

Department of Zoology

B.Sc., IMB

M.Sc., Zoology

M.Phil Zoology

M.Sc., Microbiology

B.Sc., Industrial Microbiology

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY
(From 2014-2017 batch onwards)

BACHELOR OF INDUSTRIAL MICROBIOLOGY
Semester – I

| Course | Code No | Subject | Hrs/Week | Cred. | Total Hrs | Max Mark CA | Max Marks SE | Total |
|-----------------|---------|-----------------------------|-----------|-----------|-----------|-------------|--------------|-------|
| Part I Tamil | P111 | Ikkala Ilakkiyam | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II English | P211 | English Through Prose | 6 | 3 | 90 | 25 | 75 | 100 |
| Core | IMB11 | General Microbiology | 5 | 4 | 75 | 25 | 75 | 100 |
| Core lab | IMBL11 | Lab in General Microbiology | 3 | 2 | 60 | 40 | 60 | 100 |
| Allied | | Chemistry I | 4 | 4 | 30 | 25 | 75 | 100 |
| Allied lab | | Chemistry Practical | 2 | - | 30 | - | - | - |
| VE I | VE 1 | Value Education -I | 2 | 2 | 30 | 15 | 35 | 50 |
| EVS | EVS | Environmental Studies | 2 | 2 | 30 | 15 | 35 | 50 |
| TOTAL | | | 30 | 20 | | | | |

Semester – II

| Course | Code No | Subject | Hrs/Week | Cred. | Total Hrs | Max Mark CA | Max Marks SE | Total |
|------------------------|-----------|-----------------------------------|-----------|-----------|-----------|-------------|--------------|-------|
| Part I Tamil | P121 | Bhakthi Illakiyamum Sitrillakiyam | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II English | P221 | English Through Drama | 6 | 3 | 90 | 25 | 75 | 100 |
| Core | IMB21 | Biological chemistry | 5 | 4 | 60 | 25 | 75 | 100 |
| Core Lab | IMBL21 | Lab in Biological chemistry | 3 | 2 | 60 | 25 | 75 | 100 |
| Allied | | Chemistry | 4 | 4 | 30 | 25 | 75 | 100 |
| Allied lab | | Chemistry Practical | 2 | 2 | 30 | 40 | 60 | 100 |
| Core Elective I | IMBME1 | Medical Microbiology I | 2 | 2 | 30 | 15 | 35 | 50 |
| Skill Based Elective I | IMB SBE21 | Biostatistics | 2 | 3 | 45 | 15 | 35 | 50 |
| TOTAL | | | 30 | 23 | | | | |

Semester – III

| Course | Code No | Subject | Hrs/Week | Cred. | Total Hrs | Max Mark CA | Max Marks SE | Total |
|----------------------|---------|-----------------------------------|-----------|-----------|-----------|-------------|--------------|-------|
| Part I Tamil | P131 | Kappiya Illakiyam | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II English | P231 | English Through Poetry | 6 | 3 | 90 | 25 | 75 | 100 |
| Core | IMB31 | Bioinstrumentaion | 4 | 4 | 60 | 25 | 75 | 100 |
| Core Lab | IMBL31 | Lab in Bioinstrumentaion | 2 | 2 | 30 | 40 | 60 | 100 |
| Allied | | Botany | 4 | 4 | 60 | 25 | 75 | 100 |
| Allied | | Botany Practical | 2 | - | 30 | - | - | - |
| Core Elective II | IMBME2 | Biodegradation and Bioremediation | 2 | 2 | 45 | 15 | 35 | 50 |
| Value Education II | VE 2 | Value Education -II | 2 | 2 | 30 | 15 | 35 | 50 |
| Non Major Elective I | NME31 | Human Genetics (except IMB) | 2 | 2 | 30 | 15 | 35 | 50 |
| TOTAL | | | 30 | 22 | | | | |

Semester – IV

| Course | Code No | Subject | Hrs/Week | Cred. | Total Hrs | Max mark CA | Max Mark SE | Total |
|-------------------------|---------|---|-----------|-----------|-----------|-------------|-------------|-------|
| Part I Tamil | P141 | Pandai Illakiyam | 6 | 3 | 90 | 25 | 75 | 100 |
| Part II English | P241 | English Through Fiction | 6 | 3 | 90 | 25 | 75 | 100 |
| Core | IMB41 | Molecular Biology & Microbial Genetics | 4 | 4 | 60 | 25 | 75 | 100 |
| Core Lab | IMBL41 | Lab in Molecular Biology & Microbial Genetics | 2 | 2 | 30 | 40 | 60 | 100 |
| Allied | | Botany | 4 | 4 | 60 | 25 | 75 | 100 |
| Allied | | Botany Practical | 2 | 2 | 30 | 40 | 60 | 100 |
| Core Elective - III | IMBME3 | Medical Microbiology II | 2 | 2 | 30 | 15 | 35 | 50 |
| Skill Based Elective II | ZSBE42 | Bioinformatics | 2 | 3 | 45 | 15 | 35 | 50 |
| Non Major Elective II | NME 42 | Health Education (except IMB) | 2 | 2 | 15 | 15 | 35 | 50 |
| Total | | | 30 | 25 | | | | |

Semester – V

| Course | Code No | Subject | Hrs/ Week | Cred. | Total Hrs | Max Mark CA | Max Marks SE | Total |
|------------------|---------|---|-----------|------------|-----------|-------------|--------------|-------|
| Core | IMB51 | Microbial Physiology | 5 | 4 | 75 | 25 | 75 | 100 |
| Core | IMB52 | Bioprocess Technology-I | 5 | 4 | 75 | 25 | 75 | 100 |
| Core | IMB53 | Clinical Lab Technology | 5 | 4 | 75 | 25 | 75 | 100 |
| Core | IMB54 | Food Microbiology | 4 | 4 | 60 | 25 | 75 | 100 |
| CoreLab | IMBL51 | Lab in Microbial Physiology & Food Microbiology | 3 | 2 | 45 | 40 | 60 | 100 |
| CoreLab | IMBL52 | Lab in Bioprocess Technology-I | 3 | 2 | 45 | 40 | 60 | 100 |
| CoreLab | IMBL53 | Lab in Clinical Lab Technology | 3 | 2 | 45 | 40 | 60 | 100 |
| Value Edu III | VE 3 | Value Education -III | 2 | 2 | 30 | 15 | 35 | 50 |
| Self Study Paper | SS51 | Health and Hygiene | - | (Extra 5)* | - | - | 100 | 100 |
| Total | | | 30 | 24 | | | | |

* Carries Extra 5 credits that do not form part mandatory credits (140) required for completion of the course.

Semester – VI

| Course | Code No | Subject | Hrs/ Week | Cred. | Total Hrs | Max Mark CA | Max Marks SE | Total |
|--|---------|----------------------------------|-----------|------------|------------------------------|-------------|--------------|-------|
| Core | IMB61 | Immunology | 5 | 4 | 75 | 25 | 75 | 100 |
| Core | IMB62 | Biotechnology | 5 | 4 | 75 | 25 | 75 | 100 |
| Core | IMB63 | Agricultural Microbiology | 5 | 4 | 75 | 25 | 75 | 100 |
| Core | IMB64 | Bioprocess Technology-II | 4 | 4 | 60 | 25 | 75 | 100 |
| CoreLab | IMBL61 | Lab in Immunology | 3 | 2 | 45 | 40 | 60 | 100 |
| CoreLab | IMBL62 | Lab in Biotechnology | 3 | 2 | 45 | 40 | 60 | 100 |
| CoreLab | IMBL63 | Lab in Agricultural Microbiology | 3 | 2 | 45 | 40 | 60 | 100 |
| Skill Based Elective III | ZSBE 63 | Nano biotechnology | 2 | 3 | 30 | 15 | 35 | 50 |
| TOTAL | | | 30 | 25 | | | | |
| Part V | | | | 1 | | | | |
| TOTAL CREDITS FOR SEMESTERS I to VI | | | | 140 | (20+23+23+25+24+24+1) | | | |

A) CONSOLIDATION OF CONTACT HOURS AND CREDITS: UG

| Semester | Contact Hrs/ Week | Credits |
|--------------|-------------------|------------|
| I | 30 hrs. | 20 |
| II | 30 hrs. | 23 |
| III | 30 hrs. | 22 |
| IV | 30 hrs. | 25 |
| V | 30 hrs. | 24 |
| VI | 30 hrs. | 25 |
| Part – V | -- | 1 |
| Total | 180 hrs | 140 |

B) Curriculum Credits: Part wise

| | | |
|-----------------|------------------------------|-------------------------------------|
| Part I | Tamil | 4x3 = 12 Credits |
| Part II | English | 4x3 = 12 Credits |
| Part III | Core | = 68 Credits (6+6+6+6+22+22) |
| | Allied | 5x4 = 20 Credits |
| | Core Electives | 3x3 = 09 Credits |
| Part IV | Value Education | 3x2 = 06 Credits |
| | Environmental studies | 1x2 = 02 Credits |
| | Skill Based Electives | 3x2 = 06 Credits |
| | Non – Major Electives | 2x2 = 04 Credits |
| Part V | | 1x1 = 01 Credits |
| Total | | 140 Credits |

Blue print of the total papers

| Sem | Part I | Part II | Core Theor | Core Pract | Allied Theor | Allied Pract | Major Elective | Skill based Elective | Non Major Elective | Value Educ | Env Stud | SS Paper | Total |
|------------|-----------|-----------|------------|------------|--------------|--------------|----------------|----------------------|--------------------|------------|----------|-----------|--------------|
| I | 1 | 1 | 1 | 1 | 1 | (1) | --- | --- | --- | 1 | 1 | -- | 7 |
| II | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | --- | - | - | - | 8 |
| III | 1 | 1 | 1 | 1 | 1 | (1) | 1 | | 1 | 1 | - | - | 8 |
| IV | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | -- | -- | -- | 9 |
| V | -- | --- | 4 | 3 | -- | -- | -- | -- | -- | 1 | -- | opt | 8(1) |
| VI | -- | --- | 4 | 3 | -- | -- | -- | 1 | -- | -- | | | 8 |
| Tot Hrs. | 4 | 4 | 12 | 10 | 4 | 2 | 3 | 3 | 2 | 3 | 1 | -- | 48(1) |
| Tot Cred | 12 | 12 | 48 | 20 | 16 | 4 | 9 | 6 | 4 | 6 | 2 | 5* | 139+1 |

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DEPARTMENT OF ZOOLOGY

(From 2014-2017 batch onwards)

B.Sc., Industrial Microbiology

| | | | |
|-------------|----------------------|---------------|-------|
| Course | : IMB (Core Paper-1) | Int. Marks | : 25 |
| Year & Sem. | : I Year; I Sem. | Ext. Marks | : 75 |
| Sub. Code | : IMB11 | Max. Marks | : 100 |
| Hours/Week | : 5 | No of Credits | : 4 |

Title of the Paper : **General Microbiology**

Course Objectives:

- To learn the fundamentals of microbiology
- To understand the classification, structural organization, reproduction of bacteria, fungi & viruses

Unit I

History of Microbiology - Discovery of microorganisms (Robert Hooke & Leeuwenhoek). Contributions of Francesco Redi, John Needham, Splallanzani, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich, Alexander Fleming, Dubos and Winogradsky. Classification based on – Carolus Linnaeus, Carl Woese and Robert H. Whittaker (Five Kingdom system).

Unit II

Outline classification for bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology. -Structural organization of bacteria – Size, shape and arrangement of bacterial cells -Ultrastructure of a bacterial cell - cell wall, cell membrane, ribosomes, nucleoid, capsule, flagella, fimbriae, spores and cysts. -Growth of bacterial culture – Physical & Chemical requirements for growth; Phases of growth

Unit III

Classification of viruses - General characteristics of viruses -General Morphology – Helical, polyhedral, complex -Animal viruses - Morphology and structure of Influenza virus -Plant viruses - Morphology and structure of TMV -Bacteriophage - Morphology and structure of T4 Bacteriophage -Brief study of Virioids and Prions

Unit IV

Classification of Fungi (Alexopoulos and Mims). -Distinguishing characteristics of Fungi – Filamentous, non-filamentous & dimorphic fungi -Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae*. -Growth condition and cultivation methods of fungi. Industrial uses of yeasts and molds.

Unit V

Classification of Algae (Chapman and Chapman). -Characteristics of Algae-Morphology and structure of *Chlorella* & *Anabaena*. -Biological and economic importance of algae.-General structure of Lichens.-Biological and economic importance of Lichens.

Text Books

1. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, fifth edition. McGraw-Hill. Book Co. Singapore
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9th Edition, Pearson Education, Singapore

Reference Books

1. Alcamo, I.E. 2001. Fundamentals of Microbiology, sixth edition, Addison wesley Longman, Inc. California
2. Alexopoulos, C.J., C.W. Mims and M.Blackwell. 2000. Introductory Mycology. fifth edition John Wiley & Sons. Chichester.
3. Atlas, R.A. and Bartha, R. 2000. Microbial Ecology. Fundamentals and Application, Benjamin Cummings, New York.
4. Black, J.G.2005. Microbiology-principles and explorations, 6th edition. John Wiley & Sons, Inc. New York
5. Dubey, R.C. and Maheswari, D.K. 2010. A Text Book of Microbiology. S Chand, New Delhi.
6. Johri, R.M., Snehlatha, Sandhya Shrama, 2010. A Textbook of Algae. Wisdom Press, New Delhi.
7. Kanika Sharma, 2011. Textbook of Microbiology – Tools and Techniques. 1st edition, Ane Books Pvt. Ltd., New Delhi.
8. Madigan, M.T., Martinkl, J.M. and Parker, J. 2009. Brock Biology of Microorganisms, 12th Edition, MacMillan Press, England.
9. Prescott, L.M., Harley, J.P. and Klein, D.A. 2008. Microbiology (7th edition) McGraw Hill, Newyork.
10. Schlegel, H.G. 2008. General Microbiology, Cambridge University Press,U.K.
11. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. 1991. General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.

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| | | | |
|-------------|------------------|---------------|-------|
| Course | : IMB (Core Lab) | Int. Marks | : 40 |
| Year & Sem. | : I Year; I sem | Ext. Marks | : 60 |
| Sub. Code | : IMBLI1 | Max. Marks | : 100 |
| Hours/Week | : 3 | No of Credits | : 2 |

Title of the Paper : **Lab in General Microbiology**

General Microbiology

1. Equipments needed for microbiology laboratory,
2. Laboratory safety and precautions.
3. Sterilization methods – moist heat, dry heat, filtration and radiation.
4. Preparation of culture media –solid (Selected and differential)and liquid
5. Aseptic transfer of microorganisms
6. Isolation of single colonies on solid media – Slant, Streak –Simple and Quadrant
7. Enumeration of bacterial numbers by serial dilution plating
8. Isolation of bacteria, actinomycetes and fungi from soil
9. Simple staining-Positive and negative
10. Differential staining –Gram staining
11. Spore staining
12. Capsule staining
13. Slide culture technique and fungal staining –Yeast and filamentous fungi
14. Microscopic observation of Algae- Nostoc and Spirulina
15. Bacterial motility-Hanging drop method

Reference Books

1. Cappuccino and Sherman, 2012. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi.
2. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi
3. Harry W. Seeley, J.R., Paul, J.VanDemark and John J.Lee. 1997. Microbes in Action – A Laboratory Manual of Microbiology. W.H.Freeman and Company, New York
4. Kanika Sharma, 2009. Manual of Microbiology – Tools and Techniques. 2nd Edition, Ane Books Pvt. Ltd., New Delhi.

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|-------------|-----------------|---------------|------|
| Course | : IMB | Int. Marks | : 15 |
| Year & Sem. | : I Year; I Sem | Ext. Marks | : 35 |
| Sub. Code | : ES | Max. Marks | : 50 |
| Hours/Week | : 2 | No of Credits | : 2 |

Title of the Paper : **Environmental Studies**

Course objectives:

- To understand the structure and functions of ecosystem
- To understand the sources, effects and control measures of various types of pollutants

Unit I

Definition and Scope of Environmental Studies – Ecology and Ecosystem – Structure of an Ecosystem – Food chains, food webs and ecological pyramids – Causes of Biodiversity Loss – Benefit and Conservation of Biodiversity

Unit II

Environmental problems and Management: Causes, effects and Control measures of : Air pollution – Water Pollution – Noise Pollution – Nuclear Hazards. Solid waste management and Waste Disposal methods. Climate change and Global Warming causes and Measures. Waste and Plastics. Urban environmental problems and measures. Environmental Legislations in India. Sustainable development and Inclusive growth.

Text Book

1. Kanagasabai, C.S. 2005. Environmental Studies. Rasee publishers. Madurai.

Reference Books

1. Sapru R.K. 2001. Environment Management in India, Vol. I & Vol. II Ashish publishers house, New Delhi.
2. Yogendra, N. and Srivastava, N. 1998. Environmental Pollution, Ashish Publishing House. New Delhi.

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|-------------|----------------------|---------------|-------|
| Course | : IMB (Core Paper-2) | Int. Marks | : 25 |
| Year & Sem. | : I Year; II Sem | Ext. Marks | : 75 |
| Sub. Code | : IMB21 | Max. Marks | : 100 |
| Hours/Week | : 5 | No of Credits | : 4 |

Title of the Paper: **Biological Chemistry**

Course Objective

- To introduce the structure and properties of various biomolecules
- To learn the concepts involved in the mechanism of enzyme action

Unit I

Biomolecules-interaction and bonding

Water –as biomolecule- molecular structure – non-covalent bonding – thermal and solvent properties

Henderson – Hasselbach equation.

Biochemical buffers - phosphate buffers, Tris buffer, Acetate buffers.

Unit II

Classification: Monosaccharides - glucose, fructose & galactose – structure and isomerism - biological importance.

Disaccharides-structure and biological importance of maltose, sucrose & lactose

Polysaccharides – structure and biological importance of homoglycans – starch, glycogen, and heteroglycans - Agar and peptidoglycan.

Unit III

Amino acid – basic structure – classification based on polarity of R-group – Properties and chemical reactions-zwitter ion - isoelectric PI, Stickland reaction.

Proteins – classification and important properties - levels of organization: primary, secondary –psi & phi angle - Ramachandran Plot, tertiary and quaternary structure

Structure of purines and pyrimidines.

Unit IV

Classification of lipids – structure and biological importance of triacylglycerols, phospholipids and Cholesterol Biosynthesis and degradation of fatty acids. Saturated and unsaturated fatty acids with an example.

Unit V

Enzymes – classification, properties – Mechanism of Enzyme action –Enzyme kinetics – Michaelis and Menten equation – Factors influencing enzyme kinetics (substrate and enzyme concentration, temperature and pH).

Enzyme – allosteric regulation and inhibition.

Vitamins–Types, deficiencies and Coenzymes

Text Books:

1. Ambika Shanmugam, 1998, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras.
2. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books and Allied Pvt. Ltd., Kolkata.

Reference Books:

1. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) ltd. New Delhi.
2. Conn, E.E., P.K.Stumpf, G.Bruening and R.H.Do, 1999. Outline of Biochemistry, John Wiley & Sons Inc., New York.
3. Deb, A.C. 2011. Fundamentals of Biochemistry, 10th Edition, New Central Book Agency Pvt. Ltd., Kolkata.
4. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, NewDelhi.
5. Mckee, T., and J.R.Mckee, 1996, Biochemistry an Introduction, C.Brown Publishers, London.
6. Nelson, D.L., and M.M.Cox, 2010, Lehninger Principles of Biochemistry, 5th edition, Worth Publishers, New York.
7. Ramarao, A.V.S.S. and Suryalakshmi, A 2009. Textbook of Biochemistry for Medical Students, 11th UVS Publishers Distributors Pvt. Ltd., New Delhi.
8. Rastogi, S.C.2010. Biochemistry, 3rd Edition, Tata McGraw Hill Edition, New Delhi.
9. Stryer, L., 2000. Fourth edition Biochemistry, W.H. Freeman and Company, New York.
10. Voet, D., and J.G.Voet, 1995,Biochemistry, second edition John Wiley & Sons Inc, New York.
11. Zubay, G. 1993, Biochemistry, 3rd edition . C.Brown Publishers, London

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| | | | |
|-------------|------------------|---------------|-------|
| Course | : IMB (Core Lab) | Int. Marks | : 40 |
| Year & Sem. | : I Year; II Sem | Ext. Marks | : 60 |
| Sub. Code | : IMBL21 | Max. Marks | : 100 |
| Hours/Week | : 3 | No of Credits | : 2 |

Title of the Paper : **Lab in Biological Chemistry**

1. Preparation of buffers
2. Biochemical characterization of a bacteria-IMViC, oxidase and catalase
3. Starch, casein and lipid hydrolysis
4. Extraction and Identification of aminoacids and lipids by TLC.
5. Qualitative analysis of carbohydrates and proteins
6. Qualitative analysis of proteins
7. Qualitative analysis of lipids
8. Preparation of standard graph for carbohydrates, proteins and lipids.
9. Quantitative estimation carbohydrates
10. Quantitative estimation proteins
11. Quantitative estimation lipids
12. Estimation of Alkaline phosphatase activity
13. Vitamin-C assay

Reference Books:

1. Anonymous. Open Universiteit .2004, Netharland Analysis of Amino acids, Proteins and Nucleic acids, Elsevier.
2. Boyer, R.F. 2012 Modern Experimental Biochemistry, Pearson Education, India.
3. Dua, S and N.Garg 2010 Biochemical methods of analysis, Narosa Publishing, New Delhi
4. Nigam and A.Ayyagai 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw- Hill Publication, New Delhi
5. Plummer, D.T. 2008 An Introdcetion to Practical Biochemistry, Tata McGraw- Hill Publication, New Delhi
6. Wilson K and J.Walker 2008. Practical Biochemistry, Cambridge State University Press, U.K.

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| | | | |
|-------------|--------------------------|---------------|------|
| Course | : IMB (Major Elective-I) | Int. Marks | : 15 |
| Year & Sem. | : I Year; II Sem | Ext. Marks | : 35 |
| Sub. Code | : IMBME21 | Max. Marks | : 50 |
| Hours/Week | : 2 | No of Credits | : 2 |

Title of the Paper: **Medical Microbiology-1**

Course Objectives:

- To learn about different bacteria and virus of medical importance
- To understand the pathogenesis mechanism of different pathogens

Unit : I

General Characters, mode of transmission, symptoms, control and epidemiology of Gram positive and Gram negative bacteria; Gram positive cocci –*Streptococci*, Anaerobic – *Clostridia*.

Gram negative bacteria - Enteric gram negative bacilli – *Vibrio*, *Salmonella*

Unit : II

Morphology and pathogenesis of
DNA viruses –Hepadna virus – Hepatitis B virus
RNA viruses –Retrovirus – HIV
Viral zoonoses - Japanese encephalitis, rabies.

Activities- Visit to clinical lab

Text Books:

1. Ananthanarayanan and Jeyaram Paniker C.K. 2009. 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.

Reference Books

1. Collee, J.G., A.G.Fraser, B.P.Marmion, A.Simmons, 1996. Mackie and McCartney, Practical Medical Microbiology, Fortieth edition, Churchill Livingstone.
2. David Greenwood, Richard C.B., Slack, John F. Pertherer, 2009. A Guide to Microbial infections, pathogenesis, immunity, lab diagnosis and control-17th edition.
3. Dimmock, N.J., A.J. Easton, K.N.Leppard. 2008. Introduction to modern virology. Blackwell Science.U.K.
4. Jawetz E., J.C. Melnic and E.A. Adelberg, 2001, Review of Medical Microbiology, Prentice Hall International Inc., USA.

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|------------|--------------------------------|---------------|------|
| Course | : IMB (Skill Based Elective-1) | Int. Marks | : 15 |
| Year & Sem | : I Year; II sem. | Ext. Marks | : 35 |
| Sub. Code | : IMBSE21 | Max. Marks | : 50 |
| Hours/Week | : 2 | No of Credits | : 3 |

Title of the Paper: **Biostatistics**

Course Objectives:

- To train the students to collect, organize and analyze data
- Learn to apply different statistical tools in presenting biological data

Unit I

Collection, Organization and Presentation of data-Table & Figure
Measures of central tendency; Mean, Median and Mode
Measures of Dispersion and variability; Range
Deviation: Standard deviation, Coefficient of variation

Unit II

Chi-square test
Student “t” test
Correlation —types- Karl Pearson and Regression
Anova-one way
Application of MS-Excel for basic statistical analysis

Text Books

1. Khan, I.A and Khanum, A., 2004, Fundamental of Bio- statistics, Ukaaz Publication, New Delhi.
2. Palanichamy, S. Manoharan, M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu.

Reference Books

1. Arora, P.N and P.K.Malhan 2008. Biostatistics. Himalaya Publications, Mumbai.
2. Gupta, S.P., 1987, Statistical Methods, thirty third edition, Sultan Chand and Sons Publishers, New Delhi
3. Schelfer, W.C., 1980, Statistics for the Biological Science, Addition – Wesley Publishing Company, London.
4. Sokal, R.R. and Rohlf, F.J. 1987, Introduction to Bio-statistics, W.H.Freeman and Company, New York.
5. Zar, J.H. 2008. Biostatistical Analysis, Low Price Edition Pearson Education, India

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|-------------|----------------------|---------------|-------|
| Course | : IMB (Core Paper-3) | Int. Marks | : 25 |
| Year & Sem. | : II Year; III Sem. | Ext. Marks | : 75 |
| Sub. Code | : IMB31 | Max. Marks | : 100 |
| Hours/Week | : 4 | No of Credits | : 4 |

Title of the Paper: **Bioinstrumentation**

Course Objectives

- To learn the basic principles and applications of various instruments
- Helps to understand the working mechanism of the instruments

Principle, working mechanism and application of

Unit I

Compound (Dark and Light field), Phase Contrast, Fluorescent, Electron (Transmission and Scanning), and Confocal Microscopy.

Unit II

pH meter
Centrifuge (Clinical, Density gradient and Ultra)
Quebec colony counter, GM counter, Liquid Scintillation counter
Incubator, Hot air oven, Autoclave, Sonicator, Lyophilizer, Filters (HEPA, membrane)

Unit III

Paper (Ascending, descending and circular), Thin layer, Column, gel filtration, ion exchange, Gas and High Performance Liquid Chromatography

Unit IV

Colorimeter, Spectrophotometer (visible, ultraviolet and infrared), Flame Photometer and Atomic Absorption Spectrophotometer

Unit V

SDS – PAGE, Agarose Gel Electrophoresis, 2-D Gel Electrophoresis, Gel Documentation, PCR, FACS

Text Books

1. Jeyaraman, J., 1985. Lab. Manual in Biochemistry, Wiley Eastern Ltd, New Delhi.
2. Plummer, D.T. 2008. An Introduction to Practical Biochemistry, Tata McGraw- Hill Pub. New Delhi

Reference Books:

1. Boyer, R.F. 1993, Modern Experimental Biochemistry, The Benjamin Cummings Publishing Company, Inc., New York.
2. Chatwal, G.R and S.K. Anand 2009. Instrumental methods of Chemical Analysis, Himalaya Publishing House, New Delhi.
3. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K. 2004. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Publishers Pvt. Ltd., New Delhi, India.
4. Palanichamy, S. and Shanmugavelu, M. 2011. Principles of Biophysics, 2nd Edition, Palani Paramount Publications, Palani.
5. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
6. Sawhney, S.K. and Nandhir singh, 2000. Introductory practical Biochemistry, Narosa Publishing house, New Delhi.
7. Veerakumari, L. 2009. Bioinstrumentation. MJP Publishers, Chennai.
8. Warton, D.C. and McCarthy, R.E. 1972. Experiments and Methods in Biochemistry. MacMillan, New York.
9. Williams, B.L. and Wilson, K. 1983, A Biologist's Guide to Principles and Techniques of Practical Biochemistry, Edward Arnold Publishers Ltd., London.
10. Wilson, K. and Walker, J, 2003. Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, New York. 159

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| | | | |
|-------------|--------------------------|---------------|-------|
| Course | : IMB (Core Practical-3) | Int. Marks | : 40 |
| Year & Sem. | : II Year; III Sem. | Ext. Marks | : 60 |
| Sub. Code | : IMBL31 | Max Marks | : 100 |
| Hours/Week | : 2 | No of Credits | : 2 |

Title of the Paper : **Lab in Bioinstrumentation**

1. Measurement of pH of various samples using pH meter
2. Verification of Beer's Law
3. Separation of molecules based on density gradient centrifugation principle
4. Measurement of cell using micrometry technique
5. Bacterial cell counting
6. Microbial colony counting with Quebec colony counter
7. Circular Paper Chromatographic separation of amino acids
8. Ascending Paper Chromatographic separation of sugars
9. Thin layer chromatographic separation of lipids
10. Column Chromatographic separation of plant pigments
11. Separation of proteins by SDS-PAGE (Demonstration only)
12. Separation of DNA by agarose gel electrophoresis (Demonstration only)

Reference Books:

1. Bajpai, P.K. 2010. Biological Instrumentation and Methodology. S.Chand & Company. New Delhi.
2. Janarthanan, S. and S.Vincent 2007. Practical Biotechnology, Methods and Protocols. University Press, Hyderabad., India.
3. Jeyaraman, J., 1985, Laboratory Manual in Biochemistry, Wiley Eastern Limited, New Delhi.
4. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K. 2004. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Publishers Pvt. Ltd., New Delhi, India.
5. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas 2000. Vogel's Textbook of quantitative chemical analysis. 6th edition. Pearson Education. New Delhi.
6. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques, School of Biotechnology, Madurai Kamaraj University, Madurai
7. Plummer, D, 2008. An Introduction to Practical Biochemistry, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
8. Sawhney, S.K. and Nandhir singh, 2000. Introductory Practical Biochemistry, Narosa Publishing house, New Delhi.

