

Thiagarajar College (Autonomous), Madurai – 9
Re-Accredited with ‘A’ Grade by NAAC
Department of Zoology

B. Sc., Industrial Microbiology
Course Structure (w.e.f. 2011 batch onwards)
I semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Part I	P111	Tamil	6	3	90	25	75	100
Part II	P211	English	6	3	90	25	75	100
Core paper -1	IMB 11	General Microbiology	6	4	60	25	75	100
Allied paper	AC11	Allied Chemistry – I	4	4	60	25	75	100
Allied paper	ACL11	Allied Chemistry – I Practical	2	--	30	-	-	-
Skill based elective	SBE1	Practical – Lab in General Microbiology	2	2	60	15	35	50
Skill based elective	SBE2	Medical Microbiology-1 /Medical Entomology	2	2	30	15	35	50
Environ. Studies	ES1	Environmental Studies	2	2	30	15	35	50
		Total	30	20				

II Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Part I	P121	Tamil	6	3	90	25	75	100
Part II	P221	English	6	3	90	25	75	100
Core paper -2	IMB 21	Bioinstrumentation	4	4	60	25	75	100
Core paper -3	IMBL21	Pract- Lab in Bioinstrumentation	2	2	30	40	60	100
Allied paper	AC21	Allied Chemistry – II	4	4	60	25	75	100
Allied paper	ACL11	Allied Chemistry – I Practical	2	2	30	40	60	100
Skill based elective	SBE3	Medical Microbiology-2/ Molecular Diagnostics & Serology	2	2	30	15	35	50
Skill based elective	SBE4	Biostatistics / Intellectual Property Rights & Bioethics	2	2	30	15	35	50
	VE1	Value Education	2	2	30	15	35	50
		Total	30	24				

III Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Part I	P131	Tamil	6	3	90	25	75	100
Part II	P231	English	6	3	90	25	75	100
Core paper -4	IMB 31	Biological Chemistry	3	4	45	25	75	100
Core paper -5	IMBL31	Practical-Lab in Biological Chemistry & Microbial Physiology	2	2	30	40	60	100
Allied paper	AB31	Theory	4	4	60	25	75	100
Allied paper	ABL31	Practical	2	--	30	40	60	100
Elective paper	E1	Microbial Physiology /Microbial Ecology	5	5	75	25	75	100
Non Major Elective	NME1	Human Genetics	2	2	30	15	35	50
		Total	30	23				

IV Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Part I	P141	Tamil	6	3	90	25	75	100
Part II	P241	English	6	3	90	25	75	100
Core paper- 5	IMB 41	Microbial Genetics and Molecular Biology	3	4	45	25	75	100
Core paper -6	IMBL41	Practical-Lab in Microbial Gen. & Mol. Biol. And Food Microbiology	2	2	30	40	60	100
Allied paper	AB41	Theory	4	4	60	25	75	100
Allied paper	ABL41	Practical	2	2	30	40	60	100
Elective paper	E2	Food Microbiology /Marine Microbiology	5	5	75	25	75	100
Non Major Elective	NME2	Health Education	2	2	30	15	35	50
		Total	30	25				

V Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core paper -7	IMB51	Biodegradation and Bioremediation	6	5	90	25	75	100
Core paper -8	IMB52	Bioprocess Technology	6	5	90	25	75	100
Core paper -9	IMB53	Clinical Lab Technology	6	5	90	25	75	100
Core paper 10	IMBL51	Practical-	10	4	150	40	60	100
Skill Based Elective	SBE5	Bioinformatics/Genomics	2	2	30	15	35	50
Self Study Paper	SSP	Health & Hygiene	--	--				
		Total	30	21				

VI Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core paper 11	IMB61	Immunology	6	5	90	25	75	100
Core paper 12	IMB62	Biotechnology	6	5	90	25	75	100
Core paper 13	IMB63	Agricultural Microbiology	6	5	90	25	75	100
Core paper 14	IMBL61	Practical	10	4	150	40	60	100
Elective -3	E3	Project	--	5	-	20	80	100
Skill Based Elective	SBE6	Bionanotechnology / Pharmaceutical Microbiology	2	2	30	15	35	50
		Total	30	26				

A) Consolidation of Contact Hours and Credits : UG

Semester	Contact Hrs / Week	Credits
I	30	20
II	30	24
III	30	23
IV	30	25
V	30	21
VI	30	26
Part – V		01
Total	180	140

B) Curriculum Credits : Partwise

Part I	12 Credits
Part II	12 Credits
Part III	60 Credits
Core	20 Credits
Allied	15 Credits
Elective	
Part IV	
NME (2X2)	04 Credits
SE (6X2)	12 Credits
VE	02 Credits
ES	02 Credits
Part V	01 Credits
Total	140 Credits

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Department of Zoology

(For those joined B. Sc., IMB on or after June 2011)

Course	: IMB (Core Paper-1)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: I	Max. Marks	: 100
Sub. Code	: IMB11	Hours/Week	: 6
Paper	: Core	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 of Microorganisms – 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 Miams).

