambridge University Press, Cambridge.
- 4) Stainer. R.Y., Ingraham, Wheelis, M.G. and Paintor. P.R.1986, The Microbial World, Prentice Hall, New Jersey.
- 5) Tauro. P., Kapoor, K.K. and Yadav. K.S.1989, An Introduction to Microbiology, Wiley Publications. New Delhi.
- 6) Microbiology: A laboratory manual, P. Gunasekaran, New Age international publishers, 1996.
- 7) Laboratory manual in general microbiology, N. Kannan, Panima publishers, 2002.
- 8) Microbiology: A laboratory manual. J.G. Cappuccino and N. Sherman, Addison-Wesley, 2002.
- 9) Bergey's manual determinative bacteriology, J.G. Holt and N.R. Krieg. Lippincott Williams & Wilkin publishers, 2000.
- 10) Moat AG. Foster JW and Spector MP. Microbial Physiology. 4/e Wiley-Liss, 2002.
- 11) Prescott, Harley and Klein, Microbiology. 6/e The McGraw-Hill Companies, 2006.
- 12) Caldwell DR. Wm. Microbial physiology and metabolism. C Brown publishers, USA 2002.
- 13) J.C. Cappuccino and N.Sherman, Microbiology: A laboratory manual, Addison – Wesley, 2002.
- 14) M.T.Maigan, J.M. Martinko and J.Parkar, 2000. Brock Biology of Microorganisms, (9<sup>th</sup> edition), Prentice- Hall.
- 15) C.J.Alexopoulos and C.W.Mims 1979, Introductory Mycology (3<sup>rd</sup> edition) Wiley, New York.

- 16) L.W.Nester, C.N. Roberts and M.L.Nester 1995, *Microbiology – A Human Perspectives*, Iowa, USA.
- 17) R.Y.Stainer, J.I.Ingraham, M.L. Wheelis and P.R.Painter 1999 *General Microbiological*, McMillan Educational Ltd. London.
- 18) *Principles of Biochemistry*. Lehninger, AL. 1993 2<sup>nd</sup> edition, CSB Publishers.
- 19) *Outlines of Biochemistry*, 5/e - Conn. E.E., Stumpf, P.K. Bruening, G and Doi. R.H. John Wiley & Sons (1987)
- 20) *Biochemistry*, Voet. D and Voet. JG. 1990. John Wiley & Sons. NY.
- 21) *Text book of Biochemistry*. 2/e. Devlin. T.M. 1986. Wiley Medical Publications, NY.
- 22) *Biochemistry*, 2/e, Stryer. L. 1998, W.H. Freeman and Company, NY.
- 23) *Biochemistry*, 2/e. Zubay. G. 1998. McMillan Publishers NY. Collier McMillan Company Publishers, London.
- 24) *Enzymes. Ribozymes and DNAzymes*, P. Palanivelu, 2007, Twenty first Century Publications, Palkalai Nagar, Madurai - 625 021.
- 25) *Laboratory manual in biochemistry*, 5/e, J. Jayaraman, New Age international publishers, 1996.
- 26) *Principles of practical biochemistry*, K. Wilson and J. Walker, Cambridge University press, 2000.
- 27) *An Introduction to practical biochemistry*, D.T. Plummer. TATA McGraw Hill, 1997.
- 28) *Microbial Physiology*, 4/e, Moat AG, Foster JW and Spector MP. Wiley-Liss. 2002.
- 29) *Gene VII*. Benjamin Lewin, 2000: Oxford University Press.
- 30) *Molecular biology of the Gene*, 4/e. Watson, Hopkins, Roserts. Steits and Weiner, 1987, The Benjamin/Cumming Publishing Company, Inc.
- 31) *Molecular Genetics of Bacteria*, 2/e, Larry Snyder and Wendy Champness, 2003, ASM press. Washington DC.
- 32) *Microbial genetics*. David Friefelder, 1987, Narosa Publishing Mouse.
- 33) *Essential of immunology*, Roitt. I.M. 1998, ELBS, Blackwell scientific publication.
- 34) *Immunology*, 3/e. Kuby, J. 1997, W.H.Freeman and company. NY.
- 35) *Crueger, W. and A. Crueger (2000), Biotechnology, A Text book of Industrial Microbiology*. Panima Publishers, New Delhi.
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- 37) *Sambrook, J. Cold Spring Harbor laboratory (2002)*.
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- 39) Data basis in life sciences and Biotechnology: A directory - DBT, Govt. of India, March 1995.
- 40) Protein Structure Analysis - Springer Lab Manual. R.M.Kamp, T.Choli- Papadaopoulu B. Witman Liebold.
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- 43) Rangasami G and Bagyaraj DJ. 1993. Agricultural Microbiology 2/e Prentice- Hall publications
- 44) Rangasami G and Bagyaraj DJ. 1993. Agricultural Microbiology 2/e Prentice- Hall publications.
- 45) Ronald Atlas, Bartha Richard, 1987. Microbial ecology 2/e Benjamin/ Cummings publications.
- 46) Enzymes, Ribozymes and DNazymes, P. Palanivelu, Twentyfirst Century Publications. Palkalai Nagar, Madurai - 625 021 (2006).
- 47) Enzymes-Biochemistry, Biotechnology, Clinical chemistry- T. Palmer -East-West press. New Delhi (2.004)

#### SCHEME OF EXAMINATIONS

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					Int.	Ext.	Total
	<b>I Semester</b>						
MS01	General Micro Biology	6	6	3	25	75	100
MS02	Cell Biology & Biochemistry	6	6	3	25	75	100
MS03	Agricultural & Environmental Microbiology	6	6	3	25	75	100
MS04	Practical – I	6	3	6	40	60	100
ME01	Medical Microbiology (T&P)	6	4	3	25	75	100
	<b>Total</b>	<b>30</b>	<b>25</b>				<b>500</b>