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| | | | |
|-------------|--------------------------|---------------|------|
| Course | : IMB (Major Elective-2) | Int. Marks | : 15 |
| Year & Sem. | : II Year; III Sem | Ext. Marks | : 35 |
| Sub. Code | : IMBME32 | Max. Marks | : 50 |
| Hours/Week | : 2 | No of Credits | : 2 |

Title of the Paper : **Biodegradation and Bioremediation**

Course Objective

- To learn the types of biodegradation and bioremediation process
- To understand the process and stages of waste management and treatment

Unit I

Types of Biodeterioration & Biodegradation: Physical or mechanical, Fouling and soiling (aesthetic), Chemical assimilatory and chemical dissimilatory biodeterioration.

Biodegradation and Bioremediation of - Oil, Detergent, Heavy metals

Pesticide degradation-Microbial metabolism of pesticides.

Unit II

Solid waste management -Sources and types; Methods of collection and Transport

Components of solid waste - Treatment methods-Landfall, Incineration

Composting: aerated pile method & reactors;

Liquid waste management-Primary, secondary, Tertiary and Disinfection

Text Books:

1. Allsopp, D., and J.Seal, 1986, Introduction to Biodeterioration, Edward Arnold Pub. London.
2. Jogdand, S.N.2010. Environmental Biotechnology, Himalaya Publishing House.New Delhi

Reference Books:

1. Atlas, R.M., 1997, Principle of Microbiology, second edition, WCB/McGraw-Hill Co., USA.
2. Chatterji, A.K. 2005.Introduction to Environmental Biotechnology.
3. Norris *et al.*, 1994, Handbook of Bioremediation, Lewis Publishers, London.

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| | | | |
|------------|------------------------------------|---------------|------|
| Course | : IMB (Non Major Elective Paper-1) | Int. Marks | : 15 |
| Year & Sem | : II Year; III Sem | Ext. Marks | : 35 |
| Sub. Code | : ZNME31 | Max. Marks | : 50 |
| Hours/Week | : 2 | No of Credits | : 2 |

Non Major Elective for B.Sc/B.A/B.Com/BBA students

Title of the Paper : **Human Genetics**

Course Objective

- Introduce the basic concepts involved in genetics
- To learn the structural organization of chromosomes and their aberrations

Unit I

Morphology of chromosomes-autosomes and allosomes, structure of chromosomes, simple mendelian traits in human- sex determination, twins, Autosomal Inheritance - (normal trait) inheritance of blood group-(abnormal trait) –Thalassaemia and sickle cell anaemia, sex linked inheritance-inheritance of X linked traits - haemophilia, colour blindness, inheritance of Y linked traits-hairy pinna, inheritance of sex influenced traits- baldness

Unit II

Mutation - Chromosomal aberrations-autosomal aberrations- 21 trisomy (Down's syndrome) 21 monosomy, sex chromosomal aberrations – Klinefelter and Turner syndrome; Eugenics and Genetic Counseling –Negative and positive eugenics and eugenics
Gene therapy

Text Books

1. Carlson, E. A. 1985. Human Genetics. TMH edition. Tata McGraw-Hill publishing company Ltd., New Delhi
2. Gardner, E.J., Simmons, M.J. and Snustad, D.P. 1991. Principles of Genetics. John Wiley & sons.

Reference Books:

1. Verma, P.S and Agarwal, V.K. 1993. Genetics. S.Chand and Company Ltd., New Delhi, India.
2. Weaver, R.F. and Hedrick, P.W. 1989. Genetics. Wm. C. Brown Publishers. USA.

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| | | | |
|------------|----------------------|---------------|-------|
| Course | : IMB (Core Paper-4) | Int. Marks | : 25 |
| Year & Sem | : II Year; IV sem | Ext. Marks | : 75 |
| Sub. Code | : IMB41 | Max. Marks | : 100 |
| Hours/Week | : 4 | No of Credits | : 4 |

Title of the Paper: **Molecular Biology and Microbial Genetics**

Course Objective

- To learn the fundamentals of Molecular Biology
- To understand the regulation, expression and transfer mechanisms of genes

Unit I

DNA- genetic material- Griffith and Chase experiment; chemical composition, Chargaff rule – Watson and Crick model, Palindromic sequence DNA conformations - A, B and Z.

RNA- Chemical composition, structure of mRNA, tRNA, rRNA and siRNA

Properties-Melting curves, cot ½ value, hypochromicity

Unit II

Replication – semiconservative mode of replication – leading and lagging strands-Meselson and Stahl experiment-Enzymology of DNA replication, Types of replication – rolling circular model, Uni and Bi directional replications.

Unit III

Genetic code and its characteristics.

Mutation - Types – mutagens-.

DNA Repair mechanisms-Light dependent (Photoreactivation) and Light independent (Excision, recombination and SOS).

Unit IV

Transcription – Initiation, RNA Polymerase – Elongation – termination rho dependent, rho independent, NUS A protein, antitermination. Posttranscriptional modifications.

Translation-Initiation – binding of ribosomes on mRNA- shine Dalgarno sequence-activation of amino acids – IF Elongation – peptide formation – translocation – EF – Termination – Peptide termination – Releasing factors-posttranslational modifications.

Unit V:

Lactose operon concept in *E. coli*

Plasmids and Types- F, Col and R plasmids Conjugation.

Transformation – mechanism of DNA uptake.

Transduction – mechanism of generalised and specialised transduction.

Text Books:

1. Friefelder, D 2009. Molecular Biology, II Edn, Narosa Publishing house, New Delhi, India
2. Weaver, R.F. 1999. Molecular Biology. McGraw Hill. New York.

Reference Books:

1. Allison, L.A., 2007. Fundamental Molecular Biology, Blackwell Publishing, USA.
2. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett publishers Inc, London UK.
3. Turner, P.C., A.G.McLennan, A.D.Bates and M.R.H.White, 1999, Instant notes in Molecular Biology, Viva Books Limited, New Delhi.
4. 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.
5. Wolfe, L.S., 1993 Molecular and Cellular Biology, Wadsworth publishing company.

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| | | | |
|-------------|--------------------------|---------------|-------|
| Course | : IMB (Core Practical-4) | Int. Marks | : 40 |
| Year & Sem. | : II Year; IV sem | Ext. Marks | : 60 |
| Sub. Code | : IMBL41 | Max. Marks | : 100 |
| Hours/Week | : 2 | No of Credits | : 2 |

Title of the Paper : **Lab in Molecular Biology and Microbial Genetics**

1. Extraction and estimation of DNA
2. Extraction and estimation of RNA
3. Determination of melting curve of DNA
4. UV irradiation and photoreactivation.
5. Isolation of petite mutants
6. Isolation of phage
7. Isolation of mutant colonies by Gradient plate method.
8. Isolation of mutant colonies by Replica plate method.
9. Determination of Minimum Inhibitory concentration
10. Determination of Minimum Bactericidal Concentration
11. Extraction and estimation of nucleic acids.
12. Isolation of auxotrophic mutants
13. Isolation of Lac- and Lac+ colonies
14. AMES test

Reference Books:

1. Ausubel, F.M., Roger, B., Robert E.Kingston, David A. Moore, Seidman J.G., John A. Smith and Kelvin, S. 1992. Thrid Edition, Short Protocols in Molecular Biology, John Wiley & Sons Inc., New York.
2. Berger, S.L. and Kimmel, R. 1987. Guide to Molecular Cloning Techniques, Academic Press, Inc., New York.
3. Brown, T.A. 1998. Molecular Biology Lab; Gene Analysis, Academic Press, London.
4. Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.
5. Miller, J.H. 1992. A Short Course in Bacterial Genetics: A Lab Manual & Hand Book for *E. coli* and related Bacteria. Cold spring Harbor Lab press, Cole Spring Harbar
6. Rajamanickam, C.2001 Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
7. Sambrook, I., Fritsch, E.F. and Maniatis, T. 1989. Second Edition, Molecular Cloning 1, 2, 3 - A Laboratory Manual, Cold Spring Laboratory Press, USA.

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|--------------------|----------------------------------|---------------|------|
| Course | : IMB (Major Elective-3) | Int. Marks | : 15 |
| Year & Sem. | : II Year; IV Sem | Ext. Marks | : 35 |
| Sub. Code | : IMBME43 | Max. Marks | : 50 |
| Hours/Week | : 2 | No of Credits | : 2 |
| Title of the Paper | : Medical Microbiology-II | | |

Course Objectives:

- To know about morphology and pathogenesis of different fungi & parasites
- To understand the pathogenesis mechanism

Unit I

Mycology –General characteristics, life cycle and pathogenesis of
Filamentous fungi – *Aspergillus*, *Tinea*
Non- filamentous fungi – *Candida*, *Cryptococcus*

Unit II

Parasitology – Morphology and life cycle of
Protozoan parasites- *Plasmodium*, *Entamoeba histolytica*
Helminthic parasites-*Ascaris lumbricoides*, *Wuchereria bancrofti*

Activity-Visit to clinical lab

Text Books:

1. Ananthanarayanan and Jeyaram Paniker C.K. 2009. Text Book of Microbiology, 8th Ed. Orient Longman, Chennai.
2. Rajan,S. 2009 Medical Microbiology, M.J.P.Publishers, Chennai

Reference Books:

1. Chakraborty P., 1995. A Text Book of Microbiology, New Central Book Agency (P) Ltd., Calcutta.
2. Cook, G.C.1996 Manson's tropical diseases. 20th ed. WB Saunders Co. Ltd. London
3. Cox FEG. 1993 Modern Parasitology. London; Blackwell Scientific Publication
4. Greenwood, D., Slack, R.C.B and Peutherer, J.F. 2009. Medical Microbiology, 17th Edn. Churchill Livingstone. U.K.
5. Mims,C., Dockrell, H.M., Goering, R.V., Roitt, I., Wakelin, D., Zuckerman, M. 2004. Medical Microbiology 3rd Edition, Elsevier Publications, London.
6. Mukherjee, K.L., 2010 Medical Lab Technology, Tata Mc Graw Hill Publication.
7. Rajeshwar Reddy, K. 2009. Medical Microbiology, New Age International Publishers, New Delhi

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| | | | |
|------------|--------------------------------------|---------------|------|
| Course | : IMB (Skill Based Elective Paper-3) | Int. Marks | : 15 |
| Class/Sem | : IIYear; IV sem | Ext. Marks | : 35 |
| Sub. Code | : IMBSE2 | Max. Marks | : 50 |
| Hours/Week | : 2 | No of Credits | : 3 |

Title of the Paper: **Bioinformatics**

Course Objective

- Introduce basic in silico approaches to the students
- Learn “from sequence to structure prediction” –concept
- To familiarize students in applying bioinformatic tools in biomedical research.

Unit I

Internet concepts- Applications of Bioinformatics. Biological databases- DNA and protein- primary, secondary, specialized and structural databases (PDB, CATH). Sequence similarity search (FASTA and BLAST). Significance of E-value. Multiple sequence alignment (Clustal W) and conserved domain search (CDS). Introduction to ORF and primer designing.

Unit II

Phylogenetic analysis- phylogenetic tree construction (Neighbor Joining method and Maximum parsimony).
3D structure prediction: 2D GOR, Chou –Fasman, Hidden Markov method
Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure. Data mining for drug designing and docking analysis.

Text Books

1. Attwood, T.K. and Parry, D.J – Smith, D.J. 2005. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd.
2. Twyman, R.H. 2003. Instant notes on Bioinformatics. Viva Books Pvt. Ltd., NewDelhi

Reference Books

1. Baxevanis, A.D. and Quellerie, B.F.F. 2009. Bioinformatics. A practical guide to harbour Laboratory Press, New York.
2. Lesk, M.A. 2008. Introduction to Bioinformatics. Oxford Univ. Publishers Ltd., New Delhi.
3. Mount, W. 2005. Bioinformatics sequence and genome analysis. Cold Spring
4. Pevsner, 2009. Bioinformatics and Functional Genomics. Wiley Dreamtech India the analysis of genes and proteins. II edn. Wiley-Intern Science Publication, New York.

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For those joined B.Sc (except IMB),B.A, B.Com, BBA on or after June 2014

| | |
|---|-------------------|
| Course : IMB (Non Major Elective Paper-2) | Int. Marks : 15 |
| Year& Sem. : IIYear; IV sem | Ext. Marks : 35 |
| Sub. Code : ZNME42 | Max. Marks : 50 |
| Hours/Week : 2 | No of Credits : 2 |

Title of the Paper : **Health Education** [For B.Sc/B.A/B.Com/BBA students]

Course Objectives

- Highlight the importance and role of nutrients
- To create an awareness about the importance of health and hygiene

Unit I

Dimensions and Determinants of health,
Indicators of health – Characteristics of indicators, Types of indicators,
Disease agents – Classification of disease agents- water, air, vector borne
Nutrition – Classification and functions of food, sources and requirement of Carbohydrates,
Proteins, Fats, Vitamins and Minerals, Malnutrition – Protein energy Malnutrition (PEM),
Balanced diet – Composition of balanced diet

Unit II

Water – Safe and wholesome water, criteria for water quality standards, household purification of water. Air – Health effects of air pollution, prevention and control Ventilation – Standards of ventilation, Light – The requirements of good lighting, Noise – Effects of noise exposure, Types of mental illness – Major and minor illnesses- Social pathological causes, Maternal and child health care- Immunization – Vaccines and Immunization Schedule.

Text Books:

1. Park, J.E. and Park. 2000. Text book of preventive and social medicine, 17th Edition, Banarasidas Publishers, Jabalpur.
2. Muruges, N. 2002. Health education and community pharmacy, 3rd Edition, Sathya Publishers, Madurai.

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| | | | |
|------------|----------------------|---------------|-------|
| Course | : IMB (Core Paper-5) | Int. Marks | : 25 |
| Year & Sem | : III Year; Sem.V | Ext. Marks | : 75 |
| Sub. Code | : IMB51 | Max. Marks | : 100 |
| Hours/Week | : 5 | No of Credits | : 4 |

Title of the Paper : **Microbial Physiology**

Course Objective

- To study the various physiological phenomena involved within microbes
- To study different types of extremophilic organisms

Unit I

Biochemical properties of membrane – Fluid mosaic model.

Osmosis, Diffusion: Facilitated diffusion and active transport

Group translocation across membrane

Donnan equilibrium, Nernst equation. Other transport mechanisms-iron transport

Unit II

Bioenergetics – enthalpy, entropy and free energy.

Coupling of chemical reactions – TCA cycle, Respiratory chain (ETC), Oxidative phosphorylation – chemiosmotic theory of Mitchell - efficiency of coupling.

Oxidation – Reduction potential.

Unit III

Photosynthetic equation

Oxygenic and anoxygenic types of photosynthesis

Photosynthetic microbes and their photosynthetic pigments

Light reaction in aerobic oxygenic phototrophic bacteria (Cyanobacteria)

Light reaction in anaerobic anoxygenic phototrophic bacteria (Green & Purple bacteria)

CO₂ fixation – Calvin cycle.

Unit IV

Fueling reaction in aerobic heterotrophs –glycolysis, pentose phosphate pathway, Phosphoketolase pathway Entner - Doudoroff pathway, the glyoxylate cycle.

Fueling reaction in anaerobic heterotrophs – anaerobic respiration

Unit V

Fueling reaction in chemo – organotrophs: Acetogenesis and methanogenesis.

Fueling reaction in chemolithotrophs: Hydrogen bacteria, sulphur bacteria, nitrifying bacteria. Methylotrophs and Methanotrophs. Gluconeogenesis and Glycogenesis – peptidoglycan and LPS biosynthesis. Stress response – Osmotic stress, PH, Temperature

Text Books:

1. Madigan, M.T., J.M. Martinko and J. Parker, 2000, Brock- Biology of Microorganisms, Ninth edition, Prentice Hall International Inc, New Jersey.
2. Moat, A.G., and J.W. Foster, 2009, Microbial Physiology-4th edition, John Wiley & Sons, New York.

Reference Books:

1. Atlas, R.M. 1997, Principles of Microbiology, Second edition, WCB/McGraw-Hill Co., USA.
2. Dawes, I.W., and I.W. Sutherland. 1992. Microbial Physiology, second edition. Blackwell Scientific Publications, London.
3. Doelle, H.W. 1975. Bacterial metabolism, second edition. Academic Press. New York.
4. Gottschalk, G. 1986. Bacterial metabolism, second edition. Springer – Verlag. New York.
5. Madigan, Martinko, Dunlap, Clark 2009. Brock Biology of Microorganisms 12th Edition. Pearson Publication, New York.
6. Mandelstam, J., McQuillen, K and Dawes, I.1982. Biochemistry of Bacterial Growth. third edition. Blackwell Scientific Publications, London.
7. Meenakumari, S.2006 Microbial Physiology, M.J.P.Publishers, Chennai
8. Nelson, D.L., and M.M.Cox., 2000 Lehninger, Principles of Biochemistry, Third edition, Macmillan Worth publishers.
9. Prescott, L.M., J.P.Harley and D.A. Helin, 2002, Microbiology, Fifth edition, McGraw Hill, New Delhi.
10. Rajapandian, K. 2010. Microbial Physiology. P.B.S Book Enterprises, Chennai
11. Schlegel, H.G., 1993, General Microbiology, Seventh edition, Cambridge University Press.
12. Stanier, R.Y., J.L.Ingraham, M.L.Whellis and P.R.Painter, 1986, The Microbial World, Fifth edition, Prentice Hall of India, New Delhi.
13. Sundara Rajan ,S. 2003 Microbial Physiology, Anmol Publication ,NewDelhi

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| | | | |
|-------------|----------------------|---------------|-------|
| Course | : IMB (Core Paper-6) | Int. Marks | : 25 |
| Year & Sem. | : III Year; Sem.V | Ext. Marks | : 75 |
| Sub. Code | : IMB52 | Max. Marks | : 100 |
| Hours/Week | : 5 | No of Credits | : 4 |

Title of the Paper : **Bioprocess Technology-I**

Course Objectives

- To learn the process involved in the industrial production of microbial products.
- To understand the upstream and downstream processes of fermentation.

Unit I:

Ancient and modern concepts of industrial microbiology. Isolation of industrially important strains: sources for sample collection - screening techniques – primary screening – crowded plate technique, Auxanography, enrichment technique, dye indicator and secondary screening.

Unit II:

Strain development – mutation, selection of auxotroph, protoplast fusion, parasexual reproduction and recombinant DNA techniques. Preservation techniques - serial sub-culture, mineral oil, freeze drying, N₂ storage - Storage of fungi-soil culture, silica gel culture and water storage.

Unit III:

Types of fermentation - solid state fermentation - Microbes of SSF, types of substrates. Submerged fermentation - Methods of fermentation - batch, continuous and fed batch system. Growth kinetics (Biomass in relation to substrate and time).

Unit IV:

Types and design of fermentors - General characteristics and configuration of fermentor. batch, CSTF, air lift, tower, bubble column, fluidized bed fermentor. Fermentor auxiliary equipments. sterilization of equipment and air.

Unit V:

Media - chemical composition, raw materials - saccharide, starchy, cellulose and industrial wastes. Media optimization (Response surface methodology) and sterilization (batch and continuous). Fermentation kinetics-Batch and continuous (product in relation to substrates, time and biomass) .

Text Books

1. Crueger, W. and A. Crueger, 2000. Biotechnology: A Test Book of Industrial Microbiology, 2nd edn. Panima Publishing corporation, New Delhi.
2. Patel, A.H. 1996, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.

Reference Books:

1. Casida, L.E., Jr. 1993, Industrial Microbiology, fifth edition, Wiley Eastern Ltd., New Delhi.
2. Prescott, L.M., J.P.Harley and D.A.Helin, 2002, Microbiology, fifth edition, McGraw Hill, New Delhi.
3. Stanbury, P.F., A.Whitaker and S.J.Hall, 1999. Principles of Fermentation Technology, second edition, Aditya Book (p) Ltd., New Delhi.
4. Waites, M.J., Morgan, N.L., Rockey,J.S., and Higton,G. 2001, Industrial Microbiology: An Introduction, Blackwell Science, London

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| | | | |
|------------|----------------------|---------------|-------|
| Course | : IMB (Core Paper-7) | Int. Marks | : 25 |
| Year& Sem. | : III Year; V Sem | Ext. Marks | : 75 |
| Sub. Code | : IMB53 | Max. Marks | : 100 |
| Hours/Week | : 5 | No of Credits | : 4 |

Title of the Paper: **Clinical Lab Technology**

Course Objectives:

- Learn to follow safety methods and different clinical lab techniques
- Preamble to start a clinical lab

Unit I

Laboratory designing, Code of conduct for Clinical Laboratory, SOP. - Personal hygiene for Laboratory Technologists. - National and International GLP and GMP. -Accidents-types and safety measures. -First Aid in laboratory and Precautions.

Unit II

Collection and processing of blood sample. - Determination of TC, DC, ESR, Hb, BT & CT. ABO Blood group system and determination of blood group. -Blood transfusion and Compatibility testing. -Determination of blood glucose, Urea, Cholesterol and Bilirubin. VDRL and Widal test. -Blood culture and sensitivity.

Unit III

Collection, transport and Storage of Urine sample. -Physical properties of Urine.- Chemical examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies. - Microscopic Examination of Urine – Cast Crystals and Cells. -Pregnancy Test. Urine culture and sensitivity.

Unit IV

Stool Collection and transport. Macroscopic and Microscopic examination of stool. -Chemical examination of stool. Stool Culture and sensitivity.-Occult blood and its clinical significance

Unit V

Sputum Collection and transport of specimen. Macroscopic and Microscopic examination of sputum. AFB staining. Sputum culture and sensitivity. -Collection of semen. Semen analysis – motility, total count and abnormality.

Text Book:

1. Mukherjee, L.K. 2010, Medical Laboratory Technology – 3 volumes – second edition – Hill Publishing Ltd., New Delhi.
2. Sood, R, 2010, Medical Laboratory Technology – Methods and interpretations – Seventh edition, Jaypee, New Delhi.

Reference Books:

1. Alex, C., Sonnenwirth, 1998, Gradwohl's Clinical Laboratory Methods and Diagnosis, Vol. 1&2, eighth edition, B.I. Publications Ltd., New Delhi.
2. David, S. Jacobs, Wayne R. Demott, Paul R. Finley, 1994, Laboratory Test Hand Book, third edition, Key word index, Laxi-Compinc, Hudson.
3. Jacques Wallac, L., 1986, Interpretation of Diagnostic Tests: A Synopsis of Laboratory Medicine, Little Brown and Company, Boston/Toronto, USA.
4. Kathleenbecan, M.C., Bride, 1982, Text Books of Clinical Laboratory supervision, Century Crosts, New York.
5. Ochei, J and Kolkatkar, A. 2009. Medical Laboratory Science – Theory and Practice. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.
6. Rapael, S.S., 1983, Lynch Medical Laboratory Technology, Fourth edition, W.B. Saunders Co, Singapore.
7. Woohan, I.D.P., Heather Freeman, 1990, Micro Analysis in Medical Biochemistry, sixth edition, Churchil Livingstone Publishing Ltd., USA.

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| | | | |
|--------------------|----------------------------|---------------|-------|
| Course | : IMB (Core-8) | Int. Marks | : 25 |
| Year&Sem. | : III Year; V Sem | Ext. Marks | : 75 |
| Sub. Code | : IMB54 | Max. Marks | : 100 |
| Hours/Week | : 4 | No of Credits | :4 |
| Title of the Paper | : Food Microbiology | | |

Course Objectives

- To learn the role of microbes in food preparation, preservation and spoilage
- To understand the quality of food and products

Unit I

Microbes as food: Single cell protein (SCP) and edible mushrooms.
Other food Products: Fermented meat, Idli batter & leavening of bread.
Intrinsic and Extrinsic parameters of foods that influence microbial growth.

Unit II

Fermented dairy products: Buttermilk, Sour cream, Yoghurt & Cheese.
Fermented vegetables: Sauerkraut, Olives, Soy Sauce & Pickles
Microbial fermentation: Beer, Distilled liquors (Rum, Whisky & Brandy) & Wine.

Unit III

Food spoilage: Spoilage of Milk & Milk products.
Spoilage of beer & wine,
Spoilage of vegetables, fruits, meat & canned food.

Unit IV

Parasitic infections transmitted by food: Amoebiasis & Taeniasis
Indicators of pathogens associated with Food: Coliforms, faecal coliforms, faecal streptococcal forms, *Salmonella*, *Staphylococcus* & *Pseudomonas*.
Food poisoning: *Aspergillus flavus* & *Clostridium botulinum*

Unit V

Physical preservation methods: Asepsis, filtration & centrifugation, high & low temperature & Pasteurization, desiccation, radiation, anaerobiosis, canning and controlled atmosphere.

Chemical preservation methods: Salt, Sugar, organic acid (Benzoic acid, Sorbic acid, propionates, acetic acid & lactic acid), nitrates, nitrites, sulfur dioxide, ethylene dioxide, propylene oxide, wood smoke and antibiotics.

Text Books:

1. Adams, M.R and M.O.Moss, 2006, Food microbiology, New Age international (P) Ltd., New Delhi.
2. Frazier, W.C., and D.C.Westhoff, 2005, Food Microbiology, Sixth edition, Tata McGraw-Hill Publishing Ltd., New Delhi.

Reference Books:

1. Banwart,G.J., 1987, Basic Food Microbiology, CBS Publishers & Distributors, New Delhi.
3. Deak, T, and L.R.Beuchat, 1996, Hand Book of Food Spoilage Yeasts, CRC Press, New York
4. Garbutt,J., 1997, Essentials of Food Microbiology, Arnold-International Students'edition, London.
4. Jay,J.M, 1996, Modern Food Microbiology, CBS Publishers & Distributors, ND
5. Joshi, V.K. and Ashok Pandey (Eds), 1999, Biotechnology: Food fermentation Vol.II, Educational Publishers and Distributors, New Delhi.
6. Kulshreshtha, S.K. 1994, Food Preservation, Vikas Publishing House Pvt. Ltd.,New Delhi

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| | | | |
|------------|---------------------------|---------------|-------|
| Course | : IMB (Core Practical -5) | Int. Marks | : 40 |
| Year & Sem | : III Year; V Sem | Ext. Marks | : 60 |
| Sub. Code | : IMBL51 | Max. Marks | : 100 |
| Hours/Week | : 3 | No of Credits | : 2 |

Title of the Paper : **Lab in Microbial Physiology & Food Microbiology**

1. Biochemical characterization of any bacterium--IMViC, oxidase and catalase
2. Estimation of Alkaline phosphatase activity
3. Derivation of Michaelis – Menten Constant and V-max of alkaline Phosphatase.
4. Changes in protein conformation due to pH, temperature, ionic concentration by observing UV-spectra.
5. Extraction and Identification of lipids by TLC.
6. Estimation of Cellulase activity.
7. Specific tests for amino acids
8. Vitamin C assay
9. Starch, casein and lipid hydrolysis
10. Demonstration of Hill reaction
11. Methylene Blue Reductase Test
12. Effect of temperature, pH on bacterial growth.

Reference Books:

1. Aneja, K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
2. Cappuccino, J.H. and Sherman, N. 1992. Microbiology – A Lab Manual, Third Edition, The Benjamin Publishing Company, Singapore.
3. David T. Plummer, 2008. An introduction to practical Biochemistry, Third Edition, Tata Mc Graw Hill publishing Com. Ltd., New Delhi.
4. Gunasekaran, P. 1995. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
5. Jayaraman, J. 1981. Laboratory Manual in Biochemistry, New Age International (Pvt.) Ltd. Publishers, New Delhi.
6. Kannan, N. 1996. Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
7. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
8. Sawhney, S.K. and Nandhir singh, 2000. Introductory practical Biochemistry, Narosa Publishing house, New Delhi.
9. Wilson, K. and Walker, J. 1986. (Low Price Edition 1995) Principles and Techniques of Practical Biochemistry, CUP, Cambridge.