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. 1986. Microbiology, fifth edition. McGraw-Hill. Book Co. Singapore
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2004. Microbiology: An Introduction. Pearson Education, Singapore
3. Dubey, R.C. and Maheswari, D.K. 2000. General Microbiology. S Chand ,New Delhi.

Reference Books

1. Alcamo, I.E. 1999. 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. Black, J.G.2005. Microbiology-principles and explorations, fourth edition. John Wiley & Sons, Inc. New York
4. Prescott, L.M., J.P. Harley and D.A. Helin. 2002. Microbiology. fifth edition.McGraw Hill, New Delhi.
5. Prescott, L.M., Harley, J.P. and Klein, D.A. 2006. Microbiology (7th edition) McGraw Hill, Newyork.
6. Madigan, M.T., Martinkl, J.M. and Parker, J. 2000. Brock Biology of Microorganisms, 9th Edition, MacMillan Press, England.
7. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. 1991. General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.
8. Atlas, R.A. and Bartha, R. 2000. Microbial Ecology. Fundamentals and Application, Benjamin Cummings, New York.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Practical- Skill Based Elective)	Int. Marks	: 15
Class	: I Year	Ext. Marks	: 35
Semester	: I	Max. Marks	: 50
Sub. Code	: SBE1	Hours/Week	: 2
Paper	: SBE	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. A septic 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. Microscopic observation of bacteria –Simple and Differential staining
10. Flagella staining
11. Spore staining
12. Biochemical test –IMViC TEST, Oxidase and catalase
13. Slide culture technique and fungal staining –Yeast and filamentous fungi
14. Microscopic observation of Algae- Nostoc and spirulina
15. Cultivation of aerobic and anaerobic bacteria

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Course	: IMB (Skill Based Elective Paper-2)	Int. Marks	: 15
Class	: I Year	Ext. Marks	: 35
Semester	: I	Max. Marks	: 50
Sub. Code	: SBE2	Hours/Week	: 2
Paper	: SBE	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 – Hapadna virus – Hepatitis B virus
RNA viruses – Retrovirus – HIV
Viral zoonoses - Japanese encephalitis, rabies.

Text Books:

1. Ananthanarayanan and Jeyaram Paniker C.K. 2001. Text Book of Microbiology, Orient Longman, Chennai.
2. Chakraborty P., 1995. A Text Books of Microbiology, New Central Book Agency (P) Ltd., Calcutta.

Reference Books

1. David Greenwood, Richard C.B., Slack, John F. Pertherer. A Guide to Microbial infections, pathogenesis, immunity, lab diagnosis and control-16th edition.
2. Collee, J.G., A.G.Fraser, B.P.Marmion, A.Simmons, 1996 Mackie and McCartney, Practical Medical Microbiology, Fortieth edition, Churchill Lingstone.
3. David Greenwood, Richard C.B., Slack, John F. Pertherer. A Guide to Microbial infections, pathogenesis, immunity, lab diagnosis and control-16th edition.
4. Collee, J.G., A.G.Fraser, B.P.Marmion, A.Simmons, 1996 Mackie and McCartney, Practical Medical Microbiology, Fortieth edition, Churchill Lingstone.
5. Jawetz E., J.C. Melnic and E.A. Adelberg, 2001, Review of Medical Microbiology, Prentice Hall International Inc., USA.
6. Dimmock, N.J., A.J. Easton, K.N. Leppard. Introduction to modern virology. Blackwell Science. U.K.

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Course	: IMB (Skill Based Elective Paper-2)	Int. Marks	: 15
Class	: I Year	Ext. Marks	: 35
Semester	: I	Max. Marks	: 50
Sub. Code	: SBE2 (O)	Hours/Week	: 2
Paper	: SBE	No of Credits	: 2
Title of the Paper	: Medical Entomology (Optional for Medical Microbiology-1)		

Course Objectives:

- To learn the fundamentals of medical entomology
- To understand the role of insect vectors in disease transmission and its control measures.

Unit - I

Scope of Vector Entomology- types of vectors and their medical importance - their life cycle - epidemiology, and management - mosquitoes - houseflies - sand flies - Human lice - Tsetse flies -fleas and reduviid bugs
Vector control - Insecticides - Use and consequences - Use of microbes as bio-control agents and bio pesticides.

Unit - II

Vector - borne diseases- spread through mosquitoes -malaria.
Vector - borne diseases spread through houseflies –cholera, amoebiasis
Diseases spread through sandfly, kala-azar, tsetsefly sleeping sickness.
Vector - borne diseases spread through louse - typhus
Rat flea-Bubanic plaque

Text Book

1. Karyakarte, R and A.Damle 2005. Medical Parasitology. Books and Allied (P). Ltd. Kolkata
2. Dasgupta B.Parasitology. (including entomology and Acarology) Books and Allied (P). Ltd. Kolkata

References:

1. Greenwood, D., Slack, R.C.B and Peutherer, J.F. 2002. Medical Microbiology .Churchill Livingstone. U.K.
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. Kettle, D. S., Cabi, 2000 Medical and Veterinary Entomology, Press, USA
5. Service, M.2000 Medical Entomology for students, Cambridge University Press, UK

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Course	: IMB	Int. Marks	: 15
Class	: I Year	Ext. Marks	: 35
Semester	: I	Max. Marks	: 50
Sub. Code	: ES	Hours/Week	: 2
Paper	: ES	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.