	<b>II Semester</b>						
MS05	Immunology	6	6	3	25	75	100
MS06	Molecular biology & Microbial Genetics	6	6	3	25	75	100
MS07	Fermentation Technology	6	6	3	25	75	100
MS08	Practical – II	6	3	6	40	60	100
NME01	Applied Microbiology	6	4	3	25	75	100
	<b>Total</b>	<b>30</b>	<b>25</b>				<b>500</b>
	<b>III Semester</b>						
ME02	Genomics & Proteomics (T&P)	6	4	3	25	75	100
MS09	Microbial Bioremediation	6	6	3	25	75	100
MS10	Genetic Engineering	6	6	3	25	75	100
MS11	Bioinformatics	6	6	3	25	75	100
MS12	Practical – III	6	3	6	25	75	100
	<b>Total</b>	<b>30</b>	<b>25</b>				<b>500</b>
	<b>IV Semester</b>						
MS13	Research Methodology	5	5	3	25	75	100
MS14	Project and Viva – voce	25	10		20	80	100
	<b>Total</b>	<b>30</b>	<b>15</b>				<b>200</b>
	<b>Grand Total</b>		<b>90</b>				<b>1700</b>

## MS 01 - GENERAL MICROBIOLOGY

### Unit I

History Microbiology - scope of Microbiology - Contributions of Leeuwenhoek, Robert Koch, Louis Pasteur, Edward Jenner. Winogradsky and Francesco Redi - Major characteristics used in bacterial classification -. Traditional approaches in bacterial classification - Modern approaches in bacterial taxonomy - Numerical taxonomy - Nomenclature of bacteria - Prokaryotes (Bacteria) : definition - Structure and function of cell

wall, cell membrane, capsule, mesosome, flagella and pili. Biosynthesis of peptidoglycan, outer membrane, Teichoic acid, exopolysaccharides - Archaeal cell wall & membrane structure and Genome organization.

### **Unit II**

Classification of algae by Fritsch - General characteristics of *Chlamydomonas*, Diatoms and Blue green algae - Classification of fungi by Alexopolus system - General characteristics of yeasts, *Rhizopus*, *Aspergillus*, *Agaricus* and *Cercospora*. General properties of viruses - cultivation of viruses - classification of viruses - SV40 Lytic and lysogenic cycle - viral vectors - CaMV, TMV, HIV, Avian influenza.

### **Unit III**

Microbial growth - Phases of growth curve Measurement of growth - Calculations of growth rate, generation time - Synchronous growth – Induction of synchronous growth. Synchrony Index - Factors affecting growth; pH, temperature, substrate and osmotic condition. Bacterial metabolism aerobic and anaerobic respiration, photosynthesis.

### **Unit IV**

Microbial differentiation - sporulation, endo and exospores - endospore formation in *Bacillus* sp - Exospore formation in *Streptomyces* - Sporulation in fungi - *Aspergillus* sp. *Penicillium* sp - Formation of specialized structures, akinetes, cysts and heterocysts.

### **Unit V**

Survival at extreme environments - starvation - Adaptive mechanisms in thermophilie, alkalophilie, osmophilie, and psychrophilie. Bioluminescence - Mechanisms - advantages.

Autotrophs - Heterotrophs - Myxotrophs - Cyanobacteria, photosynthetic bacteria and green algae - Photosynthesis - CO<sub>2</sub> Fixation - Calvin cycle.

## **References**

1. Pelezer Jr.J.J., Chan., E.C.S. and Kvidg. R2003. Microbiology, McGraw Hill. New York.
2. Presscott. L.M., Hariety, J.P. and Klein, D.A., 2001. Microbiology, Wm. C.Brown Publication Iowa, U.S.A.
3. Atlas, R.M., 2001. Principles of Microbiology. Moshby year Book Inc. Missouri
4. Ananthanarayan, R., Jayaram Panikar, C.K., 2004. Text Book of Microbiology. Orient Longman Limited. Chennai.
5. Meynell. G.G. and Meynell. E. 1975 Theory and practice in Experimental Bacteriology, Cambridge University Press, Cambridge.
6. Sterriff, R.M. and Lester, J.N.1988, Microbiology for Environmental and Public Health Engineers. E. and F.N.Spon., London.
7. Wilson, K. and Goulding, K.H.1986A Biologist's Guide to Principles, and Techniques of practical Biochemistry, ELBS, London.

## MS 02 - CELL BIOLOGY & BIOCHEMISTRY

### Unit - I

Discovery of cell - Cell theory - Protoplasm theory - Prokaryotic and eukaryotic cell differentiation - Cytological study of living and dead cells - Cell fractionation techniques - Cell cycle and regulations - Cell division: mitosis, meiosis, and their significance - Cytoplasm: Physical and biological properties of Cytoplasmic matrix, Plasma membrane : chemical composition, structure, and functions. Cell Wall: Chemical nature, ultra structure and functions.

### Unit II

Ribosome: Ultra structure types and function. Lysosome: Chemical composition, Polymorphism and Functions. Endoplasmic reticulum: Ultrastructure, types and functions. Mitochondria: Ultrastructure and functions - Plastids : Ultrastructure and functions. Microbodies - Peroxisomes and Glyoxysomes.

### Unit III

Introduction to metabolism – Catabolism and anabolism – Metabolic pathways – Carbohydrate metabolism – Electron transport chain and oxidative phosphorylation – Biochemical importance and regulation. Lipid metabolism – Digestion and absorption of fatty acids – Oxidation and synthesis- Synthesis of triglycerides – Essential and Non-essential fatty acids – Amino acids- Essential and Nonessential – urea synthesis.

### Unit IV

Classification of proteins, carbohydrates, vitamins and lipids, structure, composition and biological functions- solubility - Enzymes- classification- Characterization- enzyme kinetics, Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations, Denaturation of DNA.