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|------------|--------------------------|---------------|-------|
| Course | : IMB (core Practical-6) | Int. Marks | : 40 |
| Year & Sem | : III Year; V Sem | Ext. Marks | : 60 |
| Sub. Code | : IMBL52 | Max. Marks | : 100 |
| Hours/Week | : 3 | No of Credits | : 2 |

Title of the Paper: **Lab in Bioprocess Technology-I**

1. Fermentors and their components.
2. Demonstration of fermentation using Kuhne's fermentation vessel.
3. Screening of bacterial strains for enzyme production.
4. Screening of bacterial strains for antibiotic production.
5. Production of Citric acid by *Aspergillus niger* by Solid State fermentation.
6. Sudan black and Nile blue staining for screening of bacterial polymer producers
7. Production of protease by *Bacillus subtilis*
8. Yeast cell immobilization
9. Alcohol fermentation by *Saccharomyces cerevisiae*.
10. Estimation of alcohol using Potassium Di-chromate method.
11. Biogas (Methane) production.
12. Drop collapse test

Reference Books

1. Anuj Kumar Rana, 2012. Downstream Processing Techniques in Biotechnology. Global Academic Publishers, New Delhi.
2. Kulanthaivel, S and S. Janarthanan 2012. Practical Manual on Fermentation Technology. I.K. International publishing house. New Delhi
3. Pepler, H,J and Periman,D. 2008. Microbial Technology Fermentation Technology, (Two Volumes) Second Edition, Elsevier, Academic Press. U.K.
4. Ponmurugan, P., R.Nithya and M.Fredinose 2012. Experimental Procedure in Bioprocess Technology and Downstream Processing. Anjana Book House. Chennai

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|-------------|---------------------------|---------------|-------|
| Course | : IMB (core Practical- 7) | Int. Marks | : 40 |
| Year & Sem. | : III Year; V Sem | Ext. Marks | : 60 |
| Sub. Code | : IMBL53 | Max. Marks | : 100 |
| Hours/Week | : 3 | No of Credits | : 2 |

Title of the Paper: **Lab in Clinical Lab Technology**

1. Total W.B.C. & R.B.C. count
2. Differential leukocyte count
3. Determination of Bleeding & Clotting time
4. Determination of ESR
5. Estimation of Haemoglobin (sahli method)
6. Estimation of Blood Sugar (O Toluidene method)
7. Estimation of blood Urea (Zaks method)
8. Estimation of serum Cholesterol
9. Estimation of serum bilirubin (Haslewood and king method)
10. Urine sample analysis to detect sugar, Albumin, Ketone bodies and bile salts
11. Urine – Microbial Culture and Sensitivity
12. Separation of Serum protein by electrophoresis
13. Semen analysis – Motility and Total count.

Reference Books

1. Ashok, R. 2000. Antimicrobials in Laboratory Medicine, B.I. Churchill Livingstone. New Delhi.
2. Collee, J.G., A.G. Fraser, B.P. Marmion and A. Simmons 2007. Mackie and McCartney Practical medical Microbiology. Elsevier, New York.
3. Ranjan Kumar De, 2007. Diagnostic Microbiology, (For DMLT Students) Jaypee Brothers publishing, New Delhi.

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|--------------------|-----------------------------|---------------|------------|
| Course | : IMB (Self study paper-1) | Ext. Marks | : 100 |
| Year & Sem | : IIIYear; V Sem. | Max. Marks | : 100 |
| Sub. Code | : ZSS51 | No of Credits | :5 (Extra) |
| Title of the Paper | : Health and Hygiene | | |

Course Objectives

- Highlight the importance and role of nutrients
- To create an awareness about the importance of health and hygiene

Unit I

Dimensions and Determinants of health,
Indicators of health

Nutrition – Classification and functions of food, sources and requirement of Carbohydrates, Proteins, Fats, Vitamins and Minerals, Malnutrition – Protein energy Malnutrition (PEM),
Balanced diet – Composition of balanced diet

Unit II

Water – Safe and wholesome water, criteria for water quality standards, household purification of water. Air – Health effects of air pollution, prevention and control Ventilation – Standards of ventilation, Light – The requirements of good lighting, Noise – Effects of noise exposure, Types of mental illness – Major and minor illnesses, Causes of mental ill health – Social pathological causes, Preventive aspects – primary – Secondary – Tertiary, Immunization – Vaccines and Immunization Schedule, Principles of disease control and prevention.

Text Books:

1. Muruges, N. 2002. Health education and community pharmacy, 3rd Edition, Sathya Publishers, Madurai.
2. Park, J.E. and Park. 2000. Text book of preventive and social medicine, 17th Edition, Banarasidas Publishers, Jabalpur.

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|--------------------|----------------------|---------------|-------|
| Course | : IMB (Core Paper-9) | Int. Marks | : 25 |
| Year & Sem | : III Year; VI Sem | Ext. Marks | : 75 |
| Sub. Code | : IMB61 | Max. Marks | : 100 |
| Hours/Week | : 5 | No of Credits | : 4 |
| Title of the Paper | : Immunology | | |

Course Objective

- To introduce the basic principles and mechanisms involved in imparting immunity
- To recognize the significance of immune system and vaccines for maintaining human health

Unit I

History of Immunology: Contributions of Edward Jenner –Louis Pasteur – Elie Metchnikoff -
Types of immunity: Innate-anatomic, physiologic, phagocytic, and inflammatory–Acquired or
Adaptive –antigenic specificity – diversity- Immunologic memory–self/nonself recognition
Humoral–Cell-mediated immunity

Organs of immune system: Primary- Thymus & Bone marrow; Secondary – spleen –lymph
nodes – GALT & MALT. Cells: Lymphocytes (T& B) – Macrophages, NK cells – APCs -
Role.

Unit II

Antigens – Haptens – Adjuvant – Epitopes – Requirements for immunogenicity –Antigens Vs
Immunogens – Antigenic Peptides

Antibodies: Immunoglobulins – Domain structure – classes – IgG, IgA, IgM, IgD, IgE
Characteristics- Isotypes– Allotypes-Idiotypes– Humoral mediated immunity – Clonal
selection theory (N.K. Jerne) - Antigen–Antibody interactions –Primary interaction,
Secondary phenomena – Agglutination, Precipitation-kinetics of antibody response - primary
and secondary — Hybridoma Technology – Monoclonal Antibodies – Applications.

Unit III

Complement factors – Classical – Alternate Pathways-Lectin pathway-biological
functions.Cell mediated immunity – Cytokines – types – Network – Role in immune
regulation. Hypersensitivity reaction – Type I, II, III, IV. Tolerance – definition – types -
Autoimmunity–organspecific-Grave's disease - Myasthenia gravis-Hashimoto's thyroiditis-
Systemic-Rheumatoid arthritis-Multiple sclerosis-Systemic lupus erythematosus (SLE).

Unit IV

Transplantation antigens-Erythrocyte antigens-MHC – HLA – Class I & Class II Antigens –
Immunologic Basis of Graft Rejection -Allograft rejection –cells involved– GVHD –
Prevention of graft rejection.

Tumor Antigens –Immunity to tumor-Tumor evasion mechanisms-Immunodiagnosis –Tumor
therapy.

Unit V

Immunodeficiencies- Primary – B & T Cell deficiencies, combined – secondary- acquired –
HIV – AIDS. Vaccines: Types- Attenuated – Killed – Purified proteins (Toxoid) –
Recombinant Vaccines. Immunization schedule, Active & Passive immunization.

Text Books:

1. Coico, R., Sunshine, G., Benjamini, E., 2003 Immunology: A Short Course VI edition. Wiley-Blackwell, New York
2. Goldsby, R.A., T.J. Kindt., B.A. Osborne, Kuby. J. 2002. Immunology. Fifth edition. W.H. Freeman and Company, New York.

Reference Books:

1. Abbas, A.K., A.H. Lichtmann and Y.S. Pober. 2000, Cellular and Molecular Immunology, fourth edition, W.B. Saunders company, London.
2. Coleman, R.M., M.F. Lombard., & N.E. Sicard. 1992. Fundamental Immunology, second edition, Wm.C. Brown Publishers, USA.
3. Cruse, J.M. & R.E. Lewis. 1998. Atlas of Immunology. CRC Academic Press. New York.
4. Goldsby, R.A., T.J. Kindt., & B.A. Osborne. 2000. Kuby Immunology. Fourth edition. W.H. Freeman and Company, New York.
5. Roitt., Brostoff J. and Male D. 2001 Immunology VI edition, Mosby, London.
6. Nandhini Shetty. 1993. Immunology – Introductory Text Book, Wiley Eastern Limited, New Delhi.

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|-------------|---------------------------|---------------|-------|
| Course | : IMB (core Practical- 8) | Int. Marks | : 40 |
| Year & Sem. | : III Year; VI Sem | Ext. Marks | : 60 |
| Sub. Code | : IMBL61 | Max. Marks | : 100 |
| Hours/Week | : 3 | No of Credits | : 2 |

Title of the Paper : **Lab in Immunology**

- 1) Virtual dissection and onscreen display of lymphoid organs of chick and mouse
- 2) Preparation of soluble, particulate and cellular antigens.
- 3) Demonstration of immunization routes, repetitive bleeding technique in fish and Separation and preservation of serum/complements.
- 4) Virtual demonstration of repetitive bleeding technique and injection routes in mouse, rat and rabbit.
- 5) Natural resistance by bacterial killing using unimmunized serum
- 6) Direct haemagglutination assay
- 7) Passive haemagglutination assay
- 8) Bacterial agglutination assay
- 9) WBC differential count with reference to innate and adaptive immunity.
- 10) Separation of lymphocytes from peripheral blood using density gradient centrifugation
- 11) T and B-lymphocytes and separation by nylon wool column method.
- 12) Cellular immunity – scale allograft rejection in fish.
- 13) Complement mediated haemolysis.

Reference books:

1. Garvey J.S., Cremer N.E., Sussdorf D.H., 1983 Methods in Immunology, 3rd ed., Benjamin / Cummins Publishing, London.
2. Hudson. L., Hay F.C., 1989 Practical Immunology, , 3rd ed., Blackwell Publishing, London.
3. Stites D.P., Terr A.L., Parslow T.G., 1994. Basic and Clinical Immunology, Prentice Hall Publishing, Canada.

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|--------------------|------------------------|---------------|-------|
| Course | : IMB (Core Paper-10) | Int. Marks | : 25 |
| Year & Sem | : III Year; VI Sem | Ext. Marks | : 75 |
| Sub. Code | : IMB62 | Max. Marks | : 100 |
| Hours/Week | : 5 | No of Credits | : 4 |
| Title of the Paper | : Biotechnology | | |

Course Objective

- Introduce the basic principles of Genetic Engineering
- To learn various methods of gene transfer and manipulation

Unit-I

Tools for Genetic engineering – restriction endonucleases (I, II, III) – modifying enzymes – ligases, alkaline phosphatase, S1 Nuclease, PNKase -E.coli as a host – Plasmids – Phages (λ , M13) – Cosmids – Phagemids – YACs – BACs Expression vectors.

Unit-II

Different strategies of cloning – genomic libraries – cDNA libraries – Gene tagging – introduction to molecular marker technology. Methods of direct transformation – PEG mediated – microinjection – particle bombardment – electroporation. Methods of indirect transformation using *A.tumefaciens* – screening of recombinant clones.

Unit –III

Animal cell and tissue culture –natural and defined media – suspension cell culture (lymphocyte culture) – adherent cells culture (fibroblast culture) – development and maintenance of cell lines – cell hybridization – cryopreservation – stem cell isolation and culture – Gene therapy

Unit- IV

Plant cell and tissue culture, media, explant culture callus culture - Protoplast fusion techniques- Organogenesis – direct and indirect – meristem culture for virus-free plants– Micropropagation – synthetic seeds. Germplasm conservation, Gene bank, Seed bank, Pollen bank-Bioethics- social issues

Unit-V

DNA sequencing methods- Sanger, Maxam- Automated sequencing
Principles and applications of blotting techniques. - DNA finger printing – RFLP, STR- Polymerase chain reaction - types of PCR- Nested, Reverse Transcriptase –DNA Microarray, RNAi

Text Books:

1. Gupta, P.K., 2004 Biotechnology and Genomics, Rastogi & Co., Meerut
2. Primrose, S.B and R.M.Twyman 2009.Principles of Gene Manipulation and Genomics, Seventh edition, Blackwell Publishers, UK.
3. Satyanarayana V. 2010. Biotechnology, Books and Allied (P) Ltd. Kolkata, India

Reference Books:

1. Brock, J.D. 1990. The emergence of Bacterial Genetics. Cold-Spring Harbor Laboratory Press, New York.
2. Brown, T.A. 1995. Gene Cloning: An introduction. III edn. Chapman & Hall, London.
3. Darbeshwar Roy, 2010. Biotechnology .Narosa Publishing House, New Delhi.
4. Glazer, A.N. and H.Nikaido 2008. Microbial Biotechnology 2nd Edition Cambridge University Press, New Delhi.
5. Ignacimuthu, S.J., 2001, Methods in Biotechnology, Phoenix Publishing House Pvt., Ltd., New Delhi.
6. Jogdand, S.N., 2009, Gene Biotechnology, Himalaya Publishing House, New Delhi.
7. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett publishers Inc, London UK.
8. Old, R.W. and S.B. Primrose, 2003, Principles of Gene Manipulation, Blackwell Scientific, London.
9. Patnaik, B.K., T.C. Kara, S.N.Ghosh and A.K.Dalai.2012. Text Book of Biotechnology. Tata McGraw Hill, New Delhi.
10. Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Science, Oxford.
11. Trevan, M.D., S.Boffey, K.H. Goulding and P.Stanbury, 1990, Gene Biotechnology – Himalaya Publishing House, New Delhi.

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| | | | |
|------------|-----------------------|---------------|-------|
| Course | : IMB (Core Paper-11) | Int. Marks | : 25 |
| Year & Sem | : III Year; VI Sem | Ext. Marks | : 75 |
| Sub. Code | : IMB63 | Max. Marks | : 100 |
| Hours/Week | : 5 | No of Credits | : 4 |

Title of the Paper: **Agricultural Microbiology**

Course Objective

- To elaborate the role of microbes in plant growth
- To explain the importance of microbial pesticides over chemical pesticides

Unit I

General account of Biofertilizers.

Rhizobium: taxonomy, physiology of N₂ fixation, host-rhizobium interaction, (Physiology and genetics) Mass cultivation, carrier-based inoculants.

Unit II

Azospirillum – rhizosphere, competence and host plant specificity, taxonomy and physiology, carrier based inoculum, associative effect of different microorganisms.

Azotobacter – Systematic position, Characteristics, ecology, physiology, crop response, maintenance and mass cultivation.

Rhizosphere and Phyllosphere, root exudates, influence of rhizosphere on crop productivity, Plant growth promoting rhizobacteria

Unit III

Cyanobacteria (Blue green algae), Azolla and Anabaena-azolla association, nitrogen fixation, factors affecting growth, mass production & cultivation, blue green algae and Azolla in rice cultivation.

Mycorrhizal association: taxonomy, occurrence and distribution, phosphorus nutrition, phosphate mobilisation, growth and yield, collection of arbuscular Mycorrhiza (AM), isolation, stock plants and inoculum production of AM.

Unit IV

Transmission and Mechanism of Plant pathogenicity

Symptoms of Plant diseases.-Plant – microbe interaction – commensalism, mutualism.

Viral Diseases – Tobacco-mosaic, Bunchy top-Banana, Tomato Spotted wilt.

Bacterial Diseases – Potato Scab, Citrus Canker, Blight

Fungal Diseases-Smuts, Rusts, Leaf spots.

Factors affecting disease incidence.

Plant disease resistance

Unit V

Disadvantages of Chemical pesticides.

Advantages of Biopesticides and its limitations,

Bacterial pesticides: *Bacillus thuringiensis*

Fungal pesticides: Entomopathogenic fungi- *Beauveria bassiana*,

Viral pesticides : NPV, CPV, GV.

Phytotoxins: Neem derivatives

Text Books:

1. Rangaswami, G., and D.J.Bagyaraj, 2009, Agricultural Microbiology, Second edition, Prentice-Hall of India Private Limited, New Delhi.
2. Subba Rao, N.S., 2000. Advances in Agricultural Microbiology, Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi.

Reference Books:

1. Agrios, G.N., 1997. (Indian first print 2000), Plant pathology, fourth edition, Replica Press Pvt. Ltd., New Delhi.
2. Atlas, M., 2000. Microbiology-Fundamentals and Applications, Collier MacMillan Publication, London.
3. Blaine Meeting, F. 1993. Soil Microbial Ecology. Marcel Dekker Inc. New York.
4. Metting, Jr. F.B., 1993. Soil Microbial Ecology, Harcel Dekker Inc., New York.
5. Rangaswami,G., 1988. Diseases of Crop Plants in India, Third edition, Prentice-Hall of India Private Limited, New Delhi.
6. Somasegaran, P., and H.J. Hoben, 1994. Handbook for Rhizobia, Methods in Legume – Rhizobium Technology, Springer- Verlag, New York.
7. Subba Rao, N.S, 1995. Soil Microorganisms and Plant Growth, Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi.
8. Subba Rao. N.S., 1988. Biofertilizers in Agriculture, Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi.

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|------------|-----------------------|---------------|-------|
| Course | : IMB (Core Paper-12) | Int. Marks | : 25 |
| Year & Sem | : IIIYear; Sem.VI | Ext. Marks | : 75 |
| Sub. Code | : IMB64 | Max. Marks | : 100 |
| Hours/Week | : 4 | No of Credits | : 4 |

Title of the Paper : **Bioprocess Technology II**

Course objectives:

- To learn the process involved in the industrial production of microbial products
- To learn downstream processing and recovery of the product

Unit I:

Inoculum development - Bacterial, fungal spores, fungal mycelium. Sporulation on solidified media, solid media and submerged culture. Aseptic inoculation of inoculum in fermentors. Immobilization of cells and enzymes-methods and application.

Unit II

Production of organic acids and solvent- Anaerobic fermentation (Beer, wine, alcohol). Aerobic fermentation (Vinegar, Lactic acid, citric acid), Solvent (Acetone, Butanol, Glycerol).

Unit III:

Production of pharmaceutically important compounds - Amino acid (lysine, glutamic acid), Antibiotics (Penicillin, Streptomycin), Enzymes (Amylase, Protease), Vitamins (B₁₂, Riboflavin), Phytohormones (Gibberellic acid, Indole acetic acid).

Unit IV

Downstream processing –cell disruption-physical and chemical methods. Separation-precipitation, filtration, centrifugation, liquid-liquid extraction, chromatography, Solvent extraction, drying and crystallization.

Unit V

Microbial assay of vitamin (B₁₂), Amino acid (valine), Antibiotics (Streptomycin, erythromycin). Quality assurance (QC) of finished product-Sterility test, Pyrogen test, Ames test, Toxicity test and Self life test. Fermentation economics-Process cost, recovery cost and market potential.

Text Books

1. Crueger, W. and A. Crueger, 2000. Biotechnology: A Text Book of Industrial Microbiology, 2nd edn. Panima Publishing corporation, New Delhi.
2. Patel, A.H., 1996, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.

Reference Books:

1. Casida, L.E., Jr. 1993, Industrial Microbiology, fifth edition, Wiley Eastern Ltd., New Delhi.
2. Prescott, L.M., J.P.Harley and D.A.Helin, 2002, Microbiology, fifth edition, McGraw Hill, New Delhi.
3. Stanbury, P.F., A.Whitaker and S.J.Hall, 1999. Principles of Fermentation Technology, second edition, Aditya Book (p) Ltd., New Delhi.
4. Waites, M.J., Morgan, N.L., Rockey,J.S., and Highton,G. 2001, Industrial Microbiology: An Introduction, Blackwell Science, London

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|---|---------------------------|---------------|-------|
| Course | : IMB (Core Practical -9) | Int. Marks | : 40 |
| Year & Sem | : III Year; VI Sem | Ext. Marks | : 60 |
| Sub. Code | : IMBL62 | Max. Marks | : 100 |
| Hours/Week | : 3 | No of Credits | : 2 |
| Title of the Paper: Lab in Biotechnology | | | |

1. Isolation of Genomic and Plasmid DNA
2. Restriction digestion analysis
3. Agarose gel electrophoresis of DNA
4. S D S - P A G E
5. Demonstration of cloning
6. Pairwise sequence alignment (BLAST)
7. Multiple sequence alignment (CLUSTAL –W)
8. Transformation – Demonstration
9. Preparation of synthetic seeds
10. Protoplast Isolation
11. Western blotting - demonstration

Reference Books:

1. Ausubel, F.M.1997. Short Protocosl in Molecular Biology, Second Edition, John Wiley & Sons. Harvard Medical School.
2. Brown, T.A. 1998. Molecular Biology Lab Fax II Gene analysis, Second Edition, Academic Press, UK.
3. Glover, D.M. and Hames, B.D. 1995. DNA cloning – A practical approach, Vol. 1 w-4, IRC Press.
4. Janarthanan, S. and Vincent, S. 2007. Practical Biotechnology: Methods and protocols, University Press.
5. Sambrook, J., Fritsch, E.F. and Maniatis, T. 1989. Molecular Cloning – A lab manual. Vol. III – Second Edition CSH Press, Cold spring harbor.
6. Swami, P.M. 2009. Lab Manual of Biotechnology. Rastogi Publications, Meerut.

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|------------|----------------------------|---------------|-------|
| Course | : IMB (Core Practical -10) | Int. Marks | : 40 |
| Year & Sem | : III Year; VI Sem | Ext. Marks | : 60 |
| Sub. Code | : IMBL63 | Max. Marks | : 100 |
| Hours/Week | : 3 | No of Credits | : 2 |

Title of the Paper: **Lab in Agricultural Microbiology**

1. Enumeration of Microbial population from rhizosphere & Non-rhizosphere soil
2. Isolation of Azotobacter using soil plating method.
3. Isolation of Azospirillum
4. Isolation and staining of Arbuscular Mycorrhizal spores from soil (AM)
5. Isolation of Rhizobium sps. from root nodules of legumes
6. Isolation of Cyanobacteria from soil.
7. Isolation of fungal pathogens from plants – leaf, stem & fruits
8. Isolation of phosphate solubilising bacteria
9. Isolation of bacterial pathogens from plants
10. Production and estimation of IAA.
11. Production and estimation of HCN.

Reference Books:

1. Aneja K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture, Wishwa Prakashan, New Delhi.
2. Harrigan, W.F. 1998. Laboratory Methods in Food Microbiology, Third Edition
3. Reddy, S.M. and Ram Reddy, S.R. 2000. Microbiology - A Laboratory Manual, BSC Publishers & Distributors.
4. Thangaraj, M. and Santhana Krishnan, P. 1998. Practical Manual on Microbial inoculants, Centre of advanced studies in agricultural University, TNAU, Coimbatore.

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| Course | : IMB (Skill Based Elective-III) | Int. Marks | : 15 |
| Year & Sem | : IIIYear; VI Sem | Ext. Marks | : 35 |
| Sub. Code | : ZSBE3 | Max. Marks | : 50 |
| Hours/Week | : 2 | No of Credits | : 2 |
| Title of the Paper: Nanobiotechnology | | | |

Course Objective

- To explain the importance of nanoscience in biology
- To learn the application of nanostructures in biomedical science

Unit I

Bionanotechnology: Fundamental concepts, scope and application.

Different types of nanoparticles: Metallic nanoparticles: Gold/silver, titanium based,
Non metallic nano particles: carbon and silicon based.

Characterization of nanoparticles: Spectrometry: UV-visible, FTIR;

Microscopic: AFM, Scanning and Transmission
Electron microscopy;

Structural: XRD.

Unit II

Biomedical applications of nanoparticles in:

Targeted drug delivery: liposomes, nanoshells and hydrogels.

Imaging technique: quantum dots and magnetic nanoparticles

Implants: orthopaedic and vascular

Bionanosensors: nanocantilevers based on single stranded DNA

Activity- Visit to Instrumentation centre

Text Books

1. Subbiah, B. 2010. Nanobiotechnology. MJ.P.Publications, New Delhi.
2. Ratner, M and Ratner, D 2005. Nanotechnology: A Gentle introduction to the next big idea. Pearson education Inc.

Reference Books

1. Pradeep, T 2006. Nano. Tata Mc Graw Publishers. India
2. Niemeyer, C.M. and Mirkin, C.A. 2006. Nanobiotechnology Concepts: Application and properties. Wiley, VCH Publishers.
3. Tuan Vo Dinh, 2007. Nanotechnology in Biology and Medicine: Method, Devices and Applications. CRC Press

Ancillary Papers

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY
(From 2014-2017 batch onwards)
B.Sc., Industrial Microbiology
Revised Ancillary Zoology Syllabus
For Botany and Chemistry Major Students – w.e.f. 2014 June

| Major | Year | Sem | Code | Title of the Paper | Cont Hrs/W | Credit |
|------------------|------|-----|-------|--|------------|--------|
| Botany | III | V | AZ51 | Economic Zoology | 4 | 4 |
| | | VI | AZ61 | Insect Pests and Management | 4 | 4 |
| | | VI | AZL61 | Economic Zoology & Insect Pests and Management | 2 | 2 |
| Chemistry | II | III | AOZ1 | Economic Zoology | 4 | 4 |
| | | IV | AOZ2 | Clinical Chemistry | 4 | 4 |
| | | IV | AOZL1 | Economic Zoology & Clinical Chemistry | 2 | 2 |

Scheme of Examination

| Mark Statements: | Internal (CA) | External (Sum) |
|-------------------|---------------|----------------|
| Theory: | 25 | 75 |
| Practical: | 40 | 60 |

Minimum Marks required

| | Internal (CA) | External (Sum) | CA + SUM |
|------------------|---------------|----------------|----------|
| Theory | Nil | 27 / 75 | 35% |
| Practical | Nil | 21 / 60 | 35% |

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DEPARTMENT OF ZOOLOGY
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| | | | |
|------------|---|----------------|-------|
| Course | : Allied Chemistry & Botany | Int. Marks | : 25 |
| Class& Sem | : II Year Chem(III sem):III Year Botany(V sem). | Ext. Marks | : 75 |
| Sub. Code | : AOZ1 & AZ51 | Max. Marks | : 100 |
| Hours/Week | : 4 | No of Credits: | 4 |

Title of the Paper : **Economic Zoology**

Course Objectives:

- To understand the importance of beneficial insects and animals
- To study the rearing methods of beneficial organisms- an economic perspective

Unit I

Sericulture

Mulberry & non-mulberry silkworms - systematic position – Biology of silkworm – rearing of mulberry silkworm.

Unit II

Lac culture

Systematic position of Lac insect – Biology of lac insect – rearing of lac insect – uses of shellac

Unit III

Apiculture

Organization of Bee colony – Varieties of honey bee – Newton’s Bee hive - rearing of honey bees – bee dance – extraction of honey – Economic importance of honey.

Unit IV

Poultry

Breeds of poultry (layers and broilers) – housing (cage and deep litter) – winter and summer management – nutrition – diseases – Ranikhet, Pullorum, Aspergillosis, Coccidiosis and their control

Unit V

Aquaculture

Cultivable fishes and their characteristics – fish farming (pond construction, water quality management, fish harvesting) – preservation – economic importance of fishes
Ornamental fish culture, shrimp and prawn culture

Text Book:

1. Ahsan, J. and S.P. Sinha, 1985, A hand book on Economic Zoology, Third edition, S. Chand & company (P) Ltd., New Delhi.
2. Shukla, G.S. and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, Meerut

Reference books

1. David, B.V. 2002 Elements of Economic Entomology, Popular Book Depot, Chennai.
2. Ganga, G and J. Sulochana 1998. Introduction to Sericulture,
3. Santhanakumar,G. 1993. Aquaculture. JJ Publications, Madurai.
4. Singh, R.A. 1984 Poultry production, Kalyani publishers, New Delhi

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DEPARTMENT OF ZOOLOGY
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| | | | |
|------------|----------------------|---------------|-------|
| Course | : Allied Botany | Int. Marks | : 25 |
| Class& Sem | : III Year ; VI sem. | Ext. Marks | : 75 |
| Sub. Code | : AZ61 | Max. Marks | : 100 |
| Hours/Week | : 4 | No of Credits | : 4 |

Title of the Paper : **Insect Pests & Management**

Course Objectives

- To provide an idea the pest of agricultural, cattle, house hold and vectors
- To know different control measures

Unit I:

Pest: Definition & types, feeding habits & types of mouth parts. General characters and outline of orders Coleoptera, Lepidoptera, Hemiptera & Hymenoptera.

Unit II:

Biology, disease transmission and control of *Musca domestica* (cholera), *Anopheles stephensi* (malaria), *Culex quinquefasciatus* (elephantiasis) & *Aedes aegypti* (dengue).

Unit III:

Biology, mode of transmission, infestation and control measures of *Hypoderma lineatus*, *Tabanus striatus*, *Hippobosca equine*.

Unit IV

Life history, mode of infection, damage and control methods of major crop plants such as cotton boll worm (*Helicoverpa armigera*), sugarcane shoot borer (*Chilo infuscatellu*), rice stem borer (*Scirpophaga incertulas*) & Brinjal borer (*Leucinodes orbonalis*). Basic concept & application of integrated pest management (IPM) and Insecticide Resistance Management (IRM).

Unit V

Sorts of insect pests of house hold and stored products, their biology, mode of infestation, damage caused and control methods of cockroach (*Periplaneta americana*), silver fish (*Lepisma saccharina*), red flour beetle (*Tribolium castaneum*) & rice weevil (*Sitophilus oryzae*).

Text Books:

1. David, B.V., and T. Kumaraswami, 2000. Elements of Economic Entomology, Popular Book Depot, Chennai.
2. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.