Reference Books

- Yogendra, N. and Srivastava, N. 1998. Environmental Pollution, Ashish Publishing House. New Delhi.
- Kanagasabai, C.S. 2005. Environmental Studies. Rasee publishers. Madurai.
- Sapru R.K.2001. Environment Management in India, Vol. I & Vol. II Ashish publishers house, New Delhi.

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Course	: IMB (Core Paper-2)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: II	Max. Marks	: 100
Sub. Code	: IMB21	Hours/Week	: 4
Paper	: Core	No of Credits	: 4
Title of the Paper : Bioinstrumentation			

Course Objectives

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

This paper deals with the Principles and Applications of the following instruments

Unit I

Light Microscopy – Dark and Light field
Phase Contrast Microscopy
Fluorescent Microscopy
Electron Microscopy: Transmission and Scanning

Unit II

Filters (Seitz, HEPA, Membrane)
Steam Sterilizer (Autoclave)
Quebec counter, GM counter, Liquid Scintillation counter
Centrifuge- High speed centrifuge Conversion of G to RPM

Unit III

Paper and Thin layer Chromatography
Column Chromatography
Gas Chromatography (GC)
High Performance Liquid Chromatography (HPLC)

Unit IV

pH meter
SDS – PAGE
2-D Gel Electrophoresis
Agarose Gel Electrophoresis

Unit V

Flame Photometer
Colorimeter
Spectrophotometer - visible, ultraviolet and infrared
Sonicator, Freeze-dryer (Lyophilizer)

Text Books

1. Plummer, D, 1987, An Introduction to Practical Biochemistry, Tata McGraw – Hill Publishing Company Ltd., New Delhi.
2. Jeyaraman, J., 1985, Laboratory Manual in Biochemistry, Wiley Eastern Limited, New Delhi.

Reference Books:

1. Boyer, R.F., 1993, Modern Experimental Biochemistry, The Benjamin / Cummings Publishing Company, Inc., New York.
2. Williams B.L., and Wilson, K. 1983, A Biologist's Guide to Principles and Techniques of Practical Biochemistry, Edward Arnold Publishers Ltd., London.
3. Wilson, K and Walker, J, 1995, Principles and Techniques of Practical Biochemistry, Cambridge University Press, New York.

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Course	: IMB (Practical- Core Paper-3)	Int. Marks	: 40
Class	: I Year	Ext. Marks	: 60
Semester	: II	Max. Marks	: 100
Sub. Code	: IMBL21	Hours/Week	: 2
Paper	: Core	No of Credits	: 2
Title of the Paper	: Lab in Bioinstrumentation		

Bioinstrumentation (IMBL21)

1. Micrometry
2. Verification of Beer's Law
3. Estimation of Protein – Lowry et al method, Bradford method
4. Estimation of Carbohydrates – Anthrone method
5. Estimation of Lipids – Bragdon method
6. Paper Chromatographic separation of amino acids–
unidirectional & bi-directional
7. Column Chromatographic separation of plant pigments
8. Thin layer chromatography
9. Measurement of pH of fruit Juices
10. Preparation of buffers and Molar solutions
11. Absorption spectra of Proteins and pigments
12. Freeze dryer
13. Separation of proteins-PAGE- Demonstration

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Course	: IMB (Skill Based Elective Paper-3)	Int. Marks	: 15
Class	: I Year	Ext. Marks	: 35
Semester	: II	Max. Marks	: 50
Sub. Code	: SBE3	Hours/Week	: 2
Paper	: SBE	No of Credits	: 2
Title of the Paper	: Medical Microbiology-2		

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*, *Penicillium*

Non- filamentous fungi – *Candida*, *Cryptococcus*

Unit II

Parasitology – Morphology and life cycle of intracellular parasites

Protozoan parasites- *Plasmodium*, *Entamoeba histolytica*

Helminthes parasites-*Ascaris lumbricoides*, *Taenia solium*

Text Books:

1. Ananthanarayanan and Jeyaram Paniker C.K. 2001. Text Book of Microbiology, Orient Longman, Chennai.
2. Chakraborty P., 1995. A Text Books of Microbiology, New Central Book Agency (P) Ltd., Calcutta.

Reference Books:

1. Greenwood, D., Slack, R.C.B and Peutherer, J.F. 2002. Medical Microbiology, Churchill Livingstone. U.K.
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

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Course	: IMB (Skill Based Elective Paper-3)	Int. Marks	: 15
Class	: I Year	Ext. Marks	: 35
Semester	: II	Max. Marks	: 50
Sub. Code	: SBE3	Hours/Week	:2
Paper	: SBE	No of Credits	:2
Title of the Paper	: Molecular Diagnostics and Serology (Optional for Medical Virology)		

Course Objectives:

- Helps in the diagnosis, management and prevention of infections
- Enhance the knowledge and competency in molecular diagnostics

Unit I

Nucleic acid based microbial diagnostic techniques – LCR, NASBA, PCR, QBRDA and RFLP.