### Unit V

Law of Thermodynamics - Entropy, Enthalpy, oxidation and reduction reactions, redox potential, free energy and reaction. ATP energetics. Concepts of spectroscopy, chromatography and Electrophoresis.

### References

1. Cell, A molecular approach. 4/e, Cooper G and Hausman, R, ASM Publications (2007).
2. DeRobertis , E.D.P., and E.M.F.DeRobertis, 1998, Cell and Molecular Biology, Lea and Fabiger International Edition, Philadelphia.
3. Karp, G., 1985, Cell biology, Mc Graw Hill Book Company, Newyork.
4. Gupta, P.K., 1999, Cell and Molecular Biology, Rastogi Publications, Meerut.
5. Alberts, B. Johnson, A., Lewis, J.Raff, M., Roberts, K., and Walter .P.,2002, Biology of the Cell, Garland Science, New York.
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9. Text book of Biochemistry. 2/e. Devlin. T.M. 1986. Wiley Medical Publications, NY.
10. Biochemistry, 2/e, Stryer. L. 1998, W.H. Freeman and Company, NY.
11. Biochemistry, 2/e. Zubay. G. 1998. McMillan Publishers NY. Collier McMillan Company Publishers, London.
12. Enzymes. Ribozymes and DNAzymes, P. Palanivelu, 2007, Twenty first Century Publications, Palkalai Nagar, Madurai - 625 021.

## **MS03 - AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY**

### **Unit I**

Soil microbes : Bacteria, Fungi and Actinomycetes (distribution) - Microbial interactions : mutualism, amensalism and commensalism - Soil enzymes - Plant microbial interaction: N<sub>2</sub> fixation - phosphate solubilization - Rhizosphere effect - Mycorrhizal association : ecto and endomycorrhizae, actinorrhizae.

### **Unit II**

Microbial diseases of crops : Mechanism of pathogenesis, symptoms and control measures of the following diseases: *Bacterial* - Citrus canker, Red stripe of sugar cane- Fungal diseases; wheat rust, Tikka disease of groundnut, Late blight of potato, cotton wilt (Fusarium) - Viral diseases; TMV and Bunchy top of banana – Plant defense against pathogens: phytoalexins, elicitors and role of salicylic acid.

### **Unit III**

Bio fertilizers, production and methods of application - Biopesticides : bacterial, fungal and viral - microbial nematicides and microbial herbicides - Biotechnology in Agriculture : Bt cotton and herbicide tolerant plants.

### **Unit IV**

Role of microorganisms in biogeochemical cycles (N, P and C cycles) -Biodegradation of xenobiotics (chlorinated pesticides) - Microbially Enhanced Oil Recovery (MEOR) – Bioleaching of metals – microbes in waste treatment: solid waste (sanitary landfill and composting) and liquid waste - sewage treatment - BOD - pollution indicating microbes. Microbes in marine and freshwater environment - Water born pathogens - Eutrophication - quality testing of water. Wastewater treatment and composting, strategy for bioremediation.

## Unit V

Biodeterioration of paint, textile and leather - microbial detection in natural environment - extraction of DNA from soil - nucleic acid probes – nucleic acid hybridization, Biosorption of heavy metal- Biosensor ; Structure and applications. PCR applied to assess the pollution

## References

1. Mitchell, R.1992, Environmental microbiology, Wiley - liss, John Wiley & sons, Inc., Publications, New York.
2. Allop, D. and seal, K.J.1987, Introduction to bio - deterioration. ELBS, London.
3. Rheinheimer, G. 1980, Aquatic Microbiology. 2<sup>nd</sup> edition, John Wiley & Sons, New York.
4. Atlas, Ronald, M. Baratha, and Richard 1987. Microbiology Ecology. 2<sup>nd</sup> edition. Benjamin / Cummings Publishing Co., California.
5. Subbarao, N.S., 1995. Fourth edition, Soil Microorganisms and Plant Growth, Oxford and IBH, New York.
6. Pandey , B.P. 1998. Plant Pathology, Kalyani Publishers, New Delhi.

## MS - 04 PRACTICALS - 1

### Microbiology

1. Enumeration of bacterial / yeast cells viable count (Plate count) Total count.
2. Direct microscopic observations of bacterial shape - cocci, rods, chains, fungal spores, mycelium, budding of yeast, Motility test.
3. Staining methods : Simple, Negative, Gram staining, Acid fast, Spore staining, Metachromatic granular staining, Capsule staining. Lactophenol cotton blue staining.
4. Fungal slide culture.
5. Measurement of growth - Direct haemocytometer count, viable count - Growth curve, Determinations of growth rate and generation time.
6. Effect of pH, temperature and osmotic pressure on growth of bacteria.
7. Biochemical tests: Carbohydrate fermentation - acid gas production; IMVIC test; - Hydrolysis of starch; Casein; catalase test, oxidase, urease test, Nitrate reduction - Triple sugar iron test.

### Cell Biology & Biochemistry

8. Observation of electron micrographs of bacteria, Viruses and yeasts.
9. Microscopic view of chloroplast, starch grains and other inclusions.
10. Electron micrograph of cell organelles - Golgi bodies, ER, Ribosomes, Chloroplast, Mitochondria etc., Chromosomes.
11. Mitosis and Meiosis - observation of stages. Onion root tip test.



12. Blood smear preparation to identify cells types.
13. Estimation of carbohydrates, DNA, proteins & lipids.

## **Agricultural & Environmental Microbiology**

14. Enumeration of microorganisms from soil
15. Isolation of plant growth promoting bacteria – *Rhizobium*, *Phosphobacteria*; *Azotobacter*, *P.fluorescens*.
16. Assay of Siderophores.
17. Microbiological analysis of water by MPN technique.
18. Observation and Mycorrhizae infected roots.
19. Demonstration of antibiosis
20. Antibiotic Sensitivity Test.
21. Analysing BOD, COD in contaminated water.