Reference Books:

1. Ahsan, J. and S.P. Sinha, 1985, A hand book on Economic Zoology, Third edition, S. Chand & company (P) Ltd., New Delhi.
2. Fennemore, P.G. and A. Prakash, 1992, Applied Zoology, Wiley Eastern Limited, New Delhi.
3. Kotpal, R.L., S.K. Agrawal and R.P. Khetarpal, 1985, Invertebrate Zoology, Sixth edition, Rastogi publication, Meerut.
4. Nayar, K.K., T.N. Ananthakrishnan, and B.V. David, 1976. General and applied entomology. McGraw-Hill publishing company (Ltd.), New Delhi.
5. Rathinasamy, G.K., 1999. Medical entomology and elementary parasitology, Viswanathan publication, Chennai.
6. Shukla, G.S. and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, Meerut.

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DEPARTMENT OF ZOOLOGY
(From 2014-2017 batch onwards)

| | | | |
|------------|--------------------------------|---------------|-------|
| Course | : Allied lab for B.Sc., Botany | Int. Marks | : 40 |
| Class& Sem | : III Year & VI sem. | Ext. Marks | : 60 |
| Sub. Code | : AZL61 | Max. Marks | : 100 |
| Hours/Week | : 2 | No of Credits | : 2 |

Title of the Paper: **Lab on Economic Zoology and Insect Pests & Management**

Economic Zoology

1. External Morphology of *Bombyx mori*
2. Identification of lac insects
3. Identification of type of honey bees
4. Bee hives - Model
5. Broilers and layers- types
6. Estimation of Dissolved oxygen in aquarium/fish pond
7. Estimation of pH & Salinity
8. Estimation of CO₂ in aquarium/fish pond
9. Honey –Qualitative analyses

Insect Pests & Management

1. Mouthparts of Housefly, cockroach and mosquitoes
2. Life cycle of Housefly and Mosquitoes
3. Identification of pests of cattle, paddy, sugarcane and cotton
4. LC₅₀ value of a selected pesticide on mosquito larvae
5. Field study – collection, identification and preservation of insect pests and natural enemies

Reference Books:

1. David, B.V., and T. Kumaraswami, 2000. Elements of Economic Entomology, Popular Book Depot, Chennai.
2. Nayar, K.K., T.N. Ananthakrishnan, and B.V. David, 1976. General and applied entomology. McGraw-Hill publishing company (Ltd.), New Delhi.
3. Rathinasamy, G.K., 1999. Medical entomology and elementary parasitology, Viswanathan publication, Chennai.
4. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.
5. Shukla, G.S. and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, Meerut.

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DEPARTMENT OF ZOOLOGY
(From 2014-2017 batch onwards)

| | | | |
|------------|---------------------|---------------|-------|
| Course | : Allied Chemistry | Int. Marks | : 25 |
| Class& Sem | : II Year ; IV sem. | Ext. Marks | : 75 |
| Sub. Code | : AOZ2 | Max. Marks | : 100 |
| Hours/Week | : 4 | No of Credits | : 4 |

Title of the Paper: **Clinical Chemistry**

Course Objective:

- To learn the principle and applications of analytical instruments
- To learn how to analyse the urine, blood, serum

Unit I: Analytical instruments

Principle and application - colorimeter, centrifuge (types-clinical, gradient, differential) autoanalyzer, ELISA and PCR

Unit II: Urine analysis

Collection and preservation of urine sample – Physical examination (total volume, specific gravity, colour, turbidity and odour) – Chemical examination – protein (heat and acetic acid method), sugar (Benedict’s method), ketone (Rothera’s method), Bile salt and Bile pigment.

Unit III: Blood analysis

Collection of blood samples, Blood components - anticoagulants – estimation of haemoglobin (Shali’s method) – ESR (Westergren’s method) Estimation of blood sugar – GOD, BOD (enzymatic method) - estimation of blood urea.

Unit IV: Serum analysis

Serum separation – estimation of lipid profile – liver function test (bilirubin) – serum protein separation

Unit V: Hormones and Enzymes

Clinical significance of T3, T4, TSH, Alkaline phosphatase, Creatine phosphokinase, Amylase – pancreatitis.

Text books:

1. Mukherjee, K.L. 2001. Medical Lab Technology Vol I, II and III. Tata Mc Graw Hill Publishing Company Ltd. New Delhi.
2. Sood, R, 1999, Medical Laboratory Technology – Methods and Interpretations – Fifth edition, Jaypee, New Delhi.

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DEPARTMENT OF ZOOLOGY

(From 2014-2017 batch onwards)

| | | | |
|------------|----------------------------------|---------------|-------|
| Course | : Allied Lab for B.Sc. Chemistry | Int. Marks | : 40 |
| Class& Sem | : II Year & IV sem. | Ext. Marks | : 60 |
| Sub. Code | : AOZL1 | Max. Marks | : 100 |
| Hours/Week | : 2 | No of Credits | : 2 |

Title of the Paper : **Practical -1 Economic Zoology and Clinical Chemistry**

Economic Zoology

1. External Morphology of *Bombyx mori*
2. Identification of lac insects
3. Identification of type of honey bees
4. Bee hives - Model
5. Broilers and layers- types
6. Estimation of Dissolved oxygen in aquarium/fish pond
7. Estimation of pH & Salinity
8. Estimation of CO₂ in aquarium/fish pond
9. Honey –Qualitative analyses

Clinical Chemistry

1. Aminoacids separation- TLC
2. Qualitative test: URINE
 - a) Sugar, b) Albumin, c) Bile salt, d) Ketone
3. Quantitative Test: BLOOD – Estimation of
 - a) Haemoglobin, b) Sugar, c) Urea, d) Bilirubin
4. Serum protein separation (Agarose –Slide method)

Reference Books

1. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.
2. Shukla, G.S. and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, Meerut

M.Sc., Zoology

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DEPARTMENT OF ZOOLOGY
M. Sc., Zoology
Course Structure (w.e.f. 2014 -16 batch onwards)

I semester

| Course | Code | Subject/Paper | Cont Hrs/w | Credit | T.No Hrs | Max Mark CA | Max Mark SE | Total |
|--------------|-------|--|------------|-----------|------------|-------------|-------------|------------|
| Core 1 | 1PZ1 | Biological Chemistry and Biophysics | 6 | 5 | 90 | 25 | 75 | 100 |
| Core 2 | 1PZ2 | Cell and Molecular Biology | 6 | 5 | 90 | 25 | 75 | 100 |
| Lab | 1PZL1 | Lab in Biological Chemistry and Biophysics | 6 | 4 | 90 | 40 | 60 | 100 |
| Lab | 1PZL2 | Lab in Cell and Molecular Biology | 6 | 4 | 90 | 40 | 60 | 100 |
| Elective 1 | 1PZE1 | Developmental Biology and Evolution | 6 | 5 | 90 | 25 | 75 | 100 |
| Total | | | 30 | 23 | 450 | 155 | 345 | 500 |

II Semester

| Course | Code | Subject/Paper | Hrs/week | Credit | T.No Hrs | Max Mark CA | Max Mark SE | Total |
|--------------|-------|--------------------------------|-----------|-----------|------------|-------------|-------------|------------|
| Core 3 | 2PZ1 | Entomology | 6 | 5 | 90 | 25 | 75 | 100 |
| Core 4 | 2PZ2 | Microbiology | 6 | 5 | 90 | 25 | 75 | 100 |
| Lab | 2PZL1 | Lab in Entomology | 6 | 4 | 90 | 40 | 60 | 100 |
| Lab | 2PZL2 | Lab in Microbiology | 6 | 4 | 90 | 40 | 60 | 100 |
| Elective 2 | 2PZE1 | Biostatistics & Bioinformatics | 6 | 5 | 90 | 25 | 75 | 100 |
| Total | | | 30 | 23 | 450 | 155 | 345 | 500 |

III Semester

| Course | Code | Subject/Paper | Cont Hrs/w | Credit | T.No Hrs | Max Mark CA | Max Mark SE | Total |
|--------------|-------|----------------------|------------|-----------|------------|-------------|-------------|------------|
| Core 5 | 3PZ1 | Biotechnology | 6 | 5 | 90 | 25 | 75 | 100 |
| Core 6 | 3PZ2 | Immunology | 6 | 5 | 90 | 25 | 75 | 100 |
| Lab | 3PZL1 | Lab in Biotechnology | 6 | 4 | 90 | 40 | 60 | 100 |
| Lab | 3PZL2 | Lab in Immunology | 6 | 4 | 90 | 40 | 60 | 100 |
| Elective 3 | 3PZE3 | Plant Tissue Culture | 6 | 5 | 90 | 25 | 75 | 100 |
| Total | | | 30 | 23 | 450 | 155 | 345 | 500 |

IV Semester

| Course | Code | Subject/Paper | Cont Hrs/w | Credit | T.No Hrs | Max Mark CA | Max Mark SE | Total |
|--------------|-------|-------------------------------|------------|-----------|------------|-------------|-------------|------------|
| Core 7 | 4PZ1 | Animal Physiology | 6 | 5 | 90 | 25 | 75 | 100 |
| Core 8 | 4PZ2 | Ecology and Biodiversity | 6 | 5 | 90 | 25 | 75 | 100 |
| Lab | 4PZL1 | Lab in Animal Physiology | 6 | 4 | 90 | 40 | 60 | 100 |
| Lab | 4PZL2 | Lab in Ecology & Biodiversity | 6 | 4 | 90 | 40 | 60 | 100 |
| PJ | 4PZE1 | Project | 6 | 3 | 90 | 50 | 50 | 100 |
| Total | | | 30 | 21 | 450 | 180 | 320 | 500 |

A) Consolidation of Contact Hours and Credits: PG Botany

| Semester | Contact Hrs/ Week | Credits |
|-----------------|--------------------------|----------------|
| I | 30 | 23 |
| II | 30 | 23 |
| III | 30 | 23 |
| IV | 30 | 21 |
| Total | 120 | 90 |

Interdisciplinary paper: offered by the Department of Botany to M. Sc., Zoology students
Semester III: *Plant Tissue Culture

Interdisciplinary paper : Applied Zoology offered by Dept. of Zoology to M.Sc., Botany Students.

B) Curriculum Credits

| | |
|--------------|---------------|
| Core | --- 75Credits |
| Elective | ---15 Credits |
| | ----- |
| Total | 90 Credits |
| | ----- |

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DEPARTMENT OF ZOOLOGY
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| | | | |
|------------|-------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Core Paper-1) | Int. Marks | : 25 |
| Year & Sem | : I Year; I Sem | Ext. Marks | : 75 |
| Sub. Code | : 1PZ1 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 5 |

Title of the Paper : **Biological Chemistry and Biophysics**

Course Objectives:

- To understand the structure and functions of biomolecules
- To learn the structural organization of biomolecules

Unit I

Water: Structure – thermal and solvent properties – dissociation of water-pH- dissociation of weak acids – Henderson and Hasselbach equation – Buffer solutions.

Carbohydrates: Classification; Structure, properties and biological importance of ribose, deoxyribose, glucose, fructose, galactose, lactose, maltose, sucrose, starch, glycogen, cellulose and chitin.

Metabolism and its regulation: Glycolysis – Kreb's cycle – gluconeogenesis, glycogenesis, glycogenolysis, HMP shunt.

Unit II

Nucleic acid structure, synthesis and metabolism

Amino acids: Basic structure and classification- Physical and chemical properties

Biosynthesis of amino acids

Proteins: Biological significance – Classification

Levels of organization – primary, secondary, tertiary and quaternary.

Ramachandran plot.

Metabolism: Transamination, deamination and transmethylation.

Unit III

Lipids: Biological importance and classification

Structure of triglycerol, waxes, phospholipids, cholesterol and terpenes

Properties and reactions

Biosynthesis of fatty acids and cholesterol

Degradation of fatty acids and cholesterol

Ketone bodies and lipid peroxidation.

Unit IV

Vitamins: Structure, occurrence and biochemical functions

Enzymes: Properties, classification, enzyme action and regulation, enzyme kinetics, enzyme inhibitors/activators Coenzyme, isoenzyme, allosteric enzyme, abzyme and ribozyme

Unit V

Diffusion – Fick's laws, constant laws – osmotic gradient – osmotic coefficient – Gibbs Donnan equilibrium – Active transport

Laws of thermodynamics – Concept of free energy and entropy – exergonic and endergonic reaction – rate of reactions – energy activation – Arrhenius expression

Bioenergetics – Role of ATP – biological oxidation reduction reaction – redox potentials in biological system – respiratory chain and oxidative phosphorylation – high energy compounds.

Text Books

1. Ambika Shanmugam, 1998, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras.
2. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books and Allied Pvt. Ltd., Kolkata.

Reference Books:

1. Bose, S. 1982. Elementary Biophysics. Vijaya Printers, Madurai.
2. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) ltd. New Delhi.
3. Casey, E.J. 1969. Biophysics – Concepts and mechanism. East West Press. New Delhi.
4. Conn, E.E., P.K.Stumpf, G.Bruening and R.H.DoI, 1999. Outline of Biochemistry, John Wiley & Sons Inc., New York.
5. Deb, A.C. 2011. Fundamentals of Biochemistry, 10th Edition, New Central Book Agency Pvt. Ltd., Kolkata.
6. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, NewDelhi.
7. Mckee, T., and J.R.Mckee, 1996, Biochemistry and Introduction, Won.C.Brown Publishers, London.
8. Morris, J.G. 1974. A Biologist's physical chemistry. II edition. Edward Arnold – A division of Holder and Stoughton, London.
9. Nelson, D.L., and M.M.Cox, 2010, Lehninger Principles of Biochemistry, 5th edition, Worth Publishers, New York.
10. Ramarao, A.V.S.S. and Suryalakshmi, A 2009. Textbook of Biochemistry for Medical Students, 11th UVS Publishers Distributors Pvt. Ltd., New Delhi.
11. Rastogi, S.C.2010. Biochemistry, 3rd Edition, Tata McGraw Hill Edition, New Delhi.
12. Stryer, L., 2000. Fourth edition Biochemistry, W.H. Freeman and Company, New York.
13. Voet, D., and J.G.Voet, 1995, Biochemistry, second edition John Wiley & Sons Inc, New York.
14. Zubay, G. 1993, Biochemistry, third edition Won.C.Brown Communications Inc., Oxford, England.

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DEPARTMENT OF ZOOLOGY
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| | | | |
|---|-------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Core Paper-2) | Int. Marks | : 25 |
| Year & Sem | : I Year; I Sem | Ext. Marks | : 75 |
| Sub. Code | : 1PZ2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 5 |
| Title of the Paper: Cell and Molecular Biology | | | |

Course Objectives:

1. To understand the structure and functions of cell and cell organelles
2. To know about gene organization and regulation

Unit I

Structure of prokaryotic and eukaryotic (plant and animal) cells.
Cell theory, Cell types.
Working mechanism and applications of: light, phase-contrast, fluorescent, electron (TEM & SEM) and confocal microscopy: Micrometry.
Fluid mosaic model of Plasma membrane, Sodium Potassium pump

Unit II

Structure and function of: Nucleus, golgi complex, endoplasmic reticulum, mitochondria, ribosomes, lysosomes
Structure and function of: Microfilaments and microtubules.
Cell cycle, mitosis and meiosis
Chromosome – structural organization - giant chromosomes.

Unit III

Experimental evidence- DNA as genetic material
DNA: forms and types, replication (both prokaryotes and eukaryotes) and repair
RNA – types, biosynthesis, function
Plasmids – types and function
Transposons
Mutation and its types
Gene transfer - transformation, conjugation and transduction
Genetic recombination-Holliday model

Unit IV

Protein synthesis in prokaryotes and eukaryotes
mRNA splicing and its significance
Post translational modifications
Gene regulation in prokaryotes: lac and trp operon
Gene regulation in eukaryotes

Unit V

Cell signaling: G-protein coupled and TGF β receptor system
JAK/STAT, Ras and MAP kinase pathway
Cell migration and Cell-cell interaction
Cell ageing, Cell death and its regulation,
Molecular and biochemical characteristics of cancer cells

Text Books

1. Frifelder, D. 2000. Molecular Biology 2nd edition. Narosa Publishing House, New Delhi.
2. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett publishers Inc, London UK

Reference Books

1. Alberts, B. et al. 1994. Molecular Biology of the Cell (3rd edition). Garland Publishing, Inc., New York.
2. Allison LA. 2007. Fundamental Molecular Biology. Blackwell Publishing Ltd., USA.
3. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach (6th Edition). Sinauer Associates, Inc.
4. De Roberties E.D.P and E.M.F.De Roberties 2011. Cell and Molecular Biology. 8th edition. B.I. Publicatons Pvt. Ltd., India
5. Haddin J. et al. 2011 Becker's World of the Cell (8th Editon). Benjamin Cummings Publishing Company , New York
6. Karp G. 2013. Cell and Molecular Biology Concepts and Experiments. John Wiley & Sons, Inc
7. Lewin, B., 2012, Genes-X, Oxford University Press Inc., New York.
8. Lodish, Berk, Zipursky, Matsudara, Baltimore and Darnell.1999. Molecular Cell Biology, Fourth Edition, W.H.Freeman and Company, Newyork.
9. Paul, A. 2009. Cell and Molecular Biology, Books and Allied (P) ltd, India.
10. Power, C.B. 2009 Cell Biology Himalayan Publishing House, New Delhi.
11. Prakash S.L. 2007.Cell and Molecular Biology. M.J.P. publishers, Chennai
12. 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.
13. Wolfe, L.S., 1993. Molecular and Cellular Biology, Wadsworth publishing company.

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| | | | |
|------------|------------------------|---------------|-------|
| Course | : M.Sc Zoology (Lab-1) | Int. Marks | : 40 |
| Year & Sem | : I Year; I Sem | Ext. Marks | : 60 |
| Sub. Code | : 1PZLI | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 4 |

Title of the Paper : **Lab in Biological Chemistry and Biophysics**

1. Qualitative analysis of Carbohydrates.
2. Qualitative analysis of Proteins
3. Qualitative analysis of Lipids
4. pH, pKa and pH meter:
 - a. Working mechanism & determination of pH.
 - b. Titration of weak acid and strong base (titration curve)
5. Colorimeter: a. Principle and working mechanism
 - b. Verification of Beer's law
 - c. Quantitative estimation of
 - i) Carbohydrates
 - ii) Proteins
 - iii) Lipids
6. Chromatography: a. Paper chromatography
 - b. TLC
 - c. Column chromatography
7. Electrophoresis: – PAGE
8. Centrifuge - Density gradient centrifugation
9. Quantitative estimation of ascorbic acid
10. Enzymes: Analysis of amylase activity
 - Effect of substrate concentration, pH & temperature on amylase activity
11. Osmosis – Plasmolysis
12. Demonstration of Hill reaction

Reference Books:

1. Anonymous. Open Universiteit .2004, Netharland Analysis of Amino acids, Proteins and Nucleic acids, Elsevier.
2. Dua, S and N.Garg 2010. Biochemical methods of analysis, Narosa Publishing, New Delhi.
3. Plummer, D.T. 2008 An Introdcion to Practical Biochemistry, Tata McGraw- Hill Publication, New Delhi

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| | | | |
|-------------|------------------------|---------------|-------|
| Course | : M.Sc Zoology (Lab-2) | Int. Marks | : 40 |
| Year & Sem. | : I Year; I sem. | Ext. Marks | : 60 |
| Sub. Code | : IPZL2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 4 |

Title of the Paper : **Lab in Cell and Molecular Biology**

1. Observation of different types of tissues
2. Observation of Barr body
3. Observation of giant chromosomes
4. Observation of the stages of mitosis
5. Observation of the stages of meiosis
6. Quantitative estimation of nucleic acids
7. Isolation of mutant colonies by Gradient plate method.
8. Isolation of mutant colonies by Replica plate method.
9. UV-irradiation and photoreactivation experiment
10. Bacterial transformation
11. Conjugation experiment
12. Complementation test
13. Phage isolation and titration

Reference Books

1. Brown, T.A. 1998. Molecular Biology Lab; Gene Analysis, Academic Press, London.
2. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi
3. Janarthanan, S. and S.Vincent 2007. Practical Biotechnology, Methods and Protocols. University Press, Hyderabad., India
4. Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.
5. Miller, J.H. 1992. A Short Course in Bacterial Genetics: A Lab Manual & Hand Book for *E. coli* and related Bacteria. Cold spring Harbor Lab press, Cole Spring Harbar
6. Rajamanickam, C.2001. Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY
(From 2014-2016 batch onwards)

| | | | |
|--------------------|--|---------------|-------|
| Course | : M.Sc Zoology (Elective Paper-1) | Int. Marks | : 25 |
| Year & Sem | : I Year; I Sem | Ext. Marks | : 75 |
| Sub. Code | : 1PZ2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 5 |
| Title of the Paper | : Developmental Biology and Evolution | | |

Course Objectives:

- To understand the basis of development and evolution
- To learn the stages of organ development

Unit I

Gametogenesis- spermatogenesis, oogenesis; Gametes-structure and organization. Ovulation, Hormonal control of ovulation, Fertilization; Parthenogenesis.

Unit II

Cleavage, Blastulation, Gastrulation, Fate map, Morphogenetic movements, embryonic induction.
Organogenesis-Development of heart, eye, brain and kidney in Chick

Unit III

Male and female reproductive system: sexual cycle, placenta, contraceptive devices and vaccines, IVF, Twins, Embryo culture, embryo transfer, embryonic stem cells, cloning, Infertility, Teratogenesis

Unit IV

Theories of organic evolution, germ plasm theory, mutation theory, theory of biogenesis and modern synthetic theory, evidence of evolution, homologous structures, analogous structures, vestigial organs, embryological evidences, physiological and biochemical evidences, Lamarckism, Neo Lamarckism, Darwinism, Neo-Darwinism

Unit V

Modern concept of evolution, Hardy Weinberg equilibrium, genetic drift.
Species concept, types of speciation, isolation, types of isolation mechanisms, polymorphism, fossils, geological time scale, extinction, animal distribution, mimicry and colouration.

Text books

1. Balinsky, B.I 1981. An Introduction to embryology. W.B.Saunders and Co.London
2. Dobzhansky, T.1973. Evolution. Surjeet Pub. New Delhi

Reference books

1. Berril, N.J.1976. Developmental biology, Tata Mc.Graw Hill Pub.Co.Ltd.
2. Minkoff, E. 1984. Evolutionary Biology.Addison-Wesley publishing Company, California, USA
3. Theodore, H and Eaton .1970. Evolution.Thomas Nelson and Sons Ltd. Nairobi
4. Gillbert. S.F.1994. Developmental Biology. Sinauer Associates Inc. Massachusetts, USA.
5. Adams W.1986. Genetic Analysis of Animal Development. A Wiley InterScience Publication. USA.
6. Arora M.P.2009. Embryology , Himalaya Publishing House, New Delhi

Text books

1. David, B.V. 2002 Elements of Economic Entomology. Popular Book Depot, Madras.
2. Ganga, G. and Sulochana chetty, J. 1997. Introduction to Sericulture. II Edn, Oxford and IBH publishing Co Pvt. Ltd.

Reference Books

1. Chapman, R.F. 2008. The insects: Structure and Function. ELBS.
2. Chapman, R.F. and Joern, A. 1990. (eds.). Biology of Grasshoppers. John Wiley & Sons, New York.
3. Dandin, S.B., J.Jayaswal and K.Giridhar 2003. Handbook of Sericulture Technologies. Central Silkboard, Bangalore
4. David, B.V and. Ananthakrishnan, T.N. 2004. General and Applied Entomology. Tata Mc Graw Hill Publishing Co.
5. Pedigo, L.P. 2009. Entomology and Pest Management. Prentice Hall of India, New Delhi
6. Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj, K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.
7. Romoser, W.S., Stoffolano Jr, J.G. 1998, Entomology, fourth edition, WCB Mc Graw Hill Publishing Co.
8. Tembhare, D.B. 2009 Modern Entomology, Himalaya publishing house, Mumbai.
9. Wigglesworth, V.B. 1972. The principles of Insect Physiology. Chapman & Hall, New York.

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| | | | |
|---|-------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Core Paper-4) | Int. Marks | : 25 |
| Year & Sem | : I Year; II Sem | Ext. Marks | : 75 |
| Sub. Code | : 2PZ2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 5 |
| Title of the Paper: Microbiology | | | |

Course Objectives:

- To get a fundamental knowledge about microbes
- To understand the role of microbes in different spheres of life

Unit-I

Microbes in our lives

History of Microbiology- Discovery of microorganisms (Robert Hooke & Leeuwenhoek)

Contributions of Francesco Redi, Needham, Splallanzani, Pasteur, Robert Koch, Edward Jenner, Ehrlich, Fleming, Dubos and Winogradsky.

Classification based on–Carolus Linnaeus, Carl Woese and Robert –H. Whittaker (Five Kingdom system)

Unit-II

Microbial Growth – Physical & Chemical requirements

Growth of bacterial culture –Physical & Chemical requirements for growth;

Phases of growth

Prokaryotic cell –ultra structure and functions of bacterial cell wall, plasma membrane, flagella, pili, capsules, nuclear materials and spores.

Structure of enveloped (Morphology and structure of Herpes) and non-enveloped virus (Morphology and structure of Tobacco Mosaic Virus) and bacteriophages (Morphology and structure of T4 Bacteriophage).

Distinguishing characteristics of Fungi –Filamentous, non-filamentous and

dimorphic fungi; Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae*.

Unit-III

Metabolic diversity among organisms – Photoautotrophs, Photoheterotrophs, Chemoautotrophs, Chemoheterotrophs. Energy production –oxidation –Reduction reactions, Oxidative and Phosphorylation. Metabolic pathways of energy production – Glycolysis, Entner –Doudoroff pathway, Aerobic and Anaerobic respiration, Photosynthetic metabolisms –Light & Dark reactions.

Unit-IV

Food Microbiology –Types of foods –Spoilage process (souring, putrefaction, rancidity and soft rot) Preservation of foods (Physical and Chemical agents) Food poisoning and Microbial toxins.

Environmental Microbiology – Role of microorganisms in nutrient cycling -Nitrogen, Carbon, Sulphur and Phosphorous.

Unit-V

Applied Microbiology –Sewage Treatment, Biofertilizer (Rhizobium, Azolla) Production of Penicillin and SCP.

Microorganisms and Human disease – Causative agent, symptoms, transmission, prevention and control of Tuberculosis, Cholera, Typhoid, AIDS, Hepatitis, Polio and Candidiasis.

Text Books

1. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, fifth edition. McGraw-Hill. Book Co. Singapore
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9th Edition, Pearson Education, Singapore

Reference Books

1. Alcamo, I.E. 2001. Fundamentals of Microbiology, sixth edition, Addison wesley Longman, Inc. California
2. Alexopoulos, C.J., C.W. Mims and M.Blackwell. 2000. Introductory Mycology. fifth edition John Wiley & Sons. Chichester.
3. Atlas, R.A. and Bartha, R. 2000. Microbial Ecology. Fundamentals and Application, Benjamin Cummings, New York.
4. Black, J.G.2005. Microbiology-principles and explorations, 6th edition. John Wiley & Sons, Inc. New York
5. Dubey, R.C. and Maheswari, D.K. 2010. A Text Book of Microbiology. S Chand, New Delhi.
6. Johri, R.M., Snehlatha, Sandhya Shrama, 2010. A Textbook of Algae. Wisdom Press, New Delhi.
7. Kanika Sharma, 2011. Textbook of Microbiology – Tools and Techniques. 1st Edition, Ane Books Pvt. Ltd., New Delhi.
8. Madigan, M.T., Martinkl, J.M. and Parker, J. 2009. Brock Biology of Microorganisms, 12th Edition, MacMillan Press, England.
9. Prescott, L.M., Harley, J.P. and Klein, D.A. 2008. Microbiology (7th edition) McGraw Hill, Newyork.
10. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. 1991. General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.

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| | | | |
|------------|------------------------|---------------|-------|
| Course | : M.Sc Zoology (Lab-3) | Int. Marks | : 40 |
| Year & Sem | : I Year; II Sem | Ext. Marks | : 60 |
| Sub. Code | : 2PZLI | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :4 |

Title of the Paper: **Lab in Entomology**

1. Collection, preservation and identification of insect pests.
2. Types of antennae, mouthparts
3. Patterns and modification in legs and wings
4. Dissection – Cockroach – type study
 - a. Digestive system and salivary apparatus
 - b. Spiracle mounting and display of tracheal system
 - c. Nervous system
 - d. Neuro endocrine system
 - e. Malpighian tubules
 - f. Wing circulation
5. Digestive enzyme analysis
6. Study of haematocytes
7. Food utilization study in an insect
8. Pest sampling and estimates
9. Pheromone trap methods- Demonstration
10. Study on the development of resistance to pesticides – LC₅₀ value
11. Study on the life history of vectors – Mosquitoes and housefly.
12. Isolation of microbial biocontrol agents from soil and cadaver.

Reference books

1. Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj, K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.
2. Tembhare, D.B. 2009 Modern Entomology, Himalaya publishing house, Mumbai.