Unit II

Serology of Microbial diseases. Agglutination, Precipitation and ELISA based diagnosis of bacterial, viral and fungal diseases.

Text book

1. Wadhar B.H. and G.L. Boosreddy, 1995, Manual of Diagnostic Microbiology, Himalaya Publishing House, New Delhi.
2. Bartelt, M.A.2000. Diagnostic Bacteriology –A study guide. F.A. Davis Company, Philadelphia.
3. Nagoba, B.S.2005 BI publications, Noida, India

Reference Books:

1. Lippincott Williams and Wilkins. Philadelphia, Baltimore 2006. Koneman's Color Atlas and Text book of Diagnostic Microbiology.
2. Monica Cheesbrough, 2000, District Laboratory Practice in Tropical Countries, Part – 2, Cambridge University Press, Cambridge, U.K.
3. Myers R.M. and Koshi G., 1982, Diagnostic Procedures in Medical Microbiology and Immunology / Serology, Microbiology Laboratories, Christian Medical College and Hospital, Vellore.

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Course	: IMB (Skill Based Elective Paper-4)	Int. Marks	: 15
Class	: I Year	Ext. Marks	: 35
Semester	: II	Max. Marks	: 50
Sub. Code	: SBE 4	Hours/Week	:2
Paper	: SBE	No of Credits	:2
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

Probability and Distribution

Unit II

Chi-square test

Student “t” test

Correlation and Regression-types

Anova-one way

Text Books

1. Gupta, S.P., 1987, Statistical Methods, thirty third edition, Sul-ton Chand and Sons Publishers, New Delhi
2. Palanichamy, S. Manoharan,M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu..

Reference Books

1. Khan, I.A and Khanum, A., 2004, Fundamental of Bio- statistics, Ukaaz Publication, New Delhi.
2. Schelfer, W.C., 1980, Statistics for the Biological Science, Addition – Wesley Publishing Company, London.
3. Sokal, R.R. and Rohlf, F.J. 1987, Introduction to Bio-statistics, W.H.Freeman and Company, New York.

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Course	: IMB (Skill Based Elective Paper-4)	Int. Marks	: 15
Class	: I Year	Ext. Marks	: 35
Semester	: II	Max. Marks	: 50
Sub. Code	: SBE4	Hours/Week	:2
Paper	: SBE	No of Credits	:2
Title of the Paper: Intellectual Property Rights and Bioethics			
(Optional to Biostatistics)			

Course Objectives:

- Helps to know the right of an individual to enjoy his discoveries
- To get awareness about patent agencies and how to patent an innovation

Unit I

Intellectual Property Rights

Protection of Intellectual property; Indian & International organizations

GATT, TRIPS, WIPO, WTO, TNSCST

Forms of protection - copyright, trade mark, designs, patent

Patenting of biological material

Unit II

Bioethics & Biosafety

History and Principles, Issues concerning - reproduction, birth, life and death

Biomedical innovations, human rights

Biosafety - concepts and issues, agreements and regulations, biosafety concerns at different levels - individuals, institutions, society, country

Text Book

1. Baruch A. Brody and H. Tristram Engelhardt 2007. Bioethics-Reading and cases, Pearson Education, New Delhi
2. S. Ignacimuthu 2009. Bioethics Narosa Publishing house New Delhi

References

1. Rao, M.B and Manjula Guru 2007. Biotechnology-IPRs and Biodiversity Pearson Longman,
2. H.S. Chawla 2000. Introduction to Plant Biotechnology Oxford & IBH publishing Co. Pvt. Ltd. New Delhi
3. P.K. Gupta 2008. Elements of Biotechnology. Rastogi Publications, Meerut, India

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Course	: IMB (Core Paper-4)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: IMB31	Hours/Week	: 3
Paper	: Core	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

Electronic configuration of atoms and molecules - chemical composition and bonding.

Water - molecular structure – non-covalent bonding – thermal and solvent properties
Henderson – Hasselbach equation.

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

Unit II

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

Proteins – classification and important properties - levels of organization: primary, secondary (Ramachandran Plot), tertiary and quaternary structure

Unit III

Structure and biological importance of triacylglycerols, phospholipids and Cholesterol Biosynthesis and degradation of fatty acids

Unit IV

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

Disaccharides-structure and biological importance of maltose, sucrose, lactose and trehalose.

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

Unit V

Structure and biosynthesis of Purines and Pyrimidines.

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.

Text Books:

1. Conn, E.E., P.K.Stumpf, G.Bruening and R.H.DoI, 1997, Outline of Biochemistry, John Wiley & Sons Inc., New York.
2. Shanmugam,A., 1998, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras.
3. Weil,J.H., 1990, General Biochemistry, Wiley Eastern Limited, New Delhi.