## **References**

1. Betstir, L. 1996. Microbiology in Practice (6<sup>th</sup> Edition) Adeland Wesley, Langman, Newyork.
2. Benson, J.H. 1996 Microbiological applications; A laboratory Manual in General Microbiology (6<sup>th</sup> Edition) En.C.Brown Publication, IOWK USA.
3. James G.C. and Sharman, N 1996. Microbiology. A laboratory Manual (4<sup>th</sup> Edition) The Benjamin / Cummings Publishing Company, International USA.

## **ME 01 - MEDICAL MICROBIOLOGY**

### **Unit I**

The History of Infectious Diseases - Host Pathogen Interactions - Epidemiology of infectious diseases - Systemic bacteriology : General characters, molecular pathogenesis and laboratory diagnosis of *Staphylococcus*, *Streptococcus*, *Corynebacterium*, *Bacillus anthracis*, *Mycobacterium*, *Escherichia coli*, *Salmonella*, *Vibrio*, *Clostridium*, *Shigella* and *Klebsiella*.

### **Unit II**

Morphology, Molecular pathogenesis and laboratory diagnosis of Pox, Parvo virus, HSV, HBV, Polio, Retrovirus, Adenovirus, Rhabdo virus, HIV, SV40 and prions. SARS, Denque virus.

### **Unit III**

Characteristics of Fungi - Pathogenesis, diagnosis and chemotherapy of fungal Infections : Dermatophytes, *Sporothrix* and other superficial and subcutaneous Fungi -

Candida, *Aspergillus* and Other Opportunistic Fungi: *Cryptococcus*, *Histoplasma*, *Coccidioides* and Other Systemic Fungal Pathogens.

## Unit IV

Classification of protozoan parasites - Intestinal parasites (*Giardia*, *Trichomonas* and *Entamoeba histolytica*), Haemoflagellates (*Leishmania* and *Trypanosoma*), blood sporozoan (*Plasmodium*) - transport of clinical specimens - Microbiological examination of clinical specimens : urine, blood, sputum, faeces, cerebrospinal fluid, throat swabs, pus and wound exudates.

## Unit V

Nasocomial infection - Antibacterial, antifungal and antihelminthus drugs - Synthesis of antibiotics by recombinant microorganisms - role of rDNA technology in Vaccine production - molecular diagnosis of microbial diseases - reverse vaccinology.

## References

1. Greenwood, D.Richard C.B.Salk, John F.Peutherer, 2003. Medical Microbiology (5<sup>th</sup> Edition), Churchill Livingstone , USA.
2. Virellia,G. 1998, Microbiology and infectious disease (3<sup>rd</sup> Edition), B.I.Waversly Pvt Ltd., New Delhi.
3. Gillies, R.R.Gillies V and Dedds, 1989. Bacteriology, Illustrated (5<sup>th</sup> Edition ) Churchill Livingstone, USA.
4. Jawetz, E.J.M and Adel berg E.A., 2005 Review of Medical Microbiology (19<sup>th</sup> Edition) Lang Medical Publications, USA.
5. Lenette, E.H.A. Balows, W.J. Haussler. Jr and Shadowy H.J. 1985. Manual of Clinical Microbiology (4<sup>th</sup> Edition), Bethesda American Society for Microbiology.
6. Tom Elliot, Hastings, M and Desselberger, U.1997. Lecture Notes on Medical Microbiology (3<sup>rd</sup> Edition), Blackwell Science, UK.
7. Ananthanarayanan, R and Panicker, C.K.J.2004, Textbook of Microbiology, Orient Longman, Madras.
8. David Green wood, Antimicrobial Chemotherapy, Oxford University Press Oxford, Bernard.
9. Glick, Jack J.Pasternak, 2003. Molecular Biotechnology, principles and applications of recombinant DNA, ASM press, Washington DC.

## **MS 05 - IMMUNOLOGY**

### **Unit I**

History of immunology, Types of immunity : Innate and adaptive; passive and active - Cells and organs of the immune system - Physiology of immune response : Humoral and cell mediated immunity - Immunohaematology.

### **Unit II**

Antigens and Haptens - antigen antibody interaction - antigen processing and presentation - Antibody: types, structure and functions - Molecular Biology of immunoglobulin synthesis -structure - Complement components: classical and alternate pathways - Hypersensitivity reactions – idiotype network - immunity of infectious diseases.

### **Unit III**

Transplantation immunology: Rejection - Graft versus Host reaction - Transplantation antigen - HLA tissue typing and MHC - transplantation of organs (kidney and cornea) - Tumour immunology - Tumor antigens - Immunotherapy of malignancy – Autoimmune diseases - Monoclonal antibody - production and their applications - cytokines.

### **Unit IV**

Cytotoxicity assay- Labeled antibody technique in light and electron microscopy - Techniques of immunization - use of adjuvants, separation of lymphocytes and preparation of rosette forming cells, Immuno blotting, immunoprecipitation and RIA.

### **Unit V**

Immunochemical techniques: immune histochemistry-Isolation of leukocyte sub-populations: Bulk techniques, Cell selection by the FACS and Enrichment of antigen - specific populations - estimation of antibody -identification and measurement of antigen - interferons and types.

### **References**

1. Kuby J. 2003, Immunology, W.H.Freeman Co Newyork
2. Huw Davies, 1997. Introduction Immunology ( 1<sup>st</sup> Edition), chapmen & Hall Publisher London.
3. Roitt, J.M., Brostoff, J.J.2004 Immunology (7<sup>th</sup> edition), C.J.Mosby Publisher, St.Louis, USA.
4. Bellanti, J.A. 1985. Immunology (3<sup>rd</sup> edition), W.B. Saunders Co Ltd. Philadelphia
5. Talwar G.P. and Gupta, S.K. 1992, A Hand Book of practical Immunology (Volume I & II). Vikas Publishing House Pvt Ltd. New Delhi.