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| | | | |
|--------------------|------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Lab-4) | Int. Marks | : 40 |
| Year & Sem | : I Year; II Sem | Ext. Marks | : 60 |
| Sub. Code | : 2PZL2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 4 |
| Title of the Paper | : Lab in Microbiology | | |

1. Equipments needed for Microbiology Laboratory
2. Precautions to work in Microbiology Laboratory
3. Sterilization methods –moist heat, dry heat, filtration and radiation
4. Preparation of culture media –solid (Selected and differential)and liquid
5. Isolation of single colonies on solid media – Slant, Streak –Simple and Quadrant
6. Enumeration of bacterial numbers by serial dilution and plating
7. Isolation of Bacteria, actinomycetes and fungi from soil
8. Microscopic observation of bacteria –Simple and Differential staining
9. Spore staining
10. Bacterial motility- Hanging drop method
11. Biochemical test –IMViC TEST, Oxidase and catalase
12. Nitrate Reductase test
13. Slide culture technique and fungal staining –Yeast and filamentous fungi
14. Measurement of the size of the bacterial cell
15. Methylene Blue Reductase test –Milk quality

Reference Books

1. Cappuccino and Sherman, 2012. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi
2. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
3. Harry W. Seeley, J.R., Paul, J.VanDemark and John J.Lee. 1997. Microbes in Action – A Laboratory Manual of Microbiology. W.H.Freeman and Company, New York
4. Kanika Sharma, 2009. Manual of Microbiology – Tools and Techniques. 2nd Edition, Ane Books Pvt. Ltd., New Delhi.
5. Kulanthaivel,S and S. Janarthanan 2012. Practical Manual on Fermentation Technology. I.K. International Publishing house. New Delhi

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|------------|-----------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Elective Paper-2) | Int. Marks | : 25 |
| Year & Sem | : II Sem | Ext. Marks | : 75 |
| Sub. Code | : 2PZE1 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :5 |

Title of the Paper: **Biostatistics and Bioinformatics**

Course Objectives:

- To train the students to handle data and substantiate their findings using valid statistical analyses
- To familiarize students in using Microsoft office Excel (statistical tools) and on bioinformatics tools

Unit I

Statistical population and sample in biological studies, variables – qualitative and quantitative; Types of biological data-ratio, interval, ordinal, nominal, discrete and continuous; Sampling methods – probability and non-probability methods; Frequency distribution, Representation of data – Tables; histogram, frequency curve and ogives

Unit II:

Measures of central tendency – mean, median and mode; Measures of dispersion – range, quartile deviation, standard deviation, variance, standard error, kurtosis; Probability distribution – binomial, Poisson and normal distribution. Symmetry- skewness and Kurtosis, proportions of a normal curve- Z scores, assessing normality, confidence limits. Practical training using MS-Office excel.

Unit III:

Testing of hypothesis – Null and alternate hypothesis, Mann-Whitney U test, Student ‘t’ distribution, , Two tailed and one tailed hypotheses concerning mean, confidence limits for the population mean, variability about the mean; null hypothesis, one sample t-test, paired and unpaired t-tests. Chi-square test, test of independence, Practical training using MS-Office excel.

Unit IV:

Data transformations. Arcsine, logarithmic and square root transformations. Correlation – types, methods of correlation – graphic method, mathematical method; Karl Pearson’s Rank; Regression analysis – equation, estimation of unknown value from known value; Single factor ANOVA; basic assumptions under ANOVA, loss of replications, ANOVA with two treatments. A posteriori comparisons- The Tukey test. Practical training using MS-Office excel.

Unit V:

Bioinformatics- Introduction- Biological databases- DNA and protein sequence databases, structural databases-PDB

Applications-Similarity search (FASTA, BLAST), Multiple sequence alignment-Clustal W (Conserved domains search), Mult Align, Homology modelling, Phylogenetic analysis. Data mining tools for Biomedical applications-SNP analysis, drug designing and docking.

Text Books

1. Khan., IA, Khanum, A. (2004) Fundamentals of Biostatistics second edition, Ukaaz publications, Hyderabad, Andhra Pradesh
2. Zar, J.H. 1996. Biostatistical Analysis, Prentice – Hall International, USA.

Reference Books

1. Arora, P.N and P.K.Malhan 2008. Biostatistics. Himalaya Publications, Mumbai.
2. Attwood, T.K. and Parry, D.J – Smith, D.J. 2002. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd.
3. Daniel, W.W (2006) Biostatistics-A foundation for analysis in health sciences, John Wiley (Asia) & sons, Singapore.
4. Gupta S.P. 1987. Statistical Methods. Sultan Chand & Sons Publishers, New Delhi
5. Gurumani, N. 2004. An Introduction to Biostatistics. MJP publishers, Chennai.
6. Misra, B.N. and Misra, B. K. 1998. Introductory Practical Biostatistics. Naya Prakash, Calcutta.
7. Mount, W. 2001. Bioinformatics Sequence and Genome Analysis. Cold Spring harbour Laboratory Press, New York
8. Palanichamy, S. Manoharan, M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu.
9. Pevsner 2003. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi
10. Pillai, RSN and Bagavathi, V. 1989. Statistics Theory and Practice. S Chand & Company Ltd. New Delhi. Banergi, P.K. 2004 Introduction to Biostatistics, S.Chand & company Ltd. New Delhi.
11. Scheffler W.C. 1980. Statistics for the biological sciences. Addison-Wesley publishing company, New York.
12. Sokal, R.R. and Rohlf, F.J. 1987. Introduction to Biostatistics. W.H. Freeman and company, New York.
13. Sundar Rao, P.S.S. and Righard, J. 2002. An Introduction to Biostatistics. III edn. Prentice Hall of India, New Delhi.

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| | | | |
|------------|-------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Core Paper-5) | Int. Marks | : 25 |
| Year & Sem | : II Year; III Sem | Ext. Marks | : 75 |
| Sub. Code | : 3PZ1 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :5 |

Title of the Paper : **Biotechnology**

Course Objectives:

- To introduce the basic principles of genetic engineering
- To learn various methods of gene transfer and manipulation

Unit I

Genetic engineering Tools—Enzymes involved in gene manipulation – Host vector system – Plasmids- Phages— Cosmids – Phagemids – artificial chromosomes (YAC, BAC, PAC, HAC) — Expression vectors – viral vectors (Adenovirus and reterovirus).
Applications of Genetic engineering in Medicine, Agriculture, Environment.

Unit II

Different strategies of cloning – Library Construction - genomic and cDNA libraries -Gene transfer methods in Eukaryotes and Prokaryotes- Sequencing methods (Maxam and Gilbert-Sanger dideoxy). Screening of recombinant clones – Genetic, Biochemical and Immuno screening.

Unit III

Transgenesis in animals & Plants- Knockout genes- RNA interference- Differential gene Expression – Microarray – QPCR- SAGE - MPSS. DNA finger printing (RFLP, STR, VNTR & SNP).

Unit IV

Animal cell culture –natural and defined media – Primary cell culture (suspension and adherent) – Development and maintenance of cell lines – cell hybridization. Cryopreservation. Stem cell isolation and culture. Plant tissue culture - callus culture - Protoplast fusion technique – synthetic seeds.

Unit V

Fermentor design and components-large scale culture of microbes-batch culture and continuous culture - production of primary and secondary metabolites- penicillin, protease. Downstream processing – Enzyme immobilization -biomass production-waste treatment-ore leaching.

Text Books

1. Dubey R.C. 2009.A text book of Biotechnology.S.Chand & Company, New Delhi
2. Glick, R and Pasternak , J 1994. Molecular Biotechnology. Panima Publishing Corporation, New Delhi

Reference Books

1. Brown, T.A. 2006. Gene Cloning & DNA Analysis: An introduction. V edn. Blackwell publishing USA.
2. Balasubramanian, D., C.F.A. Bryce, K.Dharmalingam, Y.Green, Kunthala Jeyaraman. 2004. Concepts in Biotechnology. Universities (P) ltd. Hyderabad.
3. Chawla, H.S.2000 Introduction to Biotechnology, Oxford & IBH Publishing Co. Pvt.Ltd.New Delhi.
4. Crueger, W. and A. Crueger, 2000. Biotechnology: A Test Book of Industrial Microbiology, 2nd edn. Panima Publishing Corporation, New Delhi.
5. Mitra,S.1996 Genetic Engineering Principles and Practice Macmillan India Ltd. India
6. Trehen, K.2002. Biotechnology, New Age International (P) Ltd. New Delhi
7. Trevan, M.D., S.Boffey, K.H. Goulding and P.Stanbury, 1990, Gene Biotechnology – Himalaya Publishing House, New Delhi.

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|------------|-------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Core Paper-6) | Int. Marks | : 25 |
| Year & Sem | : II Year; III Sem | Ext. Marks | : 75 |
| Sub. Code | : 3PZ2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 5 |

Title of the Paper : **Immunology**

Course Objectives:

- To acquire knowledge on immunity and immune system
- To learn about the importance of vaccines and vaccination

Unit I

Introduction and Overview – Historical perspective, Types of immunity – Innate:anatomic, physiologic, phagocytic, and inflammatory–Acquired or Adaptive: antigenicspecificity–diversity- Immunologic memory–self/nonself recognition, Humoral–Cell-mediated immunity, Cells and organs of the immune system – Ontogeny and development of Immune cells – immunogenicity – Antigen – characteristics, classes of antigens-Haptens –Adjuvants. Antibody – structure, isotypes& functions.Generation of antibody diversity; Ag-Ab interactions – principles and assays, Pattern-Recognition Receptors

Unit II

Generation of B and T cell responses – Antigen binding receptors – T cell receptors, B cell receptors and MHC (HLA) molecules, B cell maturation, activation and differentiation – Major Histocompatibility complex – Antigen processing and presentation – T cell maturation, activation and differentiation – Principle of Antigen antibody interactions - precipitation reaction, Agglutination reaction– crossreactivity.

Unit III

Immune effector mechanisms – Cytokines – functional properties; Complement system – Classical – Alternate -Lectin components, activation; Cell mediated immunity-Cytotoxic T cells, NK cells, ADCC, Hypersensitivity – antibody mediated(Type I) reactions, antibody mediated cytotoxic (Type II) reactions, Immune complex mediated (Type III) hypersensitivity, T cell mediated (Type IV) delayed hypersensitivity. Immune response to infectious diseases – viral, bacterial, protozoan and helminthes.

Unit IV

Tolerance and Autoimmunity – organ specific autoimmune diseases, systemic autoimmune diseases, Immunodeficiency diseases – Phagocytic, complement deficiencies, humoral, cell mediated, combined immune deficiencies, Acquired Immunodeficiency. Immune system in health – Vaccines – active and passive immunization; Organism vaccines – recombinant antigen & vector vaccines – DNA vaccines – synthetic peptide vaccines, edible vaccines. Tumour immunology - immune evasion mechanism of tumour. Cancer vaccines.

Unit V

Transplantation immunology –Transplantation antigens, immunological basis of graft rejection, immunosuppressive therapy - Immunotechniques and Immunotechnology- Application of precipitation, agglutination, ELISA, RIA, Western blotting, immunofluorescence techniques. Monoclonal antibody production - antibody engineering.

Text Books:

1. Coico, R., Sunshine, G., Benjamini, E., 2003 Immunology: A Short Course, VIth edition. Wiley-Blackwell, New York
2. Goldsby, R.A., Kindt, T.J., Osborne, B.A., Kuby, J. 2002. Immunology, Vth edition, W.H. Freeman and Company, New York.

Reference Books:

- 1) Abbas, A.K., A.H. Lichtmann and Y.S. Pober. 2000, Cellular and Molecular Immunology, fourth edition, W.B. Saunders company, London.
- 2) Coleman, R.M., M.F. Lombard., & N.E. Sicared. 1992. Fundamental Immunology, second edition, Wm.C. Brown Publishers, USA.
- 3) Cruse, J.M. & R.E. Lewis. 1998. Atlas of Immunology. CRC Academic Press. New York.
- 4) Delves, P.J., Martin, S.J., Burton D.R., Roitt, I.M. 2011. Roitt's Essential Immunology. XIIth edition. Wiley-Blackwell, Oxford, UK.
- 5) Goldsby, R.A., T.J. Kindt., & B.A. Osborne. 2000. Kuby Immunology. Fourth edition. W.H. Freeman and Company, New York.
- 6) Nandhini Shetty. 1993. Immunology – Introductory Text Book, Wiley Eastern Limited, New Delhi.
- 7) Roitt., Brostaff J. and Male D. 2001 Immunology VI edition, Mosby, London.

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| | | | |
|------------|------------------------|---------------|-------|
| Course | : M.Sc Zoology (Lab-5) | Int. Marks | : 40 |
| Year & Sem | : II Year; III Sem | Ext. Marks | : 60 |
| Sub. Code | : 3PZL1 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :4 |

Title of the Paper : **Lab in Biotechnology**

1. Isolation of Plasmid and Genomic DNA from microbes
2. Isolation of Genomic DNA from animal tissues
3. Restriction digestion of Plasmid DNA
4. Competent cell preparation
5. DNA ligation, Recombinants selection- blue white screening
6. Demonstration of PCR amplification
7. Demonstration of Western Blotting
8. Protoplast Isolation
9. Biogas production-demonstration
10. Ethanol production-Khune’s fermentation

References

1. Ausubel, F.M.1997. Short Protocols in Molecular Biology, Second Edition, John Wiley & Sons. Harvard Medical School.
2. Brown, T.A. 1998. Molecular Biology Lab Fax II Gene analysis, Second Edition, Academic Press, UK.
3. Glover, D.M. and Hames, B.D. 1995. DNA cloning – A practical approach, Vol. 1 - 4, IRC Press.
4. Hardin C, Edwards, J A.Riell, D.Presutti, W.Millerr and D.Robertson.2008. Cloning Gene Expression and Protein Purification.Oxford Univeristy Press.U.K.
5. Janarthanan, S. and Vincent, S. 2007. Practical Biotechnology: Methods and protocols, University Press.
6. Sambrook, J., Fritsch, E.F. and Maniatis, T. 2001. Molecular Cloning – A lab manual. Vol. III – Second Edition CSH Press, Cold spring harbor.
7. Swami, P.M. 2009. Lab Manual of Biotechnology. Rastogi Publications, Meerut.

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| | | | |
|------------|------------------------|---------------|-------|
| Course | : M.Sc Zoology (Lab-6) | Int. Marks | : 40 |
| Year & Sem | : II Year; III Sem | Ext. Marks | : 60 |
| Sub. Code | : 3PZL2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 4 |

Title of the Paper : **Lab in Immunology**

1. Virtual dissection and Display of Lymphoid organs of mice and chicken.
2. Enumeration of percentage occurrence of innate and adaptive immune cells.
3. Isolation of lymphocytes from sheep spleen
4. Raising of polyclonal antibodies in fish:Part -1.Preparation of different types of antigen
5. Raising of polyclonal antibodies in fish: Part -2. Immunization protocol for different antigens
6. Raising of polyclonal antibodies in fish: Part -3. Bleeding techniques in different animal models (virtual and real time in fish)
7. Natural haemolytic/antibacterial activity of unimmunized serum
8. Electrophoretic separation of serum proteins
9. Complement mediated haemolysis
- 10.Haemagglutination (or) Haemolysin titration assay
- 11.Bacterial agglutination assay
- 12.Isolation and enumeration of lymphocytes from human blood.
- 13.Determination of lymphocyte viability by Trypan blue dye exclusion test
- 14.Scale allograft rejection in fish
- 15.Estimation of serum lysozyme and total peroxidase secretion

Reference books:

1. Garvey J.S., Cremer N.E and Sussdorf D.H., Methods in Immunology, (1983), 3rd ed., Benjamin / Cummins Publishing, London.
2. Hudson L and Hay F.C., Practical Immunology, (1989), 3rd ed., Blackwell Publishing, London.
3. Stites D.P., Terr A.L and Parslow T.G., Basic and Clinical Immunology, (1994), Prentice Hall Publishing, Canada.

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|------------|--------------------------------------|---------------|-------|
| Course | : M.Sc., Botany (Inter Disciplinary) | Int. Marks | : 25 |
| Year & Sem | : II Year; III Sem | Ext. Marks | : 75 |
| Sub. Code | : | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :5 |

Title of the Paper : **Applied Zoology (offered to M.Sc., Botany Students)**

Course Objectives

- To know some economically important insects
- To be familiar with the different types of animal cultures

Unit I

Protozoan and Helminthic parasites: Biology, pathogenicity and control measures of *Plasmodium vivax*, *Entamoeba Histolytica*, *Wuchereria bancrofti* & *Ascaris lumbricoides*. Major infectious and communicable disease: Pathogenicity, symptoms, treatment, prevention of Syphilis & AIDS.

Unit II

Agricultural insect pest: Biology, damage caused and control measures of any one insect pest of paddy (*Scirpophaga incertulas*), cotton (*Helicoverpa armigera*) & sugarcane (*Chilo infuscatellus*). Veterinary parasites: Biology, damage caused and control measures *Tabanus striatus*, *Bovicola bovis* & *Haematobia irritans*.

Unit III

Apiculture: Species of honey bees - Newton's bee hive - rearing of honey bees - economic importance of honey. Sericulture: Types of silk - life cycle of mulberry silkworm (*Bombyx mori*) and rearing. Lac culture: Strains of lac insects - cultivation of lac insect and economic importance.

Unit IV

Fish culture: Types of fish farming - cultivable freshwater fishes of catla, mrigal & rohu - economic importance of fishes. Prawn culture: Types of prawn fishery - species of prawns - culture of fresh water prawns. Pearl culture: Types of pearl oysters and their occurrence - pearl formation - pearl culture techniques.

Unit V

Vermiculture: Cultivable earthworm - culture technique - economic importance. Poultry: Housing - food and feeding of fowls - breeds of poultry (layers and broilers) - disease control (Ranikhet & Pullorum).

Text Books:

1. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.
2. Shukla, G.S. and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, Meerut.

Reference Books:

1. Ahsan, J. and S.P. Sinha, 1985, A hand book on economic zoology, Third edition, S. Chand & company (P) Ltd., New Delhi.
2. Banerjee, G.C., 1986, Poultry, Second edition, Oxford & IBH publisher, New Delhi.
3. Fenemore, P.G. and A. Prakash, 1992, Applied Zoology, Wiley Eastern Limited, New Delhi.
4. Kotpal, R.L., S.K. Agrawal and R.P. Khetarpal, 1985, Invertebrate Zoology, Sixth edition, Rastogi publication, Meerut.
5. Rathinasamy, G.K., 1999. Medical entomology and elementary parasitology, Viswanathan publication, Chennai.
6. Singh, R.A., 1984, Poultry production, Kalyani publisher, New Delhi.

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY
(From 2014-2016 batch onwards)

| | | | |
|------------|-------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Core Paper-7) | Int. Marks | : 25 |
| Year & Sem | : II Year; IV Sem | Ext. Marks | : 75 |
| Sub. Code | : 4PZ1 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :5 |

Title of the Paper : **Animal Physiology**

Course Objectives

- To understand the structural organization of different systems within body
- To study the functions of different organ systems in animals

Unit I

Feeding and digestion, nutritional types; feeding mechanisms; digestion –intracellular & extracellular, digestion in mouth, digestion in stomach, absorption- absorption of carbohydrates, fats, proteins; mechanisms of absorption; defaecation.

Unit II

Respiration-external respiration; respiratory movements, breathing; ventilation; process of gaseous exchange; respiratory pigments
Hemoglobin as oxygen carrier, respiratory quotient; respiratory exchange in tissues; regulation of respiration.

Unit III

General functions of blood, blood cells; blood group ;blood vascular system; heart beat and functioning of heart; cardiac cycle ;regulation of heart beat; heart sound; blood pressure;blood clotting mechanism
Excretion-products of excretion; excretory organs in animals; structure and function of human kidney, mechanism of urine formation.
Osmoregulation- osmoregulators, conformers, stenohaline and euryhaline, osmoregulation in fishes and crustaceans
Thermoregulation-hibernation, aestivation, diapause

Unit IV

Muscle system-ultra structure of muscle fibres, mechanism of muscle contraction- biochemical changes during contraction.
Nervous system, CNS and ANS; neurons; propagation of nerve impulses- synaptic transmission. Reflex action and reflex arc, sense organs

Unit V

Endocrine system- structure, hormones, endocrine glands, pituitary, thyroid parathyroid, adrenal glands, Islets of Langerhans, thymus, pineal body,
reproduction in vertebrates- mammals

Text books

1. Bijlani, R.L. 2001. Fundamentals of Physiology. I edn. JayPee brothers, New Delhi
2. Subrahmanyam, S., Madhavankutty, K. and Singh, H.D. 1996 (Eds). Text Book of Human Physiology. S. Chand & Company Ltd. New Delhi.

References

1. Clancy, J. and Mc Vicar, A.J. 1995. Physiology and anatomy. Edward Arnold, London.
2. Fox, S.I. 1999. Human Physiology. VI edn. Mc Graw-Hill Publications, New Delhi.
3. Hoar W.S 2004. General and Comparative Physiology. Prentice-Hall of India (P) Ltd.New Delhi
4. Joshi, A.S. 1998. Human Physiology. VI Edn., The Benjamin/Cummings Publishing Company, California
5. Marieb, E.N. 1998. Human anatomy and Physiology. IV edn. The Benjamin/Cummings Publishing Company, California.
6. Renganathan, T.S. 2002. A text book of Human Anatomy. VI edn. S. Chand and Company Ltd., New Delhi.
7. Singh, H.R and Neeraj Kumar 2009. Animal Physiology and Biochemistry. Vishal Publishing Co, New Delhi.
8. Tortora, G.J. 1994. Introduction to the human body: The essentials of anatomy and physiology. III edn. Harpers Collins College Publishers, New York.
9. Vander, A.J. Sherman, J.H. and Luciano, D.S. 1994. Human Physiology: The mechanism of body functions, VI edn. Mc Graw-Hill Publications, New York.

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| | | | |
|------------|-------------------------|---------------|-------|
| Course | : M.Sc Zoology (Core-8) | Int. Marks | : 25 |
| Year & Sem | : II Year; IV Sem | Ext. Marks | : 75 |
| Sub. Code | : 4PZ2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | : 5 |

Title of the Paper: **Ecology and Biodiversity**

Course Objectives

- To learn the concepts and components of ecosystems
- To learn about biodiversity and different indices

Unit 1:

Population: Population growth curves, altruism, kin selection, r and k selection, age distribution (pyramids) – population distribution – Interaction among populations – competition and coexistence, mutualism, commensalism, amensalism, predation, parasitism

Community: Classification – theory of island biogeography, biogeographic realms of India, composition

Unit 2:

Changes in community structure: Succession – Primary and secondary succession, process of succession, patterns in species richness during succession, trophic interaction, food web patterns and complexity – chain length, linkage, linkage density and connectance, ecological pyramids, energy flow, ecological niche, ecotone, edge effect - landscape and its elements

Unit 3:

Biological diversity – Species richness gradient, levels of diversity – genetic, species and ecosystem diversity, patterns of diversity – alpha, beta and gamma diversities, diversity indices – Shannon, Simpson, Brillouin index, Jaccard index, Keystone species – predators, food source, Ecosystem modifiers and ecosystem engineers, indicator species, endemism and hot spots-ecosystem services

Unit 4:

Threats to biodiversity – IUCN categories of threat, red data book, causes for biodiversity loss – habitat fragmentation, bioinvasion, pollution – types, causes, effects and mitigation measures – Global climate change – its effects on environment, agriculture, disease outbreak – Organizations/programmes – UNEP, IPCC, MAB, GEF, CBD, CITIES, Ramsar Convention, MoEF (India), NERI, NBA (India) – a brief account only

Unit 5:

Conservation and mitigation: Environmental impact assessment, remote sensing in EIA, man-animal conflicts, *insitu* (biosphere reserves, national parks, wild life sanctuaries, sacred grooves) and *exsitu* conservation (Zoological and Botanical gardens, cryopreservation, tissue culture), Project Tiger, IBCN, Joint Forest Management - Waste management – solid and liquid waste disposal - Alternate energy sources – biomass, wind and solar energy.

Text Books

1. Odum, E.P. 1996. Fundamentals of Ecology. Nataraj Publishers, Dehradun.
2. Stiling, P. 2004. Ecology – Theories and applications. Prentice Hall of India Pvt. Ltd., New Delhi.

References

1. Briggs, D., Smithson, P., Addison, K. and Atkinson, K. 1997. Fundamentals of Physical Environment. II edn. Routledge. UK.
2. Chang, K. 2002. Geological Information system. Tata McGraw Hill publishers. New Delhi.
3. Cunningham, W.P. and Saigo, B.W. 1999. Environmental science. Vth edn. Tata McGraw Hill publishing Co., New Delhi.
4. Krishnamoorthy, K.V. 2004. An Advanced Text Book of Biodiversity-principles and practice. II reprint. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
5. Mackenzie, N., Ball, A.S. and Virdee, S.R. 1999. Instant notes in Ecology. Viva Books Pvt. Ltd. New Delhi.
6. Meffe, G.K. and Carroll, C.R. 1994. Principles of Conservation Biology. Sinauer Associates, Inc., USA.
7. Miller Jr, G.T. 1996. Living in the environment. IX edn.
8. Scanvic, J.Y. 1997. Aersopatial Remote sensing in Geology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

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DEPARTMENT OF ZOOLOGY
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| | | | |
|--------------------|-----------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Lab-7) | Int. Marks | : 40 |
| Year & Sem | : II Year; IV Sem | Ext. Marks | : 60 |
| Sub. Code | : 4PZL1 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :4 |
| Title of the Paper | : Lab in Animal Physiology | | |

1. Effect of temperature on salivary amylase activity
2. Effect of pH on salivary amylase activity
3. Effect of substrate concentration on salivary amylase activity
4. Observation of Haemin crystals in human blood
5. Estimation of Haemoglobin – Sahli’s method
6. Estimation of Erythrocyte Sedimentation Rate – Westergren’s method
7. Estimation of Blood Glucose
8. Estimation of Blood Urea
9. Determination of blood pressure using Sphygmomanometer
10. Qualitative analysis of urine for albumin, sugar, ketone bodies and bile salts
11. Qualitative analysis excretory products –Ammonia, urea, uric acid
12. Determination of sperm count and its motility

Reference books:

1. Hoar W.S 2004. General and Comparative Physiology. Prentice-Hall of India (P) Ltd.New Delhi
2. Singh, H.R and Neeraj Kumar 2009. Animal Physiology and Biochemistry. Vishal Publishing Co, New Delhi.

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| | | | |
|--------------------|--|---------------|-------|
| Course | : M.Sc Zoology (Lab-8) | Int. Marks | : 40 |
| Year & Sem | : II Year; IV Sem | Ext. Marks | : 60 |
| Sub. Code | : 4PZL2 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :4 |
| Title of the Paper | : Lab in Ecology and Biodiversity | | |

1. Ecosystem designing – tracing food chain, food web and Ecological Pyramids.
2. Estimation of Dissolved Oxygen in water samples
3. Estimation of free carbon di oxide in water samples
4. Determination of alkalinity in water samples
5. Measurement of primary productivity in an ecosystem
6. Estimation Biological Oxygen demand of an aquatic ecosystem
7. Morphometric studies of a pond.
8. Biological water quality analysis – Pollution indicators
9. Analysis of Industrial effluents and waste waters
10. Detection of mutagenic agents in water samples using Ames test.
11. Survey of transport flow in Madurai city
12. Survey on the diversity of agroproduces in vegetable markets
13. Assessment of pollution status of river Vaigai.
14. Calculation of diversity indices
15. Survey on domestic biodiversity

References

1. Briggs, D., Smithson, P., Addison, K. and Atkinson. K. 1997. Fundamentals of Physical Environment. II edn. Routledge. UK.
2. Chang, K. 2002. Geological Information system. Tata McGraw Hill publishers. New Delhi.
3. Cunningham, W.P. and Saigo, B.W. 1999. Environmental science. Vth edn. Tata McGraw Hill publishing Co., New Delhi.
4. Joseph, and Nagendran, R. 2005. Essentials of environmental studies. II reprint. Pearson and
5. Krishnamoorthy, K.V. 2004. An Advanced Text Book of Biodiversity-principles and practice. II reprint. Oxford & IBH Publishing Co. pvt. Ltd. New Delhi.
6. Mackenzie, N., Ball, A.S. and Virdee, S.R. 1999. Instant notes in Ecology. Viva Books pvt. Ltd. New Delhi.
7. Meffe, G.K. and Carroll, C.R. 1994. Principles of Conservation Biology. Sinauer Associates, Inc., USA.

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DEPARTMENT OF ZOOLOGY
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| | | | |
|-------------------------------------|---------------------------------|---------------|-------|
| Course | : M.Sc Zoology (Elective paper) | Int. Marks | : 50 |
| Year & Sem | : II Year; IV Sem | Ext. Marks | : 50 |
| Sub. Code | : 4PZE1 | Max. Marks | : 100 |
| Hours/Week | : 6 | No of Credits | :4 |
| Title of the Paper : Project | | | |

M.Phil Zoology

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DEPARTMENT OF ZOOLOGY

(From 2014-2015 batch onwards)

M.Phil., Zoology

Course Structure (w.e.f. 2014 batch onwards)

I semester

| Course | Code | Subject/Paper | Cont Hrs/w | Credit | T.No Hrs | Max Mark CA | Max Mark SE | Total |
|---------------|-------------|------------------------|-------------------|---------------|-----------------|--------------------|--------------------|--------------|
| Core | 1MZ1 | Research Methodology-I | 8 | | 120 | 100 | 100 | 200 |
| Core | 1MZ2 | Applied Entomology | 8 | | 120 | 100 | 100 | 200 |
| | | Total | | | 240 | 200 | 200 | 400 |

II Semester

| Course | Code | Subject/Paper | Cont Hrs/w | Credit | T.No Hrs | Max Mark CA | Max Mark SE | Total |
|---------------|-------------|-------------------------|-------------------|---------------|-----------------|--------------------|--------------------|--------------|
| Core | 2MZ1 | Research Methodology-II | 8 | | 120 | 100 | 100 | 200 |
| | | Project | | | | 100 | 100 | 200 |
| | | Total | | | 120 | 200 | 200 | 400 |

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DEPARTMENT OF ZOOLOGY
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| | | | |
|-----------|-------------------|------------|-------|
| Course | : M.Phil, Zoology | Int. Marks | : 100 |
| Semester. | : I Sem | Ext. Marks | : 100 |
| Sub. Code | : 1MZ1 | Max. Marks | : 200 |
| Hrs/Week | : 8 | TotalHours | :120 |

Title of the Paper: **Research Methodology I**

Unit : 1

Bomb calorimeter – description of unit – operation and estimation of calorific values – Microkjldhal method of estimating nitrogen content of biological samples – calculation. pH meter- determination of pH –buffers – principle –operation and description of the apparatus. Dissociation constant of acids – titration curve of acids and bases.