Reference Books:

1. Mckee,T., and J.R.Mckee, 1996, Biochemistry and Introduction, Won.C.Brown Publishers, London.
2. Nelson, D.L., and M.M.Cox, 2000 (Print 2001), Lehninger Principles of Biochemistry, third edition, Worth Publishers, New York.
3. Stryer, L., 1995(print 2000), Fourth edition Biochemistry, W.H. Freeman and Company, New York.
4. Voet, D., and J.G.Voet, 1995, Biochemistry, second edition John Wiley & Sons Inc, New York.
5. Zubay,G. 1993, Biochemistry, third edition Won.C.Brown Communications Inc., Oxford, England.
6. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) ltd. New Delhi.

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Department of Zoology

(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Practical - Core Paper-5)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: III	Max. Marks	: 100
Sub. Code	: IMBL31	Hours/Week	: 2
Paper	: Core	No of Credits	: 2
Title of the Paper	: Lab in Biological Chemistry & Microbial Physiology		

Biological Chemistry

1. Preparation of buffers
2. Biochemical characterization of a bacterium – *E.coli*
3. Estimation of Glycogen from bacterial cell.
4. Estimation of Alkaline phosphatase activity
5. Derivation of Michaelis – Menten Constant and V-max of alkaline Phosphatase.
6. Changes in protein conformation due to pH, temperature, ionic concentration by observing UV-spectra.
7. Extraction and Identification of lipids by TLC.
8. Measurement of Cellulase activity.
9. Specific tests for amino acids
10. Vitamin assay
11. Starch, casein and lipid hydrolysis
12. Demonstration of Hill reaction

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Elective Paper-1)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: E1	Hours/Week	: 5
Paper	: Elective	No of Credits	: 5
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.

Photorespiration and its significance

Effect of Light, CO₂, pH and temperature on photosynthesis.

Unit IV

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

Special pathways for primary attack on organic compounds (pathways for utilization of sugar other than glucose) – fructose, cellulose

Fueling reaction in anaerobic heterotrophs – anaerobic respiration

Fermentations – Basic concepts

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 – peptidoglycon 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, 1988, Microbial Physiology-Second 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. Mandelstam, J., McQuillen, K and Dawes, I. 1982. Biochemistry of Bacterial Growth. third edition. Blackwell Scientific Publications, London.
6. Nelson, D.L., and M.M. Cox., 2000 Lehninger, Principles of Biochemistry, Third edition, Macmillan Worth publishers.
7. Pelczar, M.J., E.C.S. Chan and N.R. Krieg, 1986, Microbiology, Fifth edition, McGraw-Hill Book Co., Singapore.
8. Prescott, L.M., J.P. Harley and D.A. Helin, 2002, Microbiology, Fifth edition, McGraw Hill, New Delhi.
9. Rose, A.H. 1976. Chemical Microbiology: An introduction to microbial Physiology. third edition, Plenum, New York.
10. Schlegel, H.G., 1993, General Microbiology, Seventh edition, Cambridge University Press.
11. 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.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Elective Paper-1 optional)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: E1	Hours/Week	:5
Paper	: Elective	No of Credits	:5
Title of the Paper	: Microbial Ecology (Optional for Microbial Physiology)		

Course Objectives

- To understand the influence of environment on microbes
- To learn about bacterial communicate and interaction

Unit I

History and scope of microbial ecology. Development of microbial communities : structure of microbial communities, ecosystem, microbial communities in nature. Abiotic limitations to microbial growth, Leibig's law of minimum, Shelford's law of tolerance.

Unit II

Species concept – Universal, Biological, Phenetical, Evolutionary and Phylogenetic. Speciation – Bacterial, Mismatch repair as a speciation mechanism, Rapid speciation, operons, Genome economization and speciation, Hypermuation, Genome reduction.

Unit III

Bacterial communication : Quorum sensing – Evolutionary implication of quorum sensing, cell – cell communication in bacteria, Quorum sensing and evolution, Disruption or manipulation of quorum sensing response, Eavesdropping by bacteria, Oligotrophic state of nature, starvation survival, ageing, senescence and death, Dormancy or resting state and miniaturization.

Unit IV

Species Interaction and processes: Species interaction, proliferation hypothesis. Negative relationship – parasitism, predation, bacteria and viral interaction, microbial loop and bacteria as predators. Neutral relationship, positive relationship – Metabiosis and symbiosis. Biogeochemical cycle (Nitrogen, carbon and sulphur).

Unit V

Adaptation and interaction of microorganism in the extreme environments: Hot spring, acid springs and lakes, salt lakes, Antarctica, extraterrestrial system.

Text Books:

1. Microbial Ecology – An Evolutionary approach – J Vaun Mc Arthur, Elsevier publications, Academic press, 2009.
2. 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.