# **MS - 06 MOLECULAR BIOLOGY & MICROBIAL GENETICS**

## **Unit I**

Different forms of DNA - A, B and Z - Super coiling of DNA - DNA synthesis: DNA polymerase I, II & III; Topoisomerase I & II - Properties of DNA - Melting curve; Hyperchromicity -  $cot$  value - DNA Replication - Mechanism of DNA replication -  $\theta$  mode, D-loop, Rolling circle model; Reverse transcriptase.

DNA Degradation - DNase: exonucleases. Restriction endonucleases: different types. I, II & III – DNA damage and repair - SOS Repair - Excision mismatch and recombination repair.

## **Unit II**

Structure of tRNA, rRNA, mRNA – Synthesis – RNA polymerase – Structure and Transcription process, RNA processing – Structure of prokaryotic and eukaryotic promoters and terminator sequences. Detailed structure of ribosome and its constituents, role in translation-genetic codes recoding - Elucidation of genetic codes – reading frames, Wobble hypothesis Post transcriptional processing of RNA.

## **Unit III**

Origin of Mutation – fluctuation test – Mutagens-Physical and Chemical agents – induced mutation – Types – Mechanisms of mutation - Suppression of mutations - Intergenic and intragenic – Frame shift mutation – Reversion - Fine Structure mapping – rII mutants of T4, detection of mutation SNP.

## **Unit IV**

Transformation - Natural or artificial competence – Transformation in *Bacillus*, *E. coli*, *Hemophilus* and *Streptococcus* – Mechanism of recombination – Bacterial conjugation – F plasmid – Structure and functions – Origin of Conjugation – Hfr and F' strains – Interrupted and uninterrupted mating – time map and recombination map – Conjugation in *E. coli*, *Pseudomonas*, *Streptomyces*.

Transduction – generalized and specialized transduction –  $\lambda$  phage and PI Phage – mechanism of gene transfer through  $\lambda$  and PI Phages – HFT and LFT lysate – Contransduction Transduction mapping, Transposons.

## **Unit V**

Regulation of bacterial gene expression – Operon model – *Lac*, *ara*, *trp* and *His* operons, Induction and repression mechanism in operons.

## References

1. Gene VII, Benjamin, Lewin, 2000: Oxford University Press.
2. Molecular Biology of the Gene, 4/3, Watson, Hopkins, Roserts, Steits and Weiner, 1987, The Benjamin / Cumming Publishing Company, Inc.
3. Molecular Genetics of Bacterias 2/3, Larry Snyder and Wendy Champness, 2003. ASM Press, Washington DC.
4. Microbial genetics, David Friefelder, 1987, Narosa Publishing House.

## MS 07 – Fermentation Technology

### Unit I

Screening methods for industrial microbes – Detection and assay of fermentation products – classification of fermentation types – Genetic and control of fermentation – Stain selection and improvement – Mutation and recombination DNA technique for strain development.

### Unit II

Culture media formulations – optimization methods – statistical design for media formulation and optimization (Plackett Burman Design) Contour plot, Immobilization of cells and enzymes – methods & applications. Fermentation Kinetics – Yields factors – growth rate parameters – Kinetics of growth and product formation in batch, chemostat and fed-batch –

### Unit III

Geometry of bio-reactor for microbes animal cell culture - types - design of a reactor, packed/fluidized fed – transport phenomenon transfer - Newtonian and non-Newtonian fluid behaviour of fluid-Mass transfer coefficient – Ka determinations – Dimensionless numbers-agitation and aeration fermentation control – Reynold number-power number –Scale up strategies – Computer application in fermentation.

### Unit IV

Fermentation of microbial products – single cell protein (SCP) – Alcoholic fermentation – Beer and Wine, Industrial alcohol – Antibiotic fermentation – Penicillin & Streptomycin-Organic acids: Citric acid & Fumaric acid – Amino acids; Glutamic acid & lysine, vitamins – B12 & riboflavin. Hormones; Gibberellin acid & IAA: Biogas production – Methane; Enzyme – amylase, Protease. Microbial Biopolymers.

## Unit V

Downstream processing of biologicals - Foam separation precipitation, centrifugation, filtration - Solvent extraction; Separation by chromatography, membrane process – Drying-Drum-Spray dry. Fermentation economics, cost analysis.

### References

1. Manual of Industrial Microbiology and Bio-technology by Arnold L. Demain and Nadine A. Solomon, American Society of Microbiology, Washington, 1986.
2. Fermentation: A Practical approach. Mc. Nekil, B and L.M. Harve, IRL, Press, New York (Units I–III) 1990.
3. Stanbury – Fermentation Technology
4. Cruger scriffer.

## MS 08 – Major Practical – II

### Immunology

1. Haemagglutination test
2. Oucheterlony double diffusion test
3. Immuno electroporesis
4. Preparation and purification of immunoglobulin
5. ELISA
6. WIDAL test, RPR, RIA, Pregnancy test , VDRL, Western blot

### Molecular Biology & Microbial Genetics

7. UV treatment – *E.coli* survival curve
8. Enrichment of mutant by penicillin treatment
9. Isolation of auxotrophic mutants - Replica plating
10. Isolation of drug resistant mutant-Replica plating
11. Isolation of petite mutants of yeast
12. Conjugation – F'x Hfr (i) to find origin of ii) to construct time and recombination map.
13. Determination of titre in a phage stock
14. Transduction – PI, transduction of auxotrophic markers.
15. Detection of  $\beta$ -galactosidase enzyme using ONPG

### Fermentation Technology

16. Ethanol production by yeast – Determination of concentration and productivity of ethanol.
17. Enzyme production (Amylase/Protease) – submerged fermentation.
18. Immobilization of yeast and performance in batch and plug flow reactor.
19. Immobilization of enzyme performance analysis
20. Solid state fermentation technique – production of enzymes.