Unit : II

Colorimetry – Spectrophotometry – Beer and Lambert’s law. Principle and description of the apparatus – applications. Atomic Absorption Spectrometry, FT-IR, NMR, XRD, EDAX, MALDI ToF- MS, LC-MS

Unit : III

Chromatography – paper, column, thin layer, gas chromatography, HPLC –Principle - description– applications of various chromatography. Electrophoresis – Principle, method and application of acrylamide and agarose gel electrophoresis. Two dimensional gel electrophoresis.

Unit : IV

Basic principles and sedimentation - types of centrifuge –density gradient and ultra centrifuge – applications. Basic principles of microscope – compound, electron(SEM, TEM) tunneling, phase contrast, fluorescent, confocal – applications. Micrometry –fixative and staining – methods of embedding, sectioning, staining.

Unit : V

Sampling – measures of central tendency – tests of significance –Chi square test –‘t’ test – correlation and regression analysis –ANOVA- RBD, CBD, split plot design- TUKEY test. Referencing software – preparation of manuscript – proof reading – bibliography-citation index-H index-i10 index-impact factor- plagiarism

Reference books:

1. Colowick and Kaplan –Methods in Enzymology Vol I–VI Academic press.
2. Jayaraman, J.1985. Laboratory Manual in Biochemistry, Wiley Eastern Limited, New Delhi.
3. Palanivel, .P.2000. Laboratory Manual for Analytic Biochemistry and Separation Techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
4. Plummer, D.T. 2003, An Introduction of practical biochemistry III rd edn. Tata Mc Graw Hill Publishing Company Ltd. New Delhi.
5. Sadasivam, S and Manickam, A. Biochemical Methods, II nd edn. New AGE international Pvt .Ltd and Tamil Nadu Agricultural University, Coimbatore.
6. Sawhney, S.K. and Randhir S. 2006. Indroduction to Practical Biochemistry, II nd edn. Narosa Publishing House Pvt. Ltd New Delhi.
7. Williams, B.L. and Wilson , K. 1983. A Biologist Guide to Principles And Techniques of Practical Biochemistry, Edward Arnold Publishers Ltd. London.
8. Wilson, K. And Walker, J. 1995. Principle and Techniques of Practical Biochemistry IV th edn. Cambridge University Press, Cambridge.

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DEPARTMENT OF ZOOLOGY
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| | | | |
|-----------|-------------------|------------|-------|
| Course | : M.Phil, Zoology | Int. Marks | : 100 |
| Semester. | : I Sem | Ext. Marks | : 100 |
| Sub. Code | : 1MZ2 | Max. Marks | : 200 |
| Hrs/Week | : 8 | TotalHours | : 120 |

Title of the Paper: **Applied Entomology**

Unit: I

An outline classification and taxonomy of Class Insecta down to order level

Unit: II Helpful insects

Productive insects – Honey bee and lac insect-Insect pollinators-Predators and parasites- Weed killers-Soil builders-Scavengers- Aesthetic and scientific values of insects

Harmful insects - Insects pests of crops and control measures

Pests of rice-Pests of cotton- Pests of sugarcane- Pests of stored products - Insect pest in relation to public health and household with reference to Mosquito and Housefly.

Unit: III The idea of insect population

Ecosystem and agro ecosystems-The ecological role of insect outbreak-Regulation of insect population Economic decision levels for Insect Pest- populations, Economic damage, Economic injury level, Economic threshold, Calculation of economic decision level. Insect pest management - theory and practice

The concept and development of insect pest management-Ecological management of the crop environment.

Unit: IV Plant resistance and insects:

Insect and host relationships.-Mechanism of resistance; Non – preference, antibiosis, tolerance -Factors mediating the expression of resistance - physical and biological pest control: Methods and principle of pest control.-Natural control

Application of artificial or direct method-Biological control

Integrated control-Role in juvenile mimics and pheromones in the management of insect pests-Recent advances in using plant products in the management of insect pests-Microbial bio insecticides- IPM in cotton.

Unit: V

Insecticides classification of Insecticides

Classification based on mode of entry-Classification based on mode of action

Classification based on chemical nature

Plant production appliances:

Dusting and dusters-Aerosols-Spraying and sprayers- Vaporisers

Reference books:

1. Ananthakrishnan, T.N. 1982. Recent advances in Entomology in India. S. Viswanathan Publishers.
2. Busvine, J.R. 1980. Insect and Hygiene. III edition, Chapman & Hall, New York.
3. Chapman, R.F. 1982. The insect: Structure and Function. ELBS.
4. Chapman, R.F. and Joern, A.1990. (eds.). Biology of Grasshoppers. John Willy & Sons, New York.
5. David, B.V. and Kumarasamy, T. 2002. Elements of Economic Entomology. Popular Book Depot, Madras.
6. Mani, M.S. 1982. General Entomology. Oxford and IBH Publishing, New Delhi.
7. Nayar, K.K. , Ananthakrishnan, T.N. and David, B.V. 1976. General and Applied Entomology. Tata McGraw Hill Publishing Co.
8. Pedigo, L.P. 1996. Entomology and Pest Management. Prentice Hall of India, New Delhi.
9. Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj, K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.
10. Richards, O.W. and Davies, R.G. 1977. Imm's General Text Book of Entomology. X edition. Chapman & Hall, London.
11. Wigglesworth, V.B. 1972. The Principles of Insect Physiology. Chapman & Hall, New York.

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DEPARTMENT OF ZOOLOGY
(From 2014-2015 batch onwards)

| | | | |
|-----------|-------------------|------------|-------|
| Course | : M.Phil, Zoology | Int. Marks | : 100 |
| Semester. | : II Sem | Ext. Marks | : 100 |
| Sub. Code | : 2MZ1 | Max. Marks | : 200 |
| Hrs/Week | : 8 | TotalHours | : 120 |

Title of the Paper: **Research Methodology II**

Course Objectives:

- To understand the structure and functions of biomolecules

Unit : 1

Cell size determination, Chromosomal preparation, staining,
In situ hybridization, FISH, GISH–karyotyping.

Microbiological techniques- Methods of sterilization- Pure culture techniques- Measurement of growth –Bacterial staining –Preservation and Maintenance

Unit : II

Techniques in Molecular Biology; Preparation of plasmids from *E.coli*

Isolation of genomic DNA from eukaryotes and prokaryotes.

Southern, Northern and Western blotting and hybridization

PCR amplification, RAPD

Sequencing-DNA and Protein

Unit : III

Techniques genetic engineering: Vector preparation, Restriction digestion and ligation, expression vectors.

Transformation using *Agrobacterium tumifaciens*

Transformation–PEG mediated, microinjection, particle bombardment, electroporation

Construction of genomic and cDNA library

Gene expression –promoter gene –reporter genes

Unit : IV

Techniques in Animal tissue culture: Media for culturing cells, tissues- natural and defined media. Short – term lymphocyte culture (suspension)

Short-term lymphocyte culture (Suspension culture)

Fibroblast cultures from neonatal rat skin. Development and maintenance of cell lineage.

Production and application of monoclonal antibody by Hybridoma technology. In vitro cultures of oocytes, embryos; Stem cell isolation and culture

Unit : V

Scope and applications of Bioinformatics. Biological databases- DNA and protein- primary composite, secondary, specialized and structural databases.

Similarity search, pairwise alignment- FASTA, BLAST: Conserved region-Motif

Multiple sequence alignment- Local and global- Clustal W, Multalign.

Phylogenetic analysis- Phylogenetic Trees, types

Neighbor Joining method, Maximum parsimony.

Homology modeling, 3D structure prediction SPDB viewer

Reference books:

1. Attwood, T.K. and Parry, D.J – Smith, D.J. 2002. Introduction to Bioinformatics. Pearson Education (Singapore) Ptc. Ltd.
2. Baxevanis, A.D. and Quellerie, B.F.F. 2001. Bioinformatics. A practical guide to the analysis of genes and proteins. II edn. Wiley-Intern Science Publication, New York.
3. Hans.Peter – Schmauder .2003. Methods in Biotechnology. Taylor &Francis. London.
4. Janarthanan, S and S.Vincent. 2007. Practical Biotechnology: Methods and Protocols. Universities press (India) Private Limited. Hyderabad.
5. Kalaiselvan P.T. 2005. Microbiology and biotechnology- A Laboratory Manual. MJP Publishers, Chennai.
6. Lesk, M.A. 2002. Introduction to Bioinformatics. Oxford Univ. Publishers.
7. Mount, W. 2001. Bioinformatics sequence and genome analysis. Cold Spring harbour Laboratory Press, New York
8. Myers, R.L.1989. Immunology, a Laboratory manual, Wm. C.Brown Publishers, Dubuque, Iowa.
9. Pevsner 2003. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi
10. Rastogi, S.C.1996. Immunodiagnostics. Principle and Practice, New Age International Pvt. Ltd. New Delhi.
11. Sambrook, j. Fritsch, E.F. and Maniatis, T. 1989. Molecular Cloning-1,2,3 –A Laboratory Manual II edn. Cold Spring Laboratory Press, USA.
12. Tagu and C.Moussard (eds) .2006. Techniques for Molecular Biology. Science Publishers. An imprint of Edenbridge Limited., British Isles. P.O.Box. 699, Enfield, New Hampshire 03748, USA.
13. Talwer, G.P and Gupta, S.K. 1992. A Handbook of Practical and Clinical Immunology, Vol. I-II, Publishers and Distributors, Delhi.
14. Talwer, G.P. 1983. A Handbook of Practical Immunology, Vikas Publishing House Pvt.Ltd. New Delhi.

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(From 2014-2015 batch onwards)

| | | | |
|-----------|-------------------|------------|-------|
| Course | : M.Phil, Zoology | Int. Marks | : 100 |
| Semester. | : II Sem | Ext. Marks | : 100 |
| Sub. Code | : | Max. Marks | : 200 |

Title of the Paper: **Project**

**M.Sc.,
Microbiology**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY
M.Sc Microbiology
Course Structure (w.e.f. 2014 -16 batch onwards)

Semester – I

| Course | Code | Title of the Paper | Contact Hrs/W | Credits | Total No. of Hrs Alloted | Max. Marks CA | Max. Marks SE | Total |
|--------------|--------|---|---------------|-----------|--------------------------|---------------|---------------|------------|
| Core -1 | S1PY1 | General Microbiology | 6 | 5 | 90 | 25 | 75 | 100 |
| Core-2 | S1PY2 | Microbial Biochemistry and Physiology | 6 | 5 | 90 | 25 | 75 | 100 |
| Elective -1 | S1PYE | Microbial Diversity and Taxonomy | 6 | 5 | 90 | 25 | 75 | 100 |
| Lab | S1PYL1 | Lab in General Microbiology, Microbial Diversity and Taxonomy | 6 | 4 | 90 | 40 | 60 | 100 |
| Lab | S1PYL2 | Lab in Microbial Biochemistry and Physiology | 6 | 4 | 90 | 40 | 60 | 100 |
| Total | | | 30 | 23 | 450 | 155 | 345 | 500 |

Semester – II

| Course | Code | Title of the Paper | Contact Hrs/W | Credits | Total No. of Hrs Alloted | Max. Marks CA | Max marks SE | Total |
|--------------|--------|---|---------------|-----------|--------------------------|---------------|--------------|------------|
| Core -3 | S2PY1 | Immunobiology | 6 | 5 | 90 | 25 | 75 | 100 |
| Core-4 | S2PY2 | Microbial Genetics | 6 | 5 | 90 | 25 | 75 | 100 |
| Elective -2 | S2PYE | Molecular Biology | 6 | 5 | 90 | 25 | 75 | 100 |
| Lab | S2PYL1 | Lab in Immunobiology | 6 | 4 | 90 | 40 | 60 | 100 |
| Lab | S2PYL2 | Lab in Molecular Biology and Microbial Genetics | 6 | 4 | 90 | 40 | 60 | 100 |
| Total | | | 30 | 23 | 450 | 155 | 345 | 500 |

Semester – III

| Course | Code | Title of the Paper | Contact Hrs/W | Credits | Total No. of Hrs Alloted | Max. Marks CA | Max. Marks SE | Total |
|--------------|--------|---------------------------------|---------------|-----------|--------------------------|---------------|---------------|------------|
| Core -5 | S3PY1 | Medical Microbiology | 6 | 5 | 90 | 25 | 75 | 100 |
| Core-6 | S3PY2 | Genetic Engineering | 6 | 5 | 90 | 25 | 75 | 100 |
| Elective -3 | S3PYE | Analytical Microbial Technology | 6 | 5 | 90 | 25 | 75 | 100 |
| Lab | S3PYL1 | Lab in Medical Microbiology | 6 | 4 | 90 | 40 | 60 | 100 |
| Lab | S3PYL2 | Lab in Genetic Engineering | 6 | 4 | 90 | 40 | 60 | 100 |
| Total | | | 30 | 23 | 450 | 155 | 345 | 500 |

Semester – IV

| Course | Code | Title of the Paper | Contact Hrs/W | Credits | Total No. of Hrs Alloted | Max. Marks CA | Max. Marks SE | Total |
|--------------|--------|---|---------------|-----------|--------------------------|---------------|---------------|------------|
| Core -7 | S4PY1 | Bioprocess Technology | 6 | 5 | 90 | 25 | 75 | 100 |
| Core-8 | S4PY2 | Food, Agriculture and Environmental Microbiology | 6 | 5 | 90 | 25 | 75 | 100 |
| Lab | S4PYL1 | Lab in Bioprocess Technology | 6 | 4 | 90 | 40 | 60 | 100 |
| Lab | S4PYL2 | Lab in Food, Agriculture and Environmental Microbiology | 6 | 4 | 90 | 40 | 60 | 100 |
| SPJ | SPJ | Project | 6 | 3 | 90 | 25 | 75 | 100 |
| Total | | | 30 | 21 | 450 | 155 | 345 | 500 |

A) Consolidation of Contact Hours and Credits: PG Botany

| Semester | Contact Hrs/ Week | Credits |
|--------------|-------------------|-----------|
| I | 30 | 23 |
| II | 30 | 23 |
| III | 30 | 23 |
| IV | 30 | 21 |
| Total | 120 | 90 |

B) Curriculum Credits

| | |
|--------------|-------------------|
| Core | --- 75Credits |
| Elective | ---15 Credits |
| | ----- |
| Total | 90 Credits |
| | ----- |

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DEPARTMENT OF ZOOLOGY

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| | | | |
|---------------------|-------------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Core Paper -1) | Int. Marks | : 25 |
| Class | : I Year | Ext. Marks | : 75 |
| Semester | : I | Max. Marks | : 100 |
| Sub. Code | : S1PY1 | No. of Credits | : 5 |
| Title of the Paper: | General Microbiology | Hours/Week | : 6 |

Course Objectives:

- To inculcate knowledge on fundamentals and classification of microorganisms
- Make them to learn the structural organization, morphology and reproduction of microbes

Unit I

History and scope of microbiology. Characteristics of microorganisms- Morphological, chemical, cultural, metabolic, antigenic, genetic, pathogenicity and ecological. Microbial classification, nomenclature and identification. Microscope-Bright field, dark field, fluorescence, phase contrast, TEM, SEM.

Unit II

Morphology and structure of bacteria - size, shape and arrangement of bacterial cell. External structure and chemical composition of -flagella, pili, capsules, sheaths, prostheca and cell wall (Gram positive and Gram negative). Internal structure- cell membrane, cell inclusions-carbon storage polymers, polyphosphate, sulfur, minerals, magnetosomes, gas vesicles and carbonate. Formation of endospores.

Unit III

Control of microorganisms - Physical agents- conditions influencing antimicrobial action. Temperature, Desiccation, Osmotic pressure, Radiation, Filtration. Chemical agents- characteristics of an ideal antimicrobial agents, phenolic compound, Alcohol, Halogens, Heavy metals, dyes, synthetic detergents,, Quaternary ammonium compounds, Aldehydes, Gaseous agents. Evaluation of antimicrobial chemical agents.

Unit IV

Outline classification of viruses. Structure and life cycle of viruses- bacterial virus (T4, Lamda, M13), Animal virus (Pox, Influenza, Adeno), Plant virus (TMV and CMV), Insect virus (Baculovirus). Mycophages and cyanophages.

Unit V

Outline classification of fungi and algae. Distribution, importance, structure, nutrition and reproduction of fungi- *Dictyostelium*, *Physarum*, *Saprolegina*, *Rhizopus*, *Saccharomyces*, *Agaricus* and *Fusarium*. Algae - *Chlamydomonas*, *Chrysaemoeba*, *Sargassum*, *Gellidium*, *Noctiluca*. Lichens - Structures and types

Reference Books:

1. Alcamo, I.E. 2001. Fundamentals of Microbiology, Sixth Edition, Addison wesley Longman, Inc. California.
2. Alexopoulos, E.J., Mims, C.W. and Blackwell, M. 2000. Introductory Mycology, Fifth edition, John Wiley and Sons, New York.
3. Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
4. Chapman, V.J. and Chapman, D.J. 1980. Sea Weeds, Third Edition, Chapman & Hall, London.
5. Davis, B.D., Duellco, R., Fisen, H.N. and Ginsberg, H.S. 1990. Microbiology, Fourth Edition, Harper & Row Publishers, Singapore.
6. Dubey, R.C. and Maheswari, D.K. 2010. A text book of Microbiology, S. Chand and Company Ltd, NewDelhi.
7. Kreig, N.R. 1984. Bergeys Manual of Systematic Bacteriology Vol I: Sneath, P.H.A., Ed 1986, Vol II: Staley, J.T. Ed., 1989. Vol III, William., S.T., Ed., 1989, Vol IV William and William Baltimore.
8. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2009. Twelfth Edition, Brock Biology of Microorganisms, Mac Millan Press,England.
9. Mark Wheelis, 2010. Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi.
10. Pelczar, M.J., Schan, E.C. and Kreig, N.R.2010. Microbiology – An application based approach, Fifth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi.
11. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New York.
12. Salle, A.J. 1996. Fundamental Principles of Bacteriology, Tata McGraw Hill Publishing Company, New Delhi.
13. Stainer., R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.H. 1987. The Microbial World, Fifth Edition, MacMillan Press Ltd., London.
14. Tortora G.J., Funke, B.R. and Case, C.L.2009. Microbiology, Ninth Edition, Dorling Kindersely (India) Pvt. Ltd., Noida

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY
(From 2014-2016 batch onwards)

| | | | |
|-----------|------------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Core Paper-2) | Int. Marks | : 25 |
| Class | : I Year | Ext. Marks | : 75 |
| Semester | : I | Max. Marks | : 100 |
| Sub. Code | : S1PY2 | No. of Credits | : 5 |
| | | Hours/Week | : 6 |

Title of the Paper: **Microbial Biochemistry & Physiology**

Course Objectives:

- To develop a sufficient background to students about the structure, function and metabolism of biological macromolecules
- To provide hands-on experience and a critical appreciation of commonly employed analytical techniques in biochemistry

Unit I

Carbohydrates: Classification - structure and properties of monosaccharides (glucose, fructose) and disaccharides (lactose, maltose, sucrose). Properties of polysaccharides - starch, cellulose, agar- agar and peptidoglycan.

Metabolism and its regulation: Gluconeogenesis, glycolysis, kreb's cycle, hexose monophosphate shunt, glyoxylate cycle and Entner Doudroff pathway.

Amino Acid: Classification based on structure, polarity, biological importance and reactivity, physical properties and chemical reactions, biosynthesis of aminoacids – an overall view.

Protein: Classification, physical and chemical properties. Structure – primary, secondary (Ramachandran plot), tertiary and quaternary structure of proteins.

Unit II

Nucleic acids: Structure, synthesis and degradation of purines and pyrimidines. **Enzymes:** Classification, mechanism of enzyme action. Enzyme kinetics – Michaelis Menten equation, Lineweaver Burk plot. Factors influencing enzyme activity. Enzyme inhibition, active site, allosteric site. isozyme, ribozyme and abzyme.

Lipids: Classification and properties. Phospholipid and cholesterol synthesis in *E.coli*. **Metabolism - α , β and γ oxidation of fatty acids and lipid peroxidation.**

Vitamins: Vitamins as co - factors and co - enzymes.

Unit III

Growth of Bacteria: Phases of growth, growth kinetics - batch culture, continuous culture, diauxic growth and synchronous culture - induction of synchrony. Factors affecting growth - nutrition, aeration, temperature and pH. Physiological adaptation to extreme environmental conditions. Nutritional types and metabolic diversity - types based on carbon, energy and electron sources.

Unit IV

Bacterial Photosynthesis: Historical background. General types of microbial photosynthesis - oxygenic and anoxygenic. Structure of photosynthetic pigments – chlorophylls, bacteriochlorophyll, carotenoids and phycobilins. Photosynthetic bacteria - green sulphur and purple. Mechanism of photosynthesis - non-cyclic and cyclic electron transport and photophosphorylation. Carbon assimilation - calvin, reverse citric acid cycle and hydroxy propionate cycle. **Nitrogen metabolism:** Nitrogen cycle - ammonification, nitrification, denitrification, physiology of nitrogen fixation in symbiotic and free living bacteria, genetics of nitrogen fixation, acetylene reduction assay. Transamination and deamination.

Unit V

Bioenergetics: Principles and laws of thermodynamics. Coupling of chemical reactions - TCA cycle, electron transport chain, chemiosmotic theory of Mitchell - efficiency of coupling. **Biomembranes:** Fluid mosaic model, transport across membrane - diffusion, osmosis, active transport and group translocation. Sodium – Potassium pump.

Reference Books:

1. Ambika Shanmugam, 1998, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras.
2. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, New Delhi.
3. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books and Allied Pvt. Ltd., Kolkata
4. David, A. B. 2003. Nutritional biochemistry of Vitamins, Cambridge.
5. Deb, A.C. 2006. Fundamentals of Biochemistry, New Central Book Agency Pvt. Ltd., Kolkata.
6. Donald Voet and Judith G. Voet, 1995. Biochemistry. Second Edition, John Wiley and Sons, Inc. New York.
7. Kuchel, P.W. and Ralston, G.B. 2003. Sehamans outlines of biochemistry, Second Edition, Tata McGraw Hill Edition, New Delhi.
8. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2009. Twelfth Edition, Brock Biology of Microorganisms, Mac Millan Press, England.
9. Mckee, T. and Mckee, J.R. 1996. Biochemistry – An Introduction, Wm. C. Brown Communication Inc., USA.
10. Moat, A.G. and Foster, W. 1988. Microbial Physiology, Second Edition, John Wiley and Sons, New York.
11. Nelson, D.L. and Cox, M.M. 2002. Lehingers's Principles of Biochemistry, Third Edition, Mac Millan worth Publishers, New Delhi.
12. Schlegel, H.G. 2008. General Microbiology, Seventh Edition, Cambridge University Press, Great Britain.
13. Srivastava, M.L. 2008. Microbial Biochemistry, Narosa Publishing House, New Delhi.
14. Stryer, L. 2000. Biochemistry, Fourth Edition, W.H. Freeman and Company, New York.
15. Voet, A. and Voet J.G. 1995. Biochemistry, Second Edition, John Wiley & Sons Inc., New York.
16. Zubay, G. 1993. Biochemistry Vol.I & II, Third Edition, Wm. C. Brown Communication Inc., USA.

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY
(From 2014-2016 batch onwards)

| | | | |
|-----------|-----------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Lab-1) | Int. Marks | : 40 |
| Class | : I Year | Ext. Marks | : 60 |
| Semester | : I | Max. Marks | : 100 |
| Sub. Code | : S1PYL1 | No. of Credits | : 4 |
| | | Hours/Week | : 6 |

Title of the Paper: **Lab in General Microbiology, Microbial Diversity & Taxonomy**

1. Laboratory rules and regulations.
2. Cleaning and methods of sterilization.
3. Preparation of culture media.
4. Serial dilution technique.
5. Pure culture technique (A) Pour plate (B) spread plate (C) streak plate.
6. Isolation of bacteria from soil/water/air.
7. Isolation of fungi from soil/water/air.
8. Isolation of actinomycetes from soil.
9. Staining techniques- Simple, Negative, Gram's, capsule, Spores.
10. Motility test – Hanging drop method.
11. Measurement of microbial cell size – Micrometry method.
12. Cultivation of anaerobic microbes by pyrogallic acid method.
13. Identification of fungi by lactophenol cotton blue staining method.
14. Fungi slide culture technique.
15. Oligodynamic action of heavy metals on microbes
16. Measurement of bacterial growth rate and generation time –Turbidity and biomass
17. Measurement of fungal growth rate – colony diameter method.
18. Microbial diversity in soil zone - Winogradsky column method.
19. Study of microbial taxonomy by using bacterial morphology and biochemical tests.
20. Collection and identification of algae.

Reference Books:

1. Aneja, K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture, Wishwa Prakashan, New Delhi.
2. Beistir, L. 1996. Microbiology in Practice, Sixth Edition, Adeland Wesley, Langman, New York.
3. Bensen, J.R. 1996. Microbiological Applications: A Lab Manual in General Microbiology, Sixth Edition, WMc Brown Publication, U.S.A.
4. Cappuccino, J.H. and Sherman, N. 2012. Microbiology – A Lab Manual, seventh Edition, Dorling Kidersley(India)Pvt., Ltd.,New Delhi.
5. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
6. James, G.C. and Sharma, N. 1996. Microbiology: A Lab Manual, Fourth Edition, The Benjamin/Cumming Publishing Company, USA.
7. Kannan, N. 1996. Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
8. Reddy, S.W. and Reddy, R.S. 2000. Microbiology: A Laboratory Manual, BSC Publishers &. Distributors, New Delhi.
9. James, G.C. and Sharman, N. 1996. Microbiology - A Lab Manual, Fourth Edition, The Benjamin / Cummining Publishing Company, U.S.A.
10. Kannan, N. 1996. Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
11. Reddy, S.W. and Reddy, R.S. 2000. Microbiology: A Laboratory Manual, BSC Publishers &. Distributors.

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DEPARTMENT OF ZOOLOGY
(From 2014-2016 batch onwards)

| | | | |
|-----------|-----------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Lab-2) | Int. Marks | : 40 |
| Class | : I Year | Ext. Marks | : 60 |
| Semester | : I | Max. Marks | : 100 |
| Sub. Code | : S1PYL2 | No. of Credits | : 4 |
| | | Hours/Week | : 6 |

Title of the Paper: **Lab in Microbial Biochemistry and Physiology**

pH metry.

i) Preparation of buffer

ii) Titration curve of glycine aminoacid -pK_A value – estimation.

- 1) UV visible spectrophotometry.
 - Wavelength scan.
 - Time scan.
- 2) Chromatography
 - Paper chromatography – circular.
 - Thin layer chromatography - separation of aminoacids and lipids.
 - Column chromatography – separation of algal pigments by using silica gel.
 - Gas chromatography - nitrogenase estimation (Industrial Visit).
 - HPLC (Industrial Visit).
- 3) Carbohydrates:
 - Qualitative analysis of carbohydrate (mono, di and polysaccharides).
 - Quantitative estimation of glucose and glycogen from bacterial and yeast cell.
- 4) Proteins:
 - Qualitative analysis of proteins.
 - Quantitative estimation of protein from bacterial and yeast cell.
- 5) Enzymes:
 - Estimation of alkaline phosphatase activity.
 - Effect of pH and temperature on alkaline phosphatase activity.
 - Determining the activity of enzyme saccharase in yeast.
- 6) Centrifugation - density gradient centrifugation – sucrose gradient (Demonstration).
- 7) FTIR spectroscopy (Demonstration).
- 8) Environmental factor:
 - Effect of temperature on bacterial growth.
 - Effect of pH on bacterial growth.
- 9) Physiological groupings of bacteria.
 - Isolation of saccharophilic microorganisms (starch hydrolysis).
 - Proteolytic activity of microorganisms (casein and gelatin hydrolysis).
 - Lipolytic activity of microorganisms.
 - Cellulase Activity by microorganisms
- 10) Extraction and estimation of photosynthetic pigments.
 - Investigation of Hill reaction.
- 11) Biochemical Characterization.
 - Catalase assay.
 - Oxidase test.
 - Carbohydrate fermentation test.
 - Triple sugar iron agar test.
- 12) Nitrogen metabolism.
 - Nitrate reduction test.
 - Uptake of nitrate, nitrite and ammonia by microorganisms.