Reference Books

1. Tortora G.J., Funke, B.R. and Case, C.L.2009, Microbiology, Ninth Edition, Dorling Kindersely (India) Pvt. LTd., Noida.
2. Prescott, LM., Harley, J.P. and Helin, D.A. 2008, Microbiology, fifth edition, McGraw Hill, New York.

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Department of Zoology

(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Non Major Elective Paper-1)	Int. Marks	: 15
Class	: II Year	Ext. Marks	: 35
Semester	: III	Max. Marks	: 50
Sub. Code	: NME1	Hours/Week	: 2
Paper	: Non Major Elective	No of Credits	: 2
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, 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

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

Reference Books:

1. Gardner, E.J., Simmons, M.J. and Snustad, D.P. 1991. Principles of Genetics. John Wiley & sons.
2. Carlson, E. A. 1985. Human Genetics. TMH edition. Tata McGraw-Hill publishing company Ltd., New Delhi.
3. Weaver, R.F. and Hedrick, P.W. 1989. Genetics. Wm. C. Brown Publishers. USA.
4. Verma, P.S and Agarwal, V.K. 1993. Genetics. S.Chand and Company Ltd., New Delhi, India.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Core Paper-5)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: IV	Max. Marks	: 100
Sub. Code	: IMB41	Hours/Week	: 3
Paper	: Core	No of Credits	: 4
Title of the Paper: Microbial Genetics and Molecular Biology			

Course Objective

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

Unit I

DNA- genetic material, chemical composition, Chargaff rule – Watson and Crick model, DNA polymorphism-A, B and Z forms, Palindromic sequence.

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

Properties-Melting curves, $cot \frac{1}{2}$ value.

Unit II

Replication – semiconservative mode of replication – leading and lagging strands (Okazaki Fragments)-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 independent (Excision repair, Recombination and SOS).

Unit IV

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

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.

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 2000. Molecular Biology, II Edn, Narosa Publishing house, NewDelhi, India
2. Weaver,R.F. 1999. Molecular Biology. McGraw Hill. New York.
3. Glick, B.R. and Pasternak, J.J 1994 Molecular Biotechnology Principles and Applications of Recombinant DNA, ASM Press, Washington, D.C.

Reference Books:

1. Lewin, B., 2000, Genes-VII, Oxford University Press Inc., New York.
2. 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.
3. 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.
4. Wolfe, L.S., 1993 Molecular and Cellular Biology, Wadsworth publishing company.
5. Krebs,J.E., E.S.Goldstein and S.T. Kilpatrick 2009 Lewin's Gene X Jones & Bartlelt Publishers,Boston.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Practical - Core Paper-5)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: IV	Max. Marks	: 100
Sub. Code	: IMBL41	Hours/Week	: 2
Paper	: Core	No of Credits	: 2
Title of the Paper	:		

Lab Microbial Genetics and Molecular Biology & Food Microbiology

1. Antibiotic sensitivity Assay – Kirby Bauer test.
2. UV irradiation and photoreactivations.
3. Isolation of mutant colonies by Gradient plate method.
4. Isolation of mutant colonies by Replica plate method.
5. Determination of Minimum Inhibitory concentration
6. Determination of Minimum Bactericidal Concentration
7. Extraction and estimation of nucleic acids.
8. Extraction and detection of plasmids.
9. Screening of food materials for the presence of microbes
10. Methylene blue test-milk quality determination
11. Phosphatase test
12. Litmus milk reaction

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Elective Paper-2)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: IV	Max. Marks	: 100
Sub. Code	: E2	Hours/Week	:5
Paper	: Elective	No of Credits	:5
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

Microbial production: Buttermilk, Sour cream, Yoghurt & Cheese. Spoilage of Milk and Milk products.

Unit II

Microbial fermentation: Beer, Distilled liquors (Rum, Whiskey & Brandy) & Wine. Spoilage of beer and wine.

Unit III

Fermented vegetables: Sauerkraut, Olives, Soy Sauce & Pickles
Other food Products: Fermented meat, Idli batter & leavening of bread
Microbes as food: SCP & edible mushrooms.
Intrinsic and Extrinsic parameters of foods that influence microbial growth
Spoilage of vegetables and fruits.
Spoilage of meat & canned food

Unit IV

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

Unit V

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

Chemical preservation: 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, 1996, Food microbiology, New Age international (P) Ltd., New Delhi.
2. Frazier, W.C., and D.C. Westhoff, 1988, (Reprint 1995), Food Microbiology, Fourth edition, Tata McGraw-Hill Publishing Ltd., New Delhi.

Reference Books:

1. Atlas, R.M., 1997, Principles of Microbiology, Second edition, WCB/McGraw Hill, U.S.A.,
2. 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.
5. Jay, J.M, 1996, Modern Food Microbiology, CBS Publishers & Distributors, New Delhi.
6. Joshi, V.K. and Ashok Pandey (Eds), 1999, Biotechnology: Food fermentation Vol.II, Educational Publishers and Distributors, New Delhi.
7. Kulshreshtha, S.K. 1994, Food Preservation, Vikas Publishing House Pvt. Ltd., New Delhi.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Elective Paper-2)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: IV	Max. Marks	: 100
Sub. Code	: E2	Hours/Week	:5
Paper	: Elective	No of Credits	:5
Title of the Paper	: Marine Microbiology (Optional for Food Microbiology)		

Course Objectives

- To learn the role of microbes in Marine environment
- To learn the microbial interactions

Unit I

Marine environment – sea-benthic & littoral zone, saltpan, mangroves and estuarine.
Marine microbial community – planktons, bacteria, fungi, protozoa.
Role of microbes in different marine ecosystem. Microbial loop.