## References

1. Hue Dvis, 1997, Introductory Immunology, Chappman & Hall Publisher London.
2. Roitt J.M. Brostaff, J.J. and Male, J.K. 1996. Immunology 4<sup>th</sup> edition CV. Mosby Publishers St. Louis.
3. Bellanti, J.A. 1995. Immunology III, 3<sup>rd</sup>, Editor, W.B. Saunders Co., Ltd., Philadelphia.
4. Talwar, G.P. and Gupta, S.K. 1992. A Handbook of Practical Immunology (Volume I & II) Vikas Publishing House Pvt. Ltd., New Delhi.
5. Lab-Molecular Biology Lab Fax – II Gene Analysis Second edition – T.A. Brown, Academic Press, UK, 1998.
6. A short course in Bacterial Genetics – A lab manual and Handbook for E.Coli and related bacteria. Jeffrey H. Miller, Cold Spring Harbour Lab Press, 1992.
7. Experimental techniques in Bacterial Genetics, Stanley, R. Maloy, Jones and Barlet Publishers, Boston, 1990.
8. Molecular Biology – A Project approach by Susan. J. Karcher, Academic Press, 1995, USA.
9. Manual of Industrial Microbiology and Biotechnology by Arnold, Deman and Nadine A. Solomon, American Society of Microbiology, Washington, 1986.
10. Fermentation: A Practical approach, Mc Nekil, B and L.M. Harve, IRL, Press, New York, (Units I–III) 1990.

## ME 02 GENOMICS & PROTEMICS

### Unit I

Genomics – Introduction – Transcriptomics; Expressed sequence tag; Differential display; DNA Microarray; Genome mapping – Molecular markers, Genetic maps, cytogenetic maps, Physical maps, Integrated Genomic Maps and Sequencing of Genomes. Genomics of yeast, *Arabidopsis*, *thalina*, *Escherichia coli* and *Homo sapiens*-Metagenomics.

### Unit II

Nucleotide sequence data bank: Genbank, EMBL and DDBJ – protein sequence data bank: NBRF, PIR, SWISSPROT – Structural databases: PDB, NRL, 3D, MMDB – Genome databases: TIGR, EST and GSS.

### Unit III

Protemoics techniques: two dimensional gel electrophoresis - principles, methods and applications: HPLC- LC-MS: Mass Spectrometry - Ionization method & Types of Mass Analyzers: Isotope Labeling in Quantitative proteomics – *In Vitro* labeling & Metabolic labeling.

## **Unit IV**

Protein Identification by Peptide Mass Fingerprinting: Peptide Sequence Analysis by Tandem Mass Spectrometry: Protein Identification with Tandem Mass: Protein – protein interaction; Protein Microarray – principle & methods: Cell Localization.

## **Unit V**

Applications of genomics and proteomics; embryo-genomics and cancer genomics. Proteomics of multiprotein complexes and peptidomics technique for human body fluids and Cancer proteomics – Pharmacogenomics: Personalized medicine – Biomarkers – comparative genomics and study of human disease genes.

## **References**

1. Brown, T.A. Genomes 3, Garland Science (2007)
2. Genomics and Proteomics, a functional and computational aspect. Edited by Sandor Suhai, Springer (2000).
3. Introduction to proteomics, Daniel C. Liebler, Humana Press, (2001).
4. Baxevanis, A.D. and Quelling, B.F. Bioinformatics A Practical Guide to the Analysis of Genes and Proteins, Wiley-Interscience Publication, New York, (1998).
5. Smith, D.W. Biocomputing Informatics and Genome Projects, Academic Press San Diego (1994)

## **MS 09 Microbial Bioremediation**

### **Unit I**

Introduction – Global concern on environmental crisis – Utilization of waste biomass – environmental contaminants and their classifications.

### **Unit II**

Bioremediation – Types and approaches of bioremediation – Microbes for bioremediation – Bioremediation techniques – Parameters for bioremediation monitoring Biodegradation process, biodegradation of xenobiotics and hydrocarbons.

### **Unit III**

Bioremediation of contaminants: Lignin, cellulose, Waste water, treatment of domestic sewage, biological treatment of industrial waste water. Bioremediation of phenols, PCBs dyes, crude oil, petrol etc.

### **Unit IV**

Bioconversion – heavy metal remediation, pesticide degradation, synthetic polymers – radioactive waste.



## **Unit V**

Genetics of microbial bioremediation – role of plasmids in bioremediation – enhancement of microbial abilities – genetics and gene manipulation strategies – metagenomics in bioremediation.

### **References**

1. Microbial Biotechnology 2/e Glazer, AN and Nikaido, H. Cambridge University Press (2008)
2. Microbial Bioremediation, Rajendran, P and Gunasekaran, P. MJ Publishers, Chennai, (2006)

## **MS 10 –Genetic Engineering**

### **Unit I**

Vectors: Types and properties of vector; Plasmid vector –pBR 322 and pUC plasmids &  $\lambda$  vectors, M13 vectors and Phagemids; Artificial chromosomes YACs, PACs BACs and HACs – Expression vectors – Replacement vector, Shuttle vectors, insertion vectors, Fusion vector. Expressions strategies: Expression strategies for heterologous gene expression in Bacteria, Yeast, Insect cell lines and mammalian cells. Cosmids – Construction and its use in gene cloning. Plant, bacterial and animal transposons – Classification, Structure, Transposon tagging and its application.

### **Unit II**

Restriction enzymes – Types and properties; DNA modifying enzymes – Ligases, ply nucleotide kinase, Methytransferase, Phosphatase, Sulphurylase, Topoisomerases, Recombinase, S1 nuclease, Exonucleases, Terminal transferase and DNA Gyrase. Polymerase enzymes – DNA polymerase, RNA polymerase and reverse transcriptase. Linking of recombinant DNA with vector – linkers, Adaptors and Homopolymer tails, terminal dinucleotides.