Reference Books:

1. Aneja, K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture, Wishwa Prakashan, New Delhi.
2. Cappuccino, J.H. and Sherman, N. 2012. Microbiology – A Lab Manual, seventh Edition, Dorling Kidderley(India)Pvt., Ltd.,New Delhi .
3. David T. Plummer, 2008. An introduction to practical Biochemistry, Third Edition, Tata Mc Graw Hill publishing Com. Ltd., New Delhi.
4. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
5. Jayaraman, J. 1985. Laboratory Manual in Biochemistry, New Age International (Pvt.) Ltd. Publishers, New Delhi.
6. Kannan, N. 1996. Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
7. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
8. Sawhney, S.K. and Nandhir singh, 2006. Introductory practical Biochemistry, second edition,Narosa Publishing house, New Delhi.
9. Wilson, K. and Walker, J. 2008. Practical Biochemistry,Cambridge state university press,UK

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY
(From 2014-2016 batch onwards)

| | | | |
|-----------|---|----------------|-------|
| Course | : M.Sc Microbiology (Elective Paper -1) | Int. Marks | : 25 |
| Class | : I Year | Ext. Marks | : 75 |
| Semester | : I | Max. Marks | : 100 |
| Sub. Code | : S1PYE | No. of Credits | : 5 |
| | | Hours/Week | : 6 |

Title of the Paper: **Microbial Diversity & Taxonomy**

Course Objectives:

- To focus on the structure and function of microbial communities
- To become familiar with taxonomy of microorganisms

Unit I

Discovery of microbial world: History, scope and relevance of microbiology. Introduction to microbial biodiversity – distribution, abundance, ecological niche of bacterial, archaeal and Eukaryal. Prokaryotic diversity: The archaea – phylogenetic overview. Euryarcheota – extremely halophilic archaea, taxonomy and physiology of halophilic archaea. Methane producing archaea: methanogens – diversity and physiology. Thermoplasmatales – thermoplasma. Hyperthermophilic euryarcheota: Thermococcales and Methanopyrus.

Unit II

Crenarcheota: Habitat and energy metabolism, cold dwelling microbes (arctic and antarctic), hyperthermophiles – terrestrial, volcanic habitats – sulfobacterales and thermoproteales. Evolution and life at high temperature – heat stability of biomolecules, DNA stability, lipid stability. Limits to microbial existence.

Unit III

Diversity, characteristic features and significance: Spirochaetes - aerobic / microaerophilic motile, helical / vibrioid - non motile gram negative curved bacteria - gram negative aerobic rod and cocci - facultative anaerobic gram negative rod - anaerobic gram negative straight, curved & helical rods - sulfur reducing bacteria - anaerobic gram negative cocci - rickettsias and chlamydias – mycoplasmas - endosymbionts.

Unit IV

Diversity, characteristic features and significance: Gram positive cocci - endospore forming gram positive rod and cocci- regular, non sporing, gram positive rod – Irregular, non sporing gram positive rods – Mycobacteria – Nocardioformis.

Anoxygenic phototrophic bacteria – oxygenic photosynthetic bacteria – aerobic chemolithotrophic bacteria – budding and appendaged bacteria – sheathed bacteria – non photosynthetic and non fruiting bacteria - Myxobacteria – archeobacteria.

Unit V

Diversity, characteristic features and significance: Nocardioform actinomycetes – actinomycetes with multilocular sporangia – actinoplanets – Streptomyces and related genera – Maduromycetes – Thermonospora and related genera – Thermoactinomycetes – other genera.

Reference Books:

1. Atlas, R.M. 2000. Microbiology Fundamentals and Application, Macmillan Publish Company, New York.
2. Dubey, R.C. and Maheswari, D.K. 2010. A text book of Microbiology, S. Chand and Company Ltd, NewDelhi.
3. Kreig, N.R. 1984. Bergeys Manual of Systematic Bacteriology Vol I: Sneath, P.H.A., Ed 1986, Vol II: Staley, J.T. Ed., 1989. Vol III, William, S.T., Ed., 1989, Vol IV William and William, Baltimore.
4. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2000. Twelfth Edition, Biology Microorganisms, Prentice Hall, New Jersey.
5. Mark Wheelis, 2010. Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi.
6. Pelczar, M.J., Schan, E.C. and Kreig, N.R.2010. Microbiology – An application based approach, Fifth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi.
7. Postgate, J. 1998. Nitrogen Fixation, Third Edition, Cambridge University Press.
8. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New York.
9. Schlegel, H.G. 2008. General Microbiology, Seventh edition, Cambridge University Press.
10. Stanier, R., Lingraham, Y., Wheelis, M.L. and Painter, R.P. 1986. General Microbiology, Fifth Edition, Macmillan, London.
11. Tortora G.J., Funke, B.R. and Case, C.L. 2009. Microbiology, Ninth Edition, Dorling Kindersely (India) Pvt. Ltd., Noida.

THIAGARAJAR COLLEGE, MADURAI – 9.

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DEPARTMENT OF ZOOLOGY

(From 2014-2016 batch onwards)

| | | | |
|-----------|------------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Core Paper-3) | Int. Marks | : 25 |
| Class | : I Year | Ext. Marks | : 75 |
| Semester | : II | Max. Marks | : 100 |
| Sub. Code | : S2PY1 | No. of Credits | : 5 |
| | | Hours/Week | : 6 |

Title of the Paper : **Immunobiology**

Course Objectives:

- To acquire knowledge on immunity and immune system
- To understand the organs and cells in the immune system
- To learn about the importance of overall reactions shown by the immune system

Unit I

History and scope of immunology. Types of immunity – innate, acquired, passive and active. Physiology of immune response – humoral and cell mediated immunity. Lymphoid organs – primary and secondary. Cells of immune system – ontogeny and development of cells in innate and adaptive immune system. Hematopoiesis and stem cells

Unit II

Antigens – characteristics, types, cross reactivity, hapten, adjuvant, immunogenicity and antigenicity. Immunoglobulins – types, structure and functions. Molecular biology of immunoglobulin synthesis, antibody diversity and isotype switching. Antigen - Antibody interactions. Mechanism of antigen recognition by T and B cells. Immunotechnology – hybridoma and monoclonal antibodies, antibody engineering using genetic manipulations – production of chimeric and hybrid monoclonal antibodies.

Unit III

Immune effector mechanisms: Cytokines – properties and functions. Complement components – classical and alternate pathways, complement activation, and complement deficiencies. Hypersensitivity – anaphylaxis, cytotoxic, immune complex deposition and cell mediated. Auto immunity - idiotype network and autoimmune diseases. Mechanism of immune regulation – tolerance.

Unit IV

Immunity to infectious diseases – bacterial (Tuberculosis), viral (AIDS), protozoan and parasitic diseases (Malaria and Leishmaniasis). Immune deficiency disorders – T cells, B cells, phagocytic, natural killer cell associated diseases and AIDS. Vaccines: Types – inactivated, subunit, synthetic, DNA and live attenuated vaccines.

Unit V

Transplantation immunology: Graft versus host reactions. Structure, functions of class I and class II MHC molecules, HLA typing. Principles of tumour immunology: Tumour antigens, immune responses to tumour and immunotherapy of malignancy. Immunodiagnosis based on antigen and antibody interaction - precipitation, agglutination, EIA, RIA, ELISPOT assay, immunofluorescence techniques, flow cytometry and Immunohistochemistry.

Reference Books:

1. Abbas, A.K., Lichtman, A.H. and Pober, J.S. 2000. Cellular and Molecular immunology, Fourth Edition, W.B. Saunders Company, London.
2. Arora, M.P. 2010. Immunology, Ane Books Pvt. Ltd., New Delhi.
3. Coleman, R.M., Lombard, M.F. and Sicard, R.E. 1992. Fundamental Immunology, Second Edition, Wm.C.Brown Publishers, USA.
4. Cruse, J.M. and Lewis, R. 1999. Atlas of Immunology, CRC Press, New York.
5. David, M., Jonathan, B., David, B.R. and Ivan, R. 2008. Immunology, Seventh Edition, Elsevier Publications.
6. Eli Benjamini, Sunshine G. and Lespcowitz, 2000. Immunology – a short course, Fourth Edition, Wiley – Liss, New York.
7. Ian R.Tizard, 2009. Immunology – An Introduction, Fourth Edition, Cengage Learning India Pvt. Ltd., New Delhi.
8. Janeway, Jr.C.A. and Travers, P. 2001. Immunobiology, Fifth Edition, Garland Publishing, London.
9. Khan, F.H. 2009. Elements of Immunology, Dorling Kindersley India Pvt. Ltd., India.
10. Goldsby, R.A., T.J. Kindt., & B.A. Osborne, Kuby 2002. Immunology. Fourth edition. W.H. Freeman and Company, New York.
11. Roitt, I., Brostoff, J and Male, D. 2001. Immunology, Sixth Edition, Mosby, London.
12. Vaman Rao, C. 2008. Immunology, Second Edition, Narosa Publishing House, New Delhi.

THIAGARAJAR COLLEGE, MADURAI – 9.

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DEPARTMENT OF ZOOLOGY

(From 2014-2016 batch onwards)

| | | | |
|---------------------|-------------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Core Paper- 4) | Int. Marks | : 25 |
| Class | : I Year | Ext. Marks | : 75 |
| Semester | : II | Max. Marks | : 100 |
| Sub. Code | : S2PY2 | No. of Credits | : 5 |
| Title of the Paper: | Microbial Genetics | Hours/Week | : 6 |

Course Objectives:

- To gain knowledge on molecular basis of mutation at microbial level
- To understand the gene regulation and expression mechanisms, role of plasmids and gene transfer methods

Unit I

Origin of mutation. Biochemical basis of mutation: Spontaneous mutation – random and non – adaptive mutation, mutation rates. Origin of spontaneous mutation – isolation of mutants. Selection of bacterial variation: Direct - fluctuation test, indirect - replica plating. Mutagenesis & mutagenic agents. Detection of mutagen - Ames test. Molecular basis of mutation.

Unit II

DNA damage & repair: DNA damages, hit theory, UV radiation. DNA repair: post irradiation effects on survival levels - Biochemical repair mechanism - photo reactivation, liquid holding theory - excision, recombination and SOS repair.

Unit III

Regulation of bacterial gene expression. Lactose system - coordinate regulation, Lac components, positive and negative regulation, catabolite repression, lac mutant isolation. Tryptophan operon - repression vs attenuation. Arabinose operon and its regulation.

Unit IV

Plasmids: Types and Properties of plasmids - F, R & Col plasmids. Agrobacterium Ti and broad host range plasmid. Detection and purification of plasmid DNA. Transfer of plasmid DNA. Replication of plasmid. Control of copy number, plasmid amplification, curing and incompatibility.

Unit V

Gene transfer mechanisms and recombination: Transformation: Discovery - Griffith experiment, Avery *et al* experiment. Detection: standard plating test, competence - DNA uptake mechanism, molecular mechanism of transformation, mapping based on transformation. Conjugation: F plasmid, insertion of plasmid, chromosome transfer mechanism, mapping based on conjugation - interrupted and uninterrupted mating. Transduction of Lambda phage DNA, generalized & specialized transduction, molecular mechanism of lytic and lysogenic cycle in Lambda phage, mechanism of specialized transduction, co-transduction, mapping based on transduction. Recombination: Types - Holliday model, enzymes involved in recombination.

Reference Books:

1. Albert, B., Lewis, R. and Watson, B. 1994. Molecular Biology of the cell, Third Edition, IUOII. Gariand Publishing Inc., New York.
2. David Freifelder. D. 2008. Microbial Genetics, Eighteenth Edition, Narosa Publishing House, NewDelhi.
3. Freifelder, D. 2000. Molecular Biology, Second Edition, Narosa Publishing house. NewDelhi.
4. Hayes.W. 1968. Genetics of Bacteria and their viruses, Black Well Publication, London.
5. Krebs, J.E., E.S.Goldstein and S.T. Kilpatrick 2009 Lewin's Gene X Jones & Bartlett Publishers, Boston.
6. Allison, L.A., 2007. Fundamental Molecular Biology, Blackwell Publishing, USA.
7. Malacinski, G.M. and Freifelder, D. 1998. Essentials of Molecular Biology, Third Edition, Jones and Bartlett publishers, Boston.
8. Stanley R. Maloy, John E.C. and Freifelder, D.2008. Microbial Genetics, Narosa Publishing House, New Delhi.

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DEPARTMENT OF ZOOLOGY
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| | | | |
|-----------|-----------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Lab-3) | Int. Marks | : 40 |
| Class | : I Year | Ext. Marks | : 60 |
| Semester | : II | Max. Marks | : 100 |
| Sub. Code | : S2PYL1 | No. of Credits | : 4 |
| | | Hours/Week | : 6 |

Title of the Paper: **Lab in Immunobiology**

I. Immunization Techniques.

1. Preparation of soluble antigen – human serum
2. Preparation of cellular (particulate) antigen - bacterial antigen
3. Methods of antigen administration.

II. Raising of polyclonal antibodies

4. Protocols of immunization.
5. In vivo method of delayed type hypersensitivity.

III. Serum Techniques.

6. Separation and preservation of serum / complements.
7. Demonstration of natural resistance to infection by bacterial killing of serum factors.
8. Electrophoretic separation of serum proteins.
9. Immunoelectrophoretic technique (Rocket, counter - current)

IV. Precipitin Techniques.

10. Agar gel Ouchterlony double immunodiffusion.
11. Mancini single radial immunodiffusion.

V. Agglutination Techniques.

12. Haemagglutination titration assay.
13. Direct agglutination to determine ABO blood grouping.

VI. Visualization and study of Lymphoid Organs from mice and Chicken (Model).

VII. Isolation of immune cells and enumeration.

16. Determination of differential leukocyte count.
17. Isolation and enumeration of lymphocytes from human blood.
18. Determination of lymphocyte viability by trypan blue exclusion test.
19. Identification and enumeration of human T – lymphocyte using E – rosette technique.
20. Isolation and Enumeration of WBC from human blood.
21. Isolation and Enumeration of RBC from human blood.

Reference Books:

1. Carpenter D.L.1975. Immunology and Serology, Third Edition, W.B. Saunders Company, London.
2. Garvey, J.S., Cremer, N.E. and Sussdorf, D.H. 1977. Methods in Immunology, A Laboratory Text for Instruction and Research, Third Edition, The Benjamin Cummings Publishing Company Advanced Book Program, London.
3. Hudson, L. and Hay, F.C. 1989, Practical Immunology, Third Edition, Blackwell scientific Publications, Oxford.
4. Myers, R.L. 1989. Immunology: A Laboratory Manual, Wm. C.Brown Publishers, Dubuque, Iowa.
5. Rastogi S.C.1996. Immunodiagnosics Principles and Practice, New Age International (P) Ltd., New Delhi.
6. Talwar, G.P. 1983. A Hand Book of Practical Immunology, Vikas Publishing House Pvt. Ltd., New Delhi.
7. Talwar, G.P. and Gupta, S.K. 1992. A Hand Book of Practical and Clinical Immunology, Vol. 1 -2, CBS Publishers & Distributors, Delhi.
8. Turgeon, M.L. 1990. Immunology and Serology in Laboratory Medicine, The C.V. Mosby Company, Baltimore.

DEPARTMENT OF ZOOLOGY
(From 2014-2016 batch onwards)

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|-----------|-----------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Lab-4) | Int. Marks | : 40 |
| Class | : I Year | Ext. Marks | : 60 |
| Semester | : II | Max. Marks | : 100 |
| Sub. Code | : S2PYL2 | No. of Credits | : 4 |
| | | Hours/Week | : 6 |

Title of the Paper: **Lab in Microbial Genetics & Molecular Biology**

1. Isolation of genomic DNA from bacteria.
2. Isolation of genomic DNA from yeast.
3. Isolation of plasmid DNA from bacteria.
4. Extraction of total RNA from bacteria and yeast
5. Estimation of nucleic acids
 - a) UV - VIS spectrophotometric analysis.
 - b) Analysis of nucleic acids by agarose gel electrophoresis.
 - c) Tm value
6. Detection of proteins by SDS-PAGE.
7. Determination percentage of killing of bacterial cells by UV rays.
8. Plotting of UV survival curve.
9. Plotting of dark repair mechanism.
10. UV sensitivity of Rec A⁺ and Rec A⁻.
11. Reversion of auxotroph.
12. Isolation of streptomycin resistant mutants using gradient plate technique.
13. Isolation of petite mutant.
14. Detection of mutagen - AMES test.
15. Isolation of auxotrophic mutant.
16. **Gene transfer mechanisms in bacteria**
 - a) Preparation of competent cells for transformation.
 - b) Stability testing of Hfr C phenotype.
 - c) Uninterrupted bacterial conjugation.

Phage Genetics

1. Isolation of phage from septic tank.
2. P1 phage lysate preparation.
3. P1 Transduction.

References Books:

1. Ausubel, F.M., Roger, B., Robert E.Kingston, David A. Moore, Seidman J.G., John A. Smith. and Kelvin, S. 1997. Thrid Edition, Short Protocols in Molecular Biology, Jolm Wiley & Sons Inc., New York.
2. Berger, S.L. and Kimmel, R. 1987. Guide to Molecular Cloning Techniques, Academic Press, Inc., New York.
3. Brown, T.A. 1998. Molecular Biology Lab Fax 11 Gene Analysis, Academic Press, London.
4. Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.
5. Miller, J.H. 1992. A Short Course in Bacterial Genetics: A Lab Manual & Hand Book for *E. coli* and related Bacteria. Cold spring Harbor Lab press, Cole Spring Harbar
6. Rajamanickam, C.2001,Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
7. Sambrook, I., Fritsch, E.F. and Maniatis, T. 2001. Third Edition, Molecular Cloning 1, 2, 3 - A Laboratory Manual, Cold Spring Laboratory Press, USA.

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DEPARTMENT OF ZOOLOGY

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| | | | |
|-----------|--|----------------|-------|
| Course | : M.Sc Microbiology (Elective Paper-2) | Int. Marks | : 25 |
| Class | : I Year | Ext. Marks | : 75 |
| Semester | : II | Max. Marks | : 100 |
| Sub. Code | : S2PYE | No. of Credits | : 5 |
| | | Hours/Week | : 6 |

Title of the Paper: **Molecular Biology**

Course Objectives:

- To expose the students to the structure and functions of genetic material
- To focus about the genome organization, transcription and translation process in Prokaryotes & Eukaryotes

Unit I

Discovery of DNA. Molecular basis of DNA as genetic material. Structure of DNA – A, B and Z form. Forms of DNA – DNA heteroduplex, circular, superhelical DNA, twisted circle. Properties of DNA - denaturation, renaturation, melting curve, hyperchromicity. Structure of RNA - types of RNA - tRNA, mRNA & rRNA. Epigenetics - Histone proteins.

Unit II

Replication of DNA - semi conservative mode, Meselson - Stahl experiment. Enzymology of DNA replication - DNA polymerase I, II & III, topoisomerase I & II, helicase, primase, gyrase. Molecular basis of DNA replication - replication fork, origin, okazaki fragments. Types of replication - circular and theta.

Unit III

Transcription process in Prokaryotes and Eukaryotes: Initiation - promoters, upstream & down stream sequences, sigma and transcription factors. Elongation - RNA polymerase, sub units. Termination - Rho dependent and Rho independent, nus A antitermination. RNA processing (post transcriptional modifications), inhibitors of transcription. Reverse transcription.

Unit IV

Genetic code: Elucidation of triplet code, code characteristics, codon dictionary. Reading frames, sense and nonsense code. Degeneracy - wobble hypothesis, universality of genetic code. Process of translation in prokaryotes and eukaryotes: Initiation - initiation factors, initiator tRNA, amino acid activation, shine dalgarno sequences, initiation site. Elongation - elongation factors and translocation. Termination - termination factors. Post translational modifications - post translational transport, signal hypothesis.

Unit V

Tumor viruses and oncogenes: Transformed cells, detection of integral viral DNA, structure of integral viral DNA. Protein kinase and transformation by retro viruses. The cellular counterpart of src. Carcinogens. Activation of oncogenes. Oncogenic proteins - protein kinases, growth factors, Ras protein. Transformation protein in DNA viruses.

Reference Books:

1. Krebs, J.E., E.S. Goldstein and S.T. Kilpatrick 2009 Lewin's Gene X Jones & Bartlett Publishers, Boston.
2. David Freifelder. D. 2008. Microbial Genetics, Eighteenth Edition, Narosa Publishing House, New Delhi.
3. Jeyanthi, G.P. 2009. Molecular Biology, MJP Publishers, Chennai.
4. Kornberg, A. and Baker, A. 1992. DNA Replication, Second Edition, W.H. Freeman & Company, New York.
5. Rastogi, S.C. 2006. Cell and Molecular Biology, New Age International Pvt. Ltd., New Delhi.
6. Russel, P.J., Wolfe, S.L., Hertz, P.E., Starr, C. and Mc Millan, B. 2004. Cell and Molecular Biology, Cengage Learning India Pvt. Ltd., New Delhi.
7. Singer, M. and Paul Berg, 1991. Genes & Genomes, University Science Books, California.
8. Stanley R. Maloy, John E.C. and Freifelder, D. 2008. Microbial Genetics, Narosa Publishing House, New Delhi.
9. Turner, P.E., McLennan, A.G., Bates, A.D. and White, M.R.H. 1999. Instant Notes in Molecular Biology, Viva Books Ltd., New Delhi.

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DEPARTMENT OF ZOOLOGY
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| | | | |
|-----------|-------------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Core Paper- 5) | Int. Marks | : 25 |
| Class | : II Year | Ext. Marks | : 75 |
| Semester | : III | Max. Marks | : 100 |
| Sub. Code | : S3PY1 | No. of Credits | : 5 |
| | | Hours/Week | : 6 |

Title of the Paper : **Medical Microbiology**

Course Objectives:

- To know the mechanisms by which bacteria, fungi, parasites and viruses attack the body to cause disease
- To become familiar with the diagnosis, prevention, treatment and epidemiology of infectious diseases including the impact of infectious agents on the human body
- Competence in performance and interpretation of certain routine clinical laboratory microbiological methods

Unit I

Laboratory management – Biomedical waste management, Biosafety in containment laboratory. Collection and transport of clinical samples. Microbiological examination of urine, blood, faeces, cerebrospinal fluid, throat swabs, sputum and pus Normal flora of human systems – skin, respiratory tract, gastrointestinal tract and genitourinary tract. Nosocomial infections. Nucleic acid based microbial diagnostic techniques – LCR, NASBA and QBRDA.

Unit II

General characters, pathogenesis, laboratory diagnosis, control measures of: Gram positive cocci – *Staphylococci*, *Streptococci*, gram negative cocci – *Gonococci*, gram positive non spore forming bacilli: aerobic – (*Corynebacteria*) and anaerobic (*Actinomyces*), gram positive spore forming bacilli: aerobic (*Bacillus anthracis*) and anaerobic (*Clostridia*).

Unit III

General characters, pathogenesis, laboratory diagnosis, control measures of: Gram negative non spore forming bacilli: Aerobic (*Bordetella*), small gram negative facultatively anaerobic bacteria – *Yersinia*, Enteric gram negative bacilli – *Vibrio*, *E.coli* and *Salmonella*. Acid fast bacteria – *M.tuberculosis*, *M.leprae*. Cell wall less bacteria – Mycoplasma. Spirochaetes – Leptospirosis. Sexually transmitted diseases -Syphilis

Unit IV

General characteristics, pathogenesis and laboratory diagnosis : Yeast – *Cryptococcus neoformans*. Yeast like fungus – *Candida sp.* Filamentous fungi – *Aspergillus* and *Penicillium*. Dimorphic fungus – *Blastomyces dermatidis*. Morphology and life cycle: Intracellular parasites – *Cryptosporidium* and *Plasmodium*. Intralumen parasites – *Entameoba histolytica* and *Ascaris lumbricoides*. Parasitic zoonoses – *Toxoplasma* and *Taenia*.

Unit V

Morphology, pathogenesis, laboratory diagnosis and control measures of: DNA viruses – Herpes simplex virus and Hepatitis B virus. RNA viruses – Flavi virus (dengue), Retrovirus – HIV. Viral zoonoses - Japanese encephalitis and rabies. Prions and virions. Classification of antibiotics based on mode of action: antibacterial (Penicillin and Streptomycin), antiviral (Amantidine and Zidovudine), antifungal (Amphotericin and Nystatin) antiparasitic drugs (Quinine and Metranidazole) and anticancer drugs (Methotrexate and L asparaginase). Emerging and reemerging infections (MRSA – Methicillin resistant *Staphylococcus aureus*, NDMS – New Delhi methicillin strain). National programmes in prevention of infectious diseases.

Reference Books:

1. Ananthanarayanan and Jeyaram Paniker C.K. 2009. Text Book of Microbiology, Eighth Edition, Orient Longman, Chennai.
2. Chakraborty P. 1995. A Text Book of Microbiology, New Central Book Agency (P) Ltd., Kolkata.
3. Collee, J.G., Fraser, A.G., Marmion, B.P. and Simmons, A. 2007. Mackie and McCartney, Practical Medical Microbiology, Fourteenth Edition, Churchill Livingstone.
4. David Greenwood, Richard Slack, John Pertherer and Mike Barer, 2009. Medical Microbiology - A Guide to Microbial infections, pathogenesis, immunity, lab diagnosis and control, 17th Edition, Elsevier Publications.
5. Davis, B.D., Dulbecco, R., Eisen, H.N. and Ginsberg, H.S. 1990. Microbiology, Fourth Edition, Harper & Nowpublishers, Singapore.
6. Jawetz E., Melnic, J.C. and Adelberg, E.A. 2001. Review of Medical Microbiology, Prentice Hall International Inc., USA.
7. Leslie Collier, Balows A. and Sussman M. 2000. Topley & Wilson's Microbiology and Microbial infection Vol. 1 -5 Arnold Publishers, London.
8. Mandell, Douglas and Bennt's Principles and Practice of infectious diseases, 2000 vol. 1 & 2 Churchill livingstone.
9. Rajan, S. 2009. Medical Microbiology, MJP Publishers, Chennai.

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|-----------|-------------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Core Paper- 6) | Int. Marks | : 25 |
| Class | : II Year | Ext. Marks | : 75 |
| Semester | : III | Max. Marks | : 100 |
| Sub. Code | : S3PY2 | No. of Credits | : 5 |
| | | Hours/Week | : 6 |

Title of the Paper : **Genetic Engineering**

Course Objectives:

- To expose the principles behind the genetic engineering and to reveal various methods of gene manipulation
- To present an in-depth knowledge of recombinant DNA technology as the foundation of modern biotechnology
- To have basic knowledge on bioinformatics tools and become familiar with structure prediction methods

Unit I

Restriction and modification in bacteria - *E.coli* K & B system. Restriction enzymes – nomenclature, classification, Type I, II and III and applications. DNA modifying enzymes – nucleases – polymerases, ligases, cloning vectors – plasmids, cosmids, phasmids, phagemids, expression vectors, plasmid vectors – pBR 322 and pUC18, integrating shuttle vectors -YAC vectors and viral vector - SV 40 and adeno virus. Lac Z promoter – expression system – Lambda, PL / PR Promoter, T⁷ promoter, Sp6 promoter, SV – 40 promoter, Cam V 35s promoter.

Unit II

Cloning methodologies – α complementation, sticky and blunt end cloning. Cloning from mRNA – synthesis of cDNA, cloning cDNA in plasmid and phage vectors, cDNA libraries. Cloning from genomic DNA – genomic library. Shot gun cloning. screening of recombinant – phenotypic expression of characters – Blotting techniques – Western, Northern, Southern. Physical mapping of cloned genes – restriction mapping, DNA foot printing, chromosome walking. Mapping of human genes – Human genome project.

Unit III

PCR – gene amplification, primer designing, optimization, variation in the PCR (RAPD, RFLP, RACE, RT-PCR) DNA sequencing – Sanger – Coulsen's method, Maxam Gilbert's method. Using computers for DNA sequence analysis. Microbial genomics – whole genome shotgun sequencing – general characteristics of microbial genome, structural genomics – proteomics. Transposable elements – Is elements. Mechanism of transposition – conservative and replicative.

Unit IV

Cloning of human insulin, interferon, somatostatin in *E.coli*. Human antibody production by r-DNA technology. Recombinant vaccine development - HBs Ag in yeast. Cloning for commercial production of antibiotics (Penicillin). Chymosin (Rennin) in *E.coli* and yeast. Gene silencing and antisense technology: Types and mechanism of gene silencing. Gene therapy. Gene silencing in crop plants: tomato and rice. Si RNA and disease control. Plant genetic engineering: Ti plasmid, DNA delivery to plant cells – microprojectile bombardment, microinjection, electroporation and pollen tubes.

Unit V

Introduction – Bioinformatics and databases – sequence, structure & domain – application and scope. Biological tools: Nucleotide sequence databases – protein databases – specialized sequence data bases. Data retrieval and analysis. Sequence alignment: Types - local and global alignment. Alignment methods – pair wise sequence alignment: FASTA and BLAST. Multiple sequence alignment – methods and softwares – Clustal W, Multalign – phylogenetic analysis. Genomics – structural, comparative and functional genomics – gene expression analysis – micro array technology and its application.