Unit II

Extremophiles – thermophilic, alkalophilic, asomophilic and barophilic, psychrophilic microorganisms – hyperthermophiles and halophiles.

Unit III

Microbe-microbe interactions.
Lichens, antagonistic interactions – amensalism, mycoparasitism.
Animal-microbe interaction –Epi and endosymbionts,
Microbial symbionts of Sponges, corals.
Metabolic consortia and mutualism between prokaryotes

Unit IV

Marine food borne pathogens & Water borne pathogens – *Aeromonas*, *Vibrio*, *Salmonella*, *Pseudomonas*, *Clostridium bot.* Health hazards from sewage pollution at sea –coliforms, faecal *Streptococci*.

Unit V

An introduction and overview of marine microbial biotechnology.
Production and applications of marine microbial products – pigments, enzyme, antibiotics, & polysaccharide

Text Books

1. Munn, C.B. (2004) Marine Microbiology –Ecology and Applications. BIOS Scientific publisher.
2. Prescott, L.M., Harley J.P. Klein (1999). Microbiology, WCB, Mc Grow Hill Publications.

References:

1. Atlas, R.M 1988. Microbiology, Fundamentals and applications Maxwell McMillan International Editions.
2. Shimshon Belkin and Rita R. Colwell (2005). Ocean and Health: Pathogens in the marine environment. Springer.

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Department of Zoology

For those joined B.Sc (except IMB),B.A, B.Com, BBA on or after June 2011

Course	: IMB (Non Major Elective Paper-2)	Int. Marks	: 15
Class	: IIYear	Ext. Marks	: 35
Semester	: IV	Max. Marks	: 50
Sub. Code	: NME2	Hours/Week	:2
Paper	: NME	No of Credits	:2
For B.Sc/B.A/B.Com/BBA students			
Title of the Paper	: Health Education		

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

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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Department of Zoology

(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Core Paper-7)	Int. Marks	: 25
Class	: III Year	Ext. Marks	: 75
Semester	: V	Max. Marks	: 100
Sub. Code	: IMB51	Hours/Week	: 6
Paper	: Core	No of Credits	: 5

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.

Types of bioremediation:

- Natural Bioremediation.
- Pump and treat processes
- Surface soil and sludges
- Subsurface materials
- Bioventing
- Saturated subsurface material treatment

Role of genetically engineered micro organisms (GEMs) in bioremediation.

Unit II

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

Components of solid waste - Treatment methods-Landfall

Composting: aerated pile method & reactors; Incineration

Unit III

Liquid waste management-Primary, secondary, Tertiary and Disinfection

Aerobic biological treatment.

- Activated Sludge Process (ASP)
- Biological filters or fixed film system (FFS)
- Rotatory biological contractors (RBC)

Anaerobic biological treatment.

- Contact digestors (CD)
- Packed Column Reactors(PCR)

Treatment of effluent -Tannery

Unit IV

Biodegradation and Bioremediation of - Oil, Detergent, Heavy metals, Plastics and Rubber, Paints, Pharmaceuticals, Cosmetics, Leather and Paper.

Unit V

Pesticide degradation-Pesticide Industry in India, Pesticide pollution problem in India, Bioaccumulation, Pesticide biodegradation patterns, Microbial metabolism of pesticides. Recent advances in degradation of pesticides

Text Books:

1. Allsopp, D., and J.Seal, 1986, Introduction to Biodeterioration, Edward Arnold (Publishers), London.
2. Jodgand, S.N., 1995, Environmental Biotechnology, Himalaya Publishing House (Industrial Pollution Management), Bombay.

Reference Books:

1. Atlas, R.M., 1997, Principle of Microbiology, second edition, WCB/Mc Graw-Hill Co., USA.
2. Norris *et al.*, 1994, Handbook of Bioremediation, Lewis Publishers, London.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Core Paper-8)	Int. Marks	: 25
Class	: III Year	Ext. Marks	: 75
Semester	: V	Max. Marks	: 100
Sub. Code	: IMB52	Hours/Week	: 6
Paper	: Core	No of Credits	: 5

Title of the Paper : **Bioprocess Technology**

Course Objective

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

Unit I

Fermentation equipments – Basic design and components, Types of Fermentors.
Types of Culture – Batch, Continuous and fed batch
Industrial Microorganisms – Isolation, preservation & maintenance, strain improvement, cell immobilization, inoculum development
Fermentation Process control – Industrial media, pH, aeration, temperature, foam control. Computer automation.