### **Unit III**

Transgenic and Gene Knockout Technologies – Targeted gene replacement, Chromosome engineering, Strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and gene silencing; Biotechnology of medical and diagnostic products – Insulin, Somatostatin, interferon, Somatotropin; Recombinant vaccines – Edible; HIV, Malarial vaccines. Antibodies and several other applications in various fields.

### **Unit IV**

Gene cloning – Genomic libraries, eDNA libraries and PCR based libraries; Library screening – nucleic acid hybridization, Immunoscreening, Screening by function, Screening by

interaction, Phage display; Mutagenesis – cassette mutagenesis, PCR based mutagenesis and random mutagenesis. Gene Transfer Techniques; Natural, physical, chemical and biological transfer. Selection and screening of transformations, insertional inactivation – genetic complementation. Immunological screening, Molecular probes, hybridization techniques. Reporter genes – GUS, Luciferase, GFP – Processing of recombinant protein, Purification and refolding, stabilization.

## **Unit V**

Applications of Genetic engineering in Medicine - Vaccines development, Gene therapy, Environmental Biology - microbial degradation of Oil waste and microbial degradation of Xenobiotics; Agriculture - Pest Management programme and Nitrogen fixation. Potential hazards - safety aspects of RDT, biological weapons and biosafety of GM foods and GMOs - substantial equivalence and safety testing. Technology protecting systems and the terminator; Laboratory security and emergency response - dilution and control, Risks and reduction; Deliberate release of GMOs in the environment Nanobiotechnology and its applications in medicine.

## **References**

1. Glick BR and Pateric Jack J. (2001), Molecular Biotechnology, ASM Press, London.
2. Freifelder D. 1991. Molecular Biology, Narosa Publishing House.
3. Watson J.D.Gilman. M, Witkowski. J.Zoller. M (1992). Recombinant DNA Scientific American Books.
4. Old R.N. and S.B.Primrose, Principles of gene manipulation, 1996 Blackwell Science Publications, Berlin.
5. Innis, M.A., D.H.Gelfand and J.J.Sninsky (1995) PCR Strategies, IRL Press.
6. Old. R.W. and Primrose, Principles of gene manipulation, 1996 Blackwell Science Publications, Germany.
7. Seidman. L.A. and More. C.J. 1999 Basic Laboratory methods of Biotechnology – Text Book and Laboratory references. Prentice Hall Publisher, New Jersey.
8. Poole Jr.C.P. Ownes. F.J. 2003 Introduction to Nanotechnology, John Wiley & Sons, New Jersey.

## **MS 11- BIOINFORMATICS**

### **Unit I**

Introduction to computer : Basics and generations of computers - overview of functions of components of computers: input / output devices, graphics devices; functions of hardware and software - OS:Unix, Linux,- Window – Internet, Intranet, LAN, UTP, Ethernet, Fiber Optics, Telnet, FTP, TCP/IP, URL, TTP, WWW, Email, Mail Server, Newsgroups.

## **Unit II**

Biological Databases, an overview; Sequence Database - (NCB/PIR, SWISS - PROT, DDBJ, EMBL, GenBank Database (GDB), Sp-TrEMBL, PROSITE, REBASE, BLOCKS, BLITZ, dbEST, ENTREZ, DDB, Human Transcript Database OWL, PEDB, RDP, TIGR.

## **Unit III**

Structural Databases : (PDB, CSD, 3Dee, CATH, DSSP, FSSP, HSSP, MMDB, NRL - 3D, ProDom, SWEET, SCOP) Nucleic acid database (NDB) –Other Databases (BMCD), Carbohydrate database, CUTG, ENZYMA, EPD, Fly Base, Ligand, Metabolic database..

## **Unit IV**

Nucleic acid sequence analysis, an overview - protein sequence database search, sequence alignment: (Pair wise and Multiple). Patterns, motifs and profiles, Secondary structure prediction, RNA analysis, Integrated sequence analysis, (BLAST, PSI- BLAST, FASTA, CLUSTALW), Mathematical basis of molecular phylogenetic tree .

## **Unit V**

Types of interactions : Conformational principles. Conformational space: Types of movement vibrational - rotational - torsion angles - Different levels of structural organization. Structural superposition - Energy considerations, atomic and molecular level - assembling of molecules: energy calculations. Molecular mechanics and molecular dynamics - concepts, calculations, software usage – Molecular modeling.

## **References**

1. Mount, DW. Bioinformatics - sequence and genome analysis. CBS publishers & distributors, New Delhi.
2. Krawetz, S.A & Womble, D.D. Introduction to Bioinformatics - A Theoretical and practical approach, Human press, Totowa, NJ.
3. GCG User Manual – Accelrys Inc. Japan.
4. Simon Cozen, Beginning Perl, <http://learn.perl.org/library/beginning-perl/>
5. James Tisdall, 2001 Beginning Perl for Bioinformatics ISBN:0-596 -00080-4
6. Peek, Todino and Strang (O' Reilly, 2001) Learning the UNIX Operating system, fifth edition.
7. Attwood, T.K. and Parry - Smith, D.J.1999. Introduction to Bioinformatics Pearson Education Pvt Ltd., Singapore.
8. Lesk, A.M. 2002. Introduction to Bioinformatics Oxford University Press, Oxford.
9. Baxevanis, A.D. and Quелlette, B.F. 1998. Bioinformatics A Practical Guide to the Analysis of Genes and Proteins. Wiley - Interscience Publication, Newyork.

10. Smith. D.W. 1994. Biocomputing Informatics and Genome Projects. Academic Press, San Diego.
11. Gibas, C. and Jambeck, P. Developing Bioinformatics Computer Skills, Shroff Publishers, Calcutta.
12. Sundara Rajan, S. and Balaji, R. 2002. Introduction to Bioinformatics . Himalaya Publishing House, New Delhi.