Reference Books:

1. Baltz, R.H., Hegman, G.D. and Skatrud, P.L. 1993. Industrial Microorganisms - Basic and applied Molecular Genetics, American Society for Microbiology, Washington.
2. Brown, T.A. 2006. Gene Cloning, Fifth Edition, Chapman and Hall Publication, USA.
3. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
4. Glick, B.K. and Pasternak, J.J. 2002. Molecular Biotechnology Principles and Applications of Recombinant DNA, ASM Press, Washington.
5. Hammong, J., Mc Garvey, P. and Springer, V.Y. 2000. Plant Biotechnology.
6. Kumaresan, V. 2009. Biotechnology, Saras publications, Nagercoil.
7. Krebs, J.E., E.S.Goldstein and S.T. Kilpatrick 2009 Lewin's Gene X Jones & Bartlett Publishers, Boston Old R.W. and Primrose, S.B.1996. Principles of Gene Manipulations, Blackwell Science Publications, London.
8. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, Seventh Edition, Blackwell publishing, UK.
9. Sandhya Mitra, 1996. Genetic Engineering, Mac Millan India Ltd., New Delhi.
10. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
11. Symonds, N., Toussaint, A., Van De Putte, P. and Howe, M.M. 1987. Phage Mu. Cold Spring Harbor Laboratory.
12. Talwar, G.P., Rao, K.V.S. and Chauhan, V.S. 1994. Recombinant and Synthetic Vaccines, Narosa Publishing House, New Delhi.
13. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
14. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, Fourth Edition, The Benjamin Cummings Publishing Company Inc., Tokyo.
15. Winnaker, E.L. 1987. From Gene to Clone: Introduction to Gene Technology, VCH Publications, Weinbeim Federal Republic German.
16. Young, M.M. 1992. Plant Biotechnology, Pergmen Press, Oxford London.
17. Attwood, T.K. and Parry, D.J – Smith, D.J. 2002. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd.
18. Mount, W. 2001. Bioinformatics Sequence and Genome Analysis. Cold Spring harbour Laboratory Press, New York
19. Mount, W. 2001. Bioinformatics sequence and genome analysis. Cold Spring harbour Laboratory Press, New York

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DEPARTMENT OF ZOOLOGY
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| | | | |
|-----------|-----------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Lab-5) | Int. Marks | : 40 |
| Class | : II Year | Ext. Marks | : 60 |
| Semester | : III | Max. Marks | : 100 |
| Sub. Code | : S3PYL1 | No. of Credits | : 4 |
| | | Hours/Week | : 6 |

Title of the Paper: **Lab in Medical Microbiology**

1. Collection and processing of clinical specimen for microbiological examination.
2. Staining methods for morphological feature of pathogenic bacteria.
 - A. Differential stains – Gram stain, Ziehl Neelsen’s stain for AFB
 - B. Cytological stains –
 - i) Endospore stain – *Bacillus*
 - ii) Capsule stain, Negative stain Indian ink / Nigrosine staining.
Organism – *Bacillus*, *Enterobacter*, *Escherichia coli*.
 - C. Stain for Amoeba / Intestinal protozoa / Malarial parasites – Leishman’s stain, Giemsa stain.
3. Diagnostic Bacteriology : Laboratory diagnosis (isolation & identification)
 - i) Pyogenic infections – *Streptococci* – α , β and γ haemolysis. *Staphylococci* – differentiation – coagulase test.
 - ii) UTI infection – *E.coli*, *Proteus*, *Pseudomonas*.
4. Microscopic method of pathogenic fungus identification.
- Dermatophytes, *Candida albicans*.
5. Biochemical tests for bacterial identification.
 - i) MRVP test
 - ii) TSI for enteric pathogen.
6. Serodiagnosis of Bacterial Infection
 - i) Widal Test
 - ii) RPR Test
7. Preparation of dried filter paper discs for susceptibility assay.
8. Kirby – Bauer disc diffusion technique.
9. Dilution sensitivity test – MIC.
10. Antimicrobial susceptibility test against filamentous and non- filamentous fungi.
11. Detection of β lactamases.

Reference Books:

1. Baily and Scott’s Diagnostic Microbiology, 2006. Mosby London.
2. Bradshaw, L.J. 1979. Laboratory Microbiology, Third Edition, W.B. Saunders Company.
3. Collins and Lyne’s . Microbiological methods, 2001. Arnold publishers, Newyork.
4. Desai, J.D. and Desai, A.J. 1995. Methods in Microbiology Microscopy and Staining, Emkay Publications New Delhi.
5. Lippincott Williams and Wilkins. Philadelphia, Baltimore 2006. Koneman’s Color Atlas and Text book of Diagnostic Microbiology.
6. Monica Cheesbrough, 2000. District Laboratory Practice in Tropical Countries, Part – 2, Cambridge University Press, Cambridge, U.K.
7. Myers R.M. and Koshi G. 1982. Diagnostic Procedures in Medical Microbiology and Immunology / Serology, Microbiology Laboratories, Christian Medical College and Hospital, Vellore.
8. Wadhar B.H. and Boosreddy, G.L. 1995. Manual of Diagnostic Microbiology, Himalaya Publishing House, New Delhi.

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| | | | |
|-----------|-----------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Lab-6) | Int. Marks | : 40 |
| Class | : II Year | Ext. Marks | : 60 |
| Semester | : III | Max. Marks | : 100 |
| Sub. Code | : S3PYL2 | No. of Credits | : 4 |
| | | Hours/Week | : 6 |

Title of the Paper: **Lab in Genetic Engineering**

1. Isolation of Plasmid by alkaline detergent method - A miniprep procedure
2. Isolation of Chromosomal DNA from bacteria.
3. Agarose gel electrophoresis of undigested plasmid DNA
4. Recovery of DNA from gels.
5. Determination of fragment order of plasmid by single and double restriction digestion.
6. Demonstration of Ligation.
7. Acrylamide gel electrophoresis and silver staining procedure.
8. Cloning of DNA fragment in pBR 322 / pbluescript – insertion inactivation/ blue white selection.
9. Western Blotting
10. Database (homology) searches using different types of BLAST
11. Multiple sequence alignment using CLUSTAL W and Multalin.
12. Identification of restriction sites using NEB cutter.
13. Identification of protein cleavage site using pepcutter tool.
14. 3D visualization of structures using Rasmol and discovery studio viewer.
15. Molecular docking using Arguslab and Hex.

Reference Books:

1. Ausubel, F.M.1997. Short Protocols in Molecular Biology, Second Edition, John Wiley & Sons. Harvard Medical School.
2. Brown, T.A. 1998. Molecular Biology Lab Fax II Gene analysis, Second Edition, Academic Press, UK.
3. Glover, D.M. and Hames, B.D. 1995. DNA cloning – A practical approach, Vol. 1 - 4, IRC Press.
4. Janarthanan, S. and Vincent, S. 2007. Practical Biotechnology: Methods and protocols, University Press.
5. Sambrook, J., Fritsch, E.F. and Maniatis, T.2001. Molecular Cloning – A lab manual. Vol. III – Second Edition, CSH Press, Cold spring harbor.
6. Pevsner 2003. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi
7. Baxevanis, A.D. and Quellerie, B.F.F. 2001. Bioinformatics. A practical guide to the analysis of genes and proteins. II edn. Wiley-Intern Science Publication, New York.

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DEPARTMENT OF ZOOLOGY
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| | | | |
|---------------------|--|----------------|-------|
| Course | : M.Sc Microbiology | Int. Marks | : 25 |
| Class | : II Year | Ext. Marks | : 75 |
| Semester | : III | Max. Marks | : 100 |
| Sub. Code | : S3PYE | No. of Credits | : 5 |
| Title of the Paper: | Analytical Microbial Technology | Hours/Week | : 6 |

Course Objectives:

- To become familiar with the importance of water quality
- Make them to learn analytical techniques of Quality control sector in microbiological industry

Unit I

Mineral water industry: Stages of mineral water production. Analysis of water quality – pH, salinity, alkalinity, dissolved oxygen, carbonates, nitrate, silicate, phosphate, COD and BOD. Determination of microbial load in water : Faecal indicator organisms - coliform bacteria, faecal enterococci. Methods of mineral water quality assessment – MPN test, membrane filtration technique.

Unit II

Preservation of pharmaceutical Products: Chemical preservatives –role of preservatives. Finished product tests – microbial enumeration test, tests for specified microorganisms. Sterility testing – antimicrobial effectiveness testing. Sterility assurance – biological indicators, sterilization validation process. Microbial risk assessment through HACCP plan.

Unit III

Endotoxin test methods - gel clot assay, turbidometric assay and chromogenic methods. Biological assays - vitamin assay, antibiotic assay and mycoplasma testing. Endotoxin activity – risk assessment in manufacture of parenterals – pyrogen test – depyrogenation methods.

Unit IV

Rapid methods for detection of microorganisms in food. Food spoilage: Spoilage of fruit and vegetables. Spoilage of cereal and cereal products – cereal grains, and bread. Spoilage of meat and meat products – Bacon and Ham. Spoilage of milk and milk products – butter and frozen desserts. Food borne diseases – indicators of pathogens & food poisoning.

Unit V

Food preservation – principle, Methods - physical – asepsis, high temperature, low temperature, drying, radiation, canning, controlled atmosphere; chemical preservatives- organic acids and their salt, nitrites, sulfur dioxide, sulfites, sugar, salt and oxidizing agents.

Reference Books:

1. Ashutosh Kar, 2008. Pharmaceutical Microbiology, New Age International Publishers, New Delhi.
2. Cleanroom Microbiology for the Non-Microbiologist – David M. Carlberg (1995 – Interpharm Press)
3. Cleanroom Microbiology for the Non-Microbiologist – David M. Carlberg (1995 – Interpharm Press)
4. Endotoxins – Pyrogens, LAL Testing and Depyrogenation : III Edition by Kevin Williams (2007; Informa Press)
5. Endotoxins – Pyrogens, LAL Testing and Depyrogenation : III Edition by Kevin Williams (2007; Informa Press)
6. Manivasakam, N. 2001. Chemical and Microbial analysis of mineral and packaged drinking waters. Sakthi Book Service, Coimbatore.
7. Microbial Contamination Control in Parenteral Manufacturing by Kevin L. Williams
8. Microbial limit and Bioburden tests (Validation Approached and Global Requirements) by Lucia Clontz (Interpharm Press).
9. Microbial limit and Bioburden tests (Validation Approached and Global Requirements) by Lucia Clontz (Interpharm Press).
10. Microbiology in Pharmaceutical Manufacturing – II edition – Richard Prince.
11. The United States Pharmacopoeia (USP 32) NF 27 – Volume 1 (General Chapters)
12. Trivedy, R.K., Goel, P.K. and Trishal, C.L. 1987. Practical methods in Ecology and Environmental science. Environmental publishers. Karad
13. Frazier, W.C., and Westhoff, D.C. 2005. Food Microbiology, sixth edition, Tata McGraw Hill Publishing Ltd., New Delhi.
14. Garbutt, J. 1997. Essentials of Food Microbiology, Arnold – International Students edition, London.
15. Adams, M.R. and Moss, M.O. 2006. Food Microbiology, New Age International (Rt) Ltd., New Delhi.

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|--------------------|-------------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Core Paper- 7) | Int. Marks | : 25 |
| Class | : II Year | Ext. Marks | : 75 |
| Semester | : IV | Max. Marks | : 100 |
| Sub. Code | : S4PY1 | No. of Credits | : 5 |
| Title of the Paper | : Bioprocess Technology | Hours/Week | : 6 |

Course objectives:

- To learn the process involved in the industrial production of microbial products
- To understand the upstream and downstream processes of fermentation

Unit I

General concepts of industrial microbiology. Isolation of productive strains-screening technique - primary and secondary. Strain development – mutation, protoplast fusion and recombinant DNA techniques. Preservation techniques - serial sub-culture, mineral oil, freeze drying, N₂ storage. Storage of fungi-soil culture, silica gel culture and water storage.

Unit II

Types of fermentation-solid state fermentation-types of substrates. Submerged fermentation. Methods of fermentation-batch, continuous and fed batch system. Types and design of fermentors-batch, CSTF, air lift, tower, bubble column, fluidized bed fermentor. Fermentor auxiliary equipment. sterilization of equipment and air.

Unit III

Media-chemical composition, raw materials - saccharide, starchy, cellulose and industrial wastes. Media optimization and sterilization (batch and continuous). Fermentation kinetics-Batch and continuous. Inoculum development- Bacterial, fungal spores, fungal mycelium. Immobilization of cells and enzymes-methods and application.

Unit IV

Fermentation of microbial products-Anaerobic fermentation (Beer, wine, alcohol). Aerobic fermentation (Vinegar, citric acid), Amino acid (lysine, glutamic acid), Antibiotics (Penicillin, Streptomycin), Enzymes (Amylase, Protease), Vitamins (B₁₂, Riboflavin), Hormones (Gibberellic acid, Indole acetic acid).

Unit V

Downstream processing –cell disruption-physical and chemical methods. Separation-precipitation, filtration, centrifugation, liquid-liquid extraction, chromatography, drying and crystallization. Microbial assay of vitamin (B₁₂), Amino acid (valine), Antibiotics (Streptomycin, erythromycin). Fermentation economics-Process cost, recovery cost, market potential and Cost benefit ratio.

Reference Books:

1. Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
2. Casida, J.F. 2010. Industrial Microbiology, New Age International India Pvt. Ltd., New Delhi.
3. Crueger, W. and Crueger, A. 2000. Biotechnology: A Text Book of Industrial Microbiology, Second Edition, Panima Publishing corporation, New Delhi.
4. Demain A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology & Biotechnology. ASM press.
5. Flickinger, M.C. and Drew, S.W. 1999. Encyclopaedia of Bioprocess Technology Fermentation, Biocatalysis and Bioseparation Vol.V., John Wiley and Sons Publications.
6. Kalaichelvan, P.T. and Arul Pandi, I. 2007. Bioprocess Technology, MJP publishers, Chennai.
7. Patel, A.H., 1996, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.
8. Peppler, H., and Pearman, D. 2008. Microbial Technology, second edition, Vol.I, Academic Press, New York.
9. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New Delhi.
10. Stanbury, P.F, Whitaker, A. and Hall, S.J.1999. Principles of Fermentation Technology, Second Edition, Aditya Book (P) Ltd., New Delhi.
11. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. 2001. Industrial Microbiology: An Introduction, Blackwell Science, London.
12. Wulf Cruger, Anneliese Cruger, and Thomas D. Brock, 1991. Biotechnology, A Text book of Industrial Microbiology.

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(From 2014-2016 batch onwards)

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|-----------|-------------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Core Paper- 8) | Int. Marks | : 25 |
| Class | : II Year | Ext. Marks | : 75 |
| Semester | : IV | Max. Marks | : 100 |
| Sub. Code | : S4PY2 | No. of Credits | : 5 |
| Paper | : Core | Hours/Week | : 6 |

Title of the Paper : **Food, Agriculture & Environmental Microbiology**

Course Objectives:

- To predict the necessary measures to control the spoilage and pathogenic microorganisms in food
- To learn the interrelationships of microorganisms with foods and their role in food manufacture and food spoilage
- To elaborate the role of microbes in plant growth and to explain the importance of microbial pesticides over chemical pesticides

Unit I

Production of fermented dairy products: Cheese, yoghurt and butter milk.

Fermented vegetables; Sauerkraut, pickles and soy sauce. Fermented meat, Fermented Indian foods - leavening of bread. Food spoilage: Spoilage of fruit and vegetables, cereal and cereal products, Meat and meat products, milk and milk products. Food borne diseases – food intoxications & food poisoning. Microbes as food (Probiotics) – Potential and therapeutic applications.

Unit II

Food preservation – principle, Methods - physical – asepsis, high temperature, low temperature, drying, radiation, canning, controlled atmosphere; chemical preservatives- organic acids and their salt, nitrites, sulfur dioxide, sulfites, sugar, salt and oxidizing agents. Food Inspection – Hazard Analysis Critical Control point.

Unit III

Transmission of plant pathogens, mechanism of microbial pathogenicity, factors affecting disease incidence. Bacteria – *Xanthomonas malvacearum* (Cotton blight), and *Xanthomonas citri* (Citrus canker). Fungi – *Ustilago maydis* (Smut rust of Corn) and *Cercospora arachidicola* (Tikka disease of ground nut). Virus – DNA virus (Bhendi yellow vein clearing virus), RNA virus – (Cucumber mosaic virus). Phytoplasma – Brinjal little leaf and sesamum phyllody.

Unit IV

Biofertilizers: General account of taxonomy, physiology, mass cultivation, carrier based inoculants, quality control of *Rhizobium*, *Frankia*, *Azotobacter*, *Cyanobacteria* and AM.

Biopesticides: Bacterial pesticides: *Bacillus thuringiensis*, *Pseudomonas*. Viral Pesticides: Nuclear Polyhedrosis virus. Fungal pesticides: Entomopathogenic fungi - *Beauveria bassiana*.

Endophytes – Plant Growth Promoting Organisms

Unit V

Microbial interactions within the community - symbiosis, amensalism, commensalisms, predation, parasitism and competition. Waste treatment- types of wastes - characteristics of solid and liquid wastes. Treatment of solid wastes - composting and vermiform composting. Treatment of liquid wastes - primary, secondary (trickling filter, activated sludge, oxidation pond, oxidation ditch) and tertiary treatment. Eutrophication. Microbial remediation - phenolics, metals, sewage nutrients (phosphate and nitrate), xenobiotics. Microbial leaching of ores. Microbial deterioration - paper, leather, wood, paint and textiles.

Reference Books:

1. Adams, M.R. and Moss, M.O. 2006. Food Microbiology, New Age International (Rt) Ltd., New Delhi.
2. Alexander M. 1997. Introduction to soil microbiology, John Wiley & Sons, Inc, New York.
3. Benwart, G.J. 1987. Basic Food Microbiology, CBS Publishers & Distributors, New Delhi.
4. Deak, T. and Beuchat, L.R. 1996. Hand Book of Food Spoilage yeasts, CRC Press, New York.
5. Ec Eldowney S., Hardman, D.J. and Waite, S. 1993. Pollution Ecology and Biotreatment-Longman Scientific Technical.
6. Frazier, W.C., and Westhoff, D.C. 2005. Food Microbiology, sixth edition, Tata McGraw Hill Publishing Ltd., New Delhi.
7. Garbutt, J. 1997. Essentials of Food Microbiology, Arnold – International Students edition, London.
8. Grant, W.D. and Long, P.L. 1981. Environmental Microbiology. Blackie Glasgow and London.
9. Mehrotra, R.S. 1983. Plant Pathology, Tata McGraw Hill Publishing Company Ltd., New Delhi.
10. Pandey, B.P. 1997. Plant Pathology (Pathogen & Plant Disease), S.Chand & Company Ltd., New Delhi.
11. Ray Chadhuri, S.P. 1977. A Manual of Virus Diseases of Tropical Plants, MacMillan Company of India Ltd., Delhi.
12. Rengaswami, G. and Rajagopalan, S. 1973. Bacterial Plant Pathology – Tamil Nadu Agriculture University, Coimbatore.
13. Subba Rao, N.S. 2000. Soil Microorganisms and Plant Growth, Third Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

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| | | | |
|-----------|-----------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Lab-7) | Int. Marks | : 40 |
| Class | : II Year | Ext. Marks | : 60 |
| Semester | : IV | Max. Marks | : 100 |
| Sub. Code | : S4PYL1 | No. of Credits | : 4 |
| | | Hours/Week | : 6 |

Title of the Paper: Lab in Bioprocess Technology

1. Demonstration of fermentation using Kuhn's fermentation vessel.
2. Screening, production and assay of amylase from microbes
3. Screening, production and assay of protease from microbes
4. Screening, production and assay of cellulase from microbes
5. Screening, production and assay of Xylanase from microbes
6. Screening, production and assay of Phosphatase from microbes
7. Screening, production and assay of citric acid from microbes
8. Screening of antibiotic producing microbes
9. Production and assay of sucrase from microbes
10. Production and assay of gluconic acid from microbes
11. Production and assay of glutamic acid from microbes
12. Production and assay of Pectinase from microbes
13. Production and estimation of Proline
14. Production and estimation of alcohol
15. Production and quantitative analysis of beer and wine
16. Bacterial cell /enzyme immobilization in sodium alginate gel
17. Cell disruption for endoenzymes by sonication
18. Enzyme purification by acetone precipitation
19. Estimation of biomass and substrate concentration in fermentation, determination of kinetic parameters (yield and productivity)
20. Preservation of industrially important bacteria by lyophilization.

Reference Books:

1. Demain, A.L, and Davis, J.E. 1999. Manual of Industrial Microbiology and Biotechnology, second edition, American Society for Microbiology, Washington.
2. Gunasekaran, P. A Lab Manual Approaches for Improvement of Microbial Strains for industrial enzyme production, Department of Microbial Technology, M.K.U.
3. Mc.Neil, B. and Harvery, L.M. 1990. Fermentation: A Practical Approach (Units I-III), IRL Ptrd, New York.
4. Kulanthaivel,S and S. Janarthanan 2012. Practical Manual on Fermentation Technology. I.K. International Publishing house. New Delhi.
5. Peppler,H,J and Periman,D. 2008.Microbial Technology Fermentation Technology, (Two Volumes)Second Edition, Elsevier, Academic Press.U.K.

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|-----------|------------------------------|----------------|-------|
| Course | : M.Sc Microbiology (Lab- 8) | Int. Marks | : 40 |
| Class | : II Year | Ext. Marks | : 60 |
| Semester | : IV | Max. Marks | : 100 |
| Sub. Code | : S4PYL2 | No. of Credits | : 4 |
| | | Hours/Week | : 6 |

Title of the Paper: **Lab in Food, Agriculture & Environmental Microbiology**

1. Viable count of bacteria in milk.
2. Methylene Blue Dye reduction test.
3. Resazurin dye reduction test.
4. Phosphatase test.
5. Turbidity test
6. Litmus milk reactions.
7. Microbial Contamination in plant food products.
8. Microbial Contamination in animal food products.
9. Potability analysis of drinking water.
10. Structure of root & stem nodules.
11. Isolation of *Rhizobium* from root nodules.
12. Isolation of *Xanthomonas malvacearum* from angular leaf spot of cotton
13. Isolation of pathogenic fungi from plant
14. Isolation of cyanobacteria from soil
15. Isolation of Arbuscular Mycorrhizal spores from soil.
16. Staining of VAM.
17. Isolation & enumeration of *Azospirillum* – an associative symbiotic nitrogen fixing bacteria.
18. Isolation & enumeration of *Azotobacter* & *Beijerinckia* – non symbiotic nitrogen fixing bacteria.
19. Isolation of Phosphate solubilizing Microorganisms from soil.
20. Vermicomposting.
21. Development of Winogradsky column.
22. Physical, Chemical, Microbial assessment of water – Acidity, Alkalinity, BOD, COD.
23. Degradation of Phenol – Colorimetric Method.
24. Visit to Aavin /CFTRI / TNAU.

Reference Books:

1. Aneja K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture, Wishwa Prakashan, New Delhi.
2. Harrigan, W.F. 1998. Laboratory Methods in Food Microbiology, Third Edition.
3. Reddy, S.M. and Ram Reddy, S.R. 2000. Microbiology - A Laboratory Manual, BSC Publishers & Distributors.
4. Thangaraj, M. and Santhana Krishnan, P. 1998. Practical Manual on Microbial inoculants, Centre of Advanced Studies in Agricultural University, TNAU, Coimbatore.

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|-----------|---|----------------|-------|
| Course | : M.Sc Microbiology (Elective Paper- 4) | Int. Marks | : 40 |
| Class | : II Year | Ext. Marks | : 60 |
| Semester | : IV | Max. Marks | : 100 |
| Sub. Code | : SPJ | No. of Credits | : 3 |
| | | Hours/Week | : 6 |

Title of the Paper: **Project Work**

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|------------|----------------------------|---------------|-------|
| Class | : II Year B.Sc IMB | Int.Marks | :25 |
| Semester | : I & III | Ext. Marks | : 75 |
| Sub. Code | : | Max. Marks | : 100 |
| Hours/Week | : 2 | Hrs/Sem | : 20 |
| Paper | : Certificate course paper | No of Credits | : |

Title of the Paper: **Water Quality Analysis (Certificate Course)**

Course Objectives

- To make the students aware of the importance of potable water
- To make them learn how to analyse the water samples

Unit I

Analysis of water quality - pH, salinity, alkalinity, dissolved oxygen, COD and BOD.
Estimation of carbonates, nitrate, silicate and phosphate

Unit II

Determination of microbial load and faecal contamination. – MPN test-presumptive, confirmatory and completed test. Membrane filtration technique. Coliform bacteria.

Unit III

Analysis of heavy metals – Lead, Copper and Mercury. Aquatic pollution indicators.

Unit IV

Water Pollution control and prevention. Waste water treatment- primary, secondary and tertiary methods

Unit V

Water purification techniques. Biofilters. Environmental impact assessment.

References

1. Goldman, C.R. and A.J.Horne 1983. Limnology , International Student Edition, USA.
2. Metelev V.V. and A.I. Karnaev 1983. Water Toxicology Amerind Publishing Co.Pvt.Ltd.
3. Trivedy, K.K., Goel, P.K and Trisal, C.L 1987. Practical methods in Ecology and Environmental science, Environmental Publication, Karad.
4. Patnaik, P 1997. Hanb book of Envirmental Analysis, Lewis Publishers
5. Leadly, A and Brown 1971. Ecology and Fresh water, Heinmann Educational Books, Cole, G. A 1983. Textbook of Limnology 3rd edition, The C.V. Mosby company
6. Manivasakam, N. 2001. Chemical and Microbial analysis of mineral and packaged drinking waters. Sakthi Book Service, Coimbatore.
7. Michael, P. 1987. Ecological methods for field and laboratory investigations. Tata McGraw Hill Publishing Co., New Delhi.
8. Southwood, TRE. 1978. Ecological methods. ELBS. USA.
9. Trivedy, R.K., Goel, P.K. and Trishal, C.L. 1987. Practical methods in Ecology and Environmental science. Environmental publishers. Karad

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Class : M.Sc Zoology & Microbiology
Year & Sem : I year & I sem
Sub. Code :
Hours/Week : 2 Hours/Sem : 20

Int. Marks : 25
Ext. Marks : 75
Max. Marks : 100

Title of the Paper: **Food Processing Technology**

Course Objective:

- To focus on methods of food preparation, processing and quality control analysis.
- To become familiar with methods used to determine microorganisms in different varieties of foods.

Unit I

Food processing: Principles, Methods – Physical and chemical. Fruits: Role of fat and oils in food and health. Making squash from cherry. Formation of Geriatric (old age) health drink. Preparation and preservation of custard apple pulp. Valuable products from pear – Preparation of squash, pear bar, pear jam and pear wine.

Unit II

Vegetables: Legume based yoghurt – Preparation of cowpea and green gram dhal mix, preparation of yoghurt, quality analysis, product yield, chemical constituents, organoleptic qualities. Chickpea processed product – Fried Dhal, Vada, Halwa, Burfi, Pakories and Dhokla. Food products from bottle gourd – Sweet pickle, Hot pickle and Tuiti fruity. Preparation and Quality evaluation of potato powder. Spices and Herbs – Medicinal and antimicrobial properties.

Reference Books:

1. Journal of Beverage & Food World – May 2006, Vol.33 No.5.
2. Journal of Beverage & Food World – December 2003, Vol. 30 No. 12.
3. Journal of Beverage & Food World – February 2008, Vol. 35, No.2.
4. Journal of Beverage & Food World – March, 2008, Vol. 35, No. 3.
5. Journal of Beverage & Food World – November 2007, Vol. 34, No. 11.
6. Journal of Beverage & Food World – August, 2008, Vol. 35, No. 8.
7. Journal of Beverage & Food World – November, 2008, Vol.35, No. 11.

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Class : M.Sc Zoology & Microbiology

Year & Sem : I year & II sem

Sub. Code :

Hours/Week : 2 Hours/Sem : 20

Int. Marks : 40

Ext. Marks : 60

Max. Marks : 100

Title of the Paper: **Techniques in Food Processing**

1. Preparation of jam from guava and tomato.
2. Preparation of jelly from pineapple.
3. Preparation of squash from pineapple and grapes.
4. Preparation of dates syrup.
5. Preparation of cake and biscuit.
6. Preparation of pickles (fish, cucumber and mango).
7. Preparation of milk kova.
8. Preparation of rasagulla.
9. Preparation of wheat halwa.
10. Preparation of mushroom soup.
11. Preparation of dhall flour.
12. Preparation of corn soup.
13. Microbiological analysis of canned foods.
14. Microbiological analysis of dried food products.

Reference Books:

1. Journal of Beverage & Food World – May 2006, Vol.33 No.5.
2. Journal of Beverage & Food World – December 2003, Vol. 30 No. 12.
3. Journal of Beverage & Food World – February 2008, Vol. 35, No.2.
4. Journal of Beverage & Food World – March, 2008, Vol. 35, No. 3.
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6. Journal of Beverage & Food World – August, 2008, Vol. 35, No. 8.
7. Journal of Beverage & Food World – November, 2008, Vol.35, No. 11