### **MS 12- PRACTICALS - III**

1. Isolation of microbes resistant to pesticides, herbicides and other organic pollutants.
2. Isolation of lignin /cellulose /starch degrading microbes.
3. Determination of metal tolerance of microbes.
4. Isolation of plasmid (pBR322/ Bluescript) from *E.coli* - Separation by agarose gel electrophoresis.
5. Restriction digestion of plasmid - single and double digestion - determination of molecular weight - Physical mapping.
6. Cloning of fragment in pBR322/Bluescript –insertional inactivation /Blue white selection.
7. PCR amplification of DNA, RAPD, RELP; gel electrophoresis - analysis of fragments - Finger printing analysis.
8. Isolation of bacterial chromosomal DNA - Determination of purity quantity
9. Unix, Linux, Windows, Internet, Intranet, Telnet, HTTP, E-mail, etc.
10. Nucleic acid and protein sequence databases.
11. Access to structural (Nucleic acid and protein) databases.
12. Human genome database.
13. Pair wise sequence alignment.
14. Multiple sequence alignment.
15. Secondary structure prediction
16. RNA sequence analysis.
17. Analysis of phylogenetic tree.

### **References**

1. Microbial Biotechnology 2/e Glazer, AN and Nikaido, H. Cambridge University Press (2008).
2. Rajendran, P. and Gunasekaran, P. 2006. Microbial Bioremediation. MJP Publishers (2006).
3. Environmental Microbiology, William Hurst, ASM Publishers.
4. Molecular cloning – A lab manual II Edition, Volume III, Sambrook, Fristch, Maniatis, CSH Press, (1989).
5. DNA Cloning – a practical approach (V. i-4) D.M. Glover and B.D. Hames, IRL Press, (1995).

6. Short Protocols in Molecular Biology II edition, John Wiley & Sons, Edited By Fredrick M. Ausubel. Harvard Medical School.
7. Lab – Molecular Biology Lab Fax – II. Gene Analysis, Second edition – T.A. Brown. Academic Press, UK. (1998).

## **NME 01 - APPLIED MICROBIOLOGY**

### **Unit I**

History and Scope of industrial microbiology - Strain development – production media - industrial sterilization - Culture preservation - Bioreactor: types and structural components - Factors regulating bioprocessing: Mass transfer, oxygen, viscosity, optimization of aeration, agitation and foam control.

### **Unit II**

Upstream and Downstream process - recovery and purification of intracellular and extracellular products fermentation Economics - Newtonian and Non - Newtonian heat transfer – Application of computers in fermentation.

### **Unit III**

Microbial production of antibiotics : Penicillin, streptomycin, - Organic acids : Citric acid and vinegar - Vitamins : B12, riboflavin – solvents: ethyl alcohol and glycerol - amino acids : glutamic acid and lysine - Enzymes: amylase and Pectinase - alcoholic beverages: Beer, Wine - Vinegar - Single Cell Proteins.

### **Unit IV**

Biosafety – Intellectual property rights (IPR) – Patents and copyrights -brief account of World Intellectual Property Organization (WIPO) General Agreement on Tariff and Trade (GATT).

### **References**

1. Frazier, W.C. and Westhoff, D.C. 1995. Food Microbiology (8/e), TATA McGraw Hill Publications Co Ltd., New Delhi.
2. Adams and M.R and Moss, M.O. 1996 Food Microbiology, New Age International (P) Ltd.
3. Cruger, W. and Crueger, A. 1995, Biotechnology. Black Well Scientific Publications, Oxford.
4. Peppler, H.J. and Pearlman, 2004. Microbial Technology, Vol – I, and Academic press, New Delhi.

5. Stanbury, P.F., Whitaker, A and Hall, S.A. 2000. Principles of Fermentation Technology, Second edition, Pergamon Press – Oxford.
6. Demain, A.L. and Davis, J.E.2004, Industrial Microbiology and Biotechnology, (2/e), ASM Press Washington, DC.

## **MS - 13 Research Methodology**

### **Unit I**

Colorimetry & Spectrophotometry. pH & pH meter – Buffers, preparation of Buffers, Henderson Hasselbach equation.

### **Unit II**

Radioactivity & Measurement of radioactivity. Effects of radiation on living systems - Safety aspects – Disposal of radioactive wastes – Dialysis, Ultrafiltration & Lyophilization.

### **Unit III**

Separation techniques ; Centrifugations – Electrophoresis of Protein & Nucleic acids, Chromatography : Adsorption; Paper, TLC, Ion-exchange, Gel filtration, Affinity, HPLC & GLC.

### **Unit IV**

Enzyme techniques : Free energy concept, activation energy, Extraction & purification of enzymes, enzyme kinetics (Michaelis - Menten , L-B plot, Eadie – Hofstee Hanes – Woolf). Enzyme assays - Enzyme engineering, gene fusions, site directed mutagenesis, gene tags.

### **Unit V**

Biostatistics - Probability, Distribution - Binomial, poisson & Normal, students Test. Chi - square test, Correlation & Regression. ANOVA one-way & two -way .

Collection, Tabulation & Graphical representation of data - Thesis writing - Introduction, Review of literature, Results & discussion, References.

## **References**

1. Analytical Biochemistry & Separation Techniques, III Edition, - P.Palanivelu, 21<sup>st</sup> Century Publication, Palkalai Nagar, Madurai - 625021 (2004).
2. Bio – Statistics, Analyses by Zar. Second edition, Prentice Hall International Englewood Cliffs, New Jersey.
3. Enzymes, Ribozymes and DNazymes, P.Palanivelu, Twenty first Century Publications, Palkalai Nagar , Madurai 625021 (2006)