Unit II

Industrial Production of Healthcare Products

- Antibiotics - Penicillin, Streptomycin
- Vaccines - Bacterial, viral
- Hormones - Insulin, stomatostatin
- Vitamins - Riboflavin, cyanocobalamins

Unit III

Industrial Production of Organic acids & Organic solvents

- Organic acids - Acetic acid, Citric acid, Lactic acid.
- Organic solvents - Acetone, Butanol, Glycerol

Unit IV

Industrial Production of Aminoacids & Plant growth hormones

- Aminoacids - Lysine, Glutamic acid
- Plant growth Hormones – Gibberellic acid, 3-Indole Acetic acid.

Unit V

Industrial Production of Enzymes & Fuel

- Enzyme - Protease, Amylase, Cellulase
- Fuel - Ethanol, methane, hydrogen.

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. 1985. (Reprint, 1996), Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.

Reference Books:

1. Atlas, R.M., 1997, Principles of Microbiology, second edition, WCB/McGraw Hill Co., USA.
2. Casida, L.E., Jr. 1963, Industrial Microbiology, fifth edition, Wiley Eastern Ltd., New Delhi.
3. Prescott, L.M., J.P. Harley and D.A. Helin, 2002, Microbiology, fifth edition, McGraw Hill, New Delhi.
4. Stanbury, P.F., A. Whitaker and S.J. Hall, 1995, (Reprint 1999), Principles of Fermentation Technology, second edition, Aditya Book (p) Ltd., New Delhi.
5. Waites, M.J., Morgan, N.L., Rockey, J.S., and Higton, G. 2001, Industrial Microbiology: An Introduction, Blackwell Science, London.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Core Paper-9)	Int. Marks	: 25
Class	: III Year	Ext. Marks	: 75
Semester	: V	Max. Marks	: 100
Sub. Code	: IMB53	Hours/Week	: 6
Paper	: Core	No of Credits	:5
Title of the Paper : Clinical Lab Technology			

Course Objective

- Introduce laboratory designing and safety methods to the students
- To learn different clinical lab techniques
- Preamble to start a clinical lab

Unit I

Laboratory designing and safety methods-

Laboratory designing, Code of conduct for Clinical Laboratory, SOP

Personal hygiene for Laboratory Technologists

National and International GLP and GMP.

Accidents-types, safety measures

First Aid in laboratory and Precautions

Unit II

Blood-

Haematology: Phlebotomy (Peripheral and venous) Composition of Blood-plasma and corpuscles-cell study-counting of cells – TC and DC, Platelets, ESR, Hb, BT & CT.

Blood Banking: ABO Blood group system-side ABO groupings test, Rh Typing-Slide test, Blood components separation, Blood transfusion-Compatibility testing.

Clinical Chemistry: Blood glucose GTT, Diabetes Mellitus-types, Urea, Cholesterol, Bilirubin.

Serology: Widal test, VDRL, Rheumatoid factor

Blood culture and sensitivity.

Unit III

Urine-

Collection, Storage and transport of Urine sample

Physical properties of Urine – Colour, Volume, Specific gravity, Odour, Turbidity.

Chemical examination-urine sugar, albumin, bile salts, Bile pigments, urobilinogen, Bence – Jones proteins, ketones.

Microscopic Examination of Urine deposits – Cast Crystals – Cells.

Pregnancy Test

Metabolic disorder – Phenylketonuria & Alkalptonuria

Urine – Microbial culture and sensitivity

Unit IV

Stool-

Collection and transport of specimen – Macroscopic examination – Colour, Odour, Consistency, Chemical examination- Occult blood and pH.

Microscopic examination – ova and cyst

Stool – Microbial analysis – Culture and sensitivity

Unit V

Sputum and Semen-

Sputum and Induced sputum: Collection and transport of specimen – Macroscopic examination – consistency and appearance – Microscopic examination – *Pneumocystis Jiroveci* AFB staining

Sputum – Microbial culture and sensitivity

Semen: Semen analysis – Collection and gross examination of specimen– Microscopic examination – motility, total count and abnormality.

Text Book:

1. Sood, R, 1999, Medical Laboratory Technology – methods and interpretations – Fifth 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. Mukherjee, L.K. 1988, Medical Laboratory Technology – 3 volumes – second edition – Hill Publishing Ltd., New Delhi.
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.
8. Ochei, J and Kolkatkar, A. 2000. Medical Laboratory Science – Theory and Practice. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Practical- core paper-10)	Int. Marks	: 40
Class	: III Year	Ext. Marks	: 60
Semester	: V	Max. Marks	: 100
Sub. Code	: IMBL51	Hours/Week	: 10
Paper	: Core	No of Credits	:4

Title of the Paper: **Biodegradation & Bioremediation, Bioprocess Technology and Clinical Lab Technology (Lab)**

Unit: I Biodegradation & Bioremediation

1. Estimation of BOD and COD from water sample.
2. Dye degrading Bacterial isolates.
3. Detection of indicator micro-organism from water sample.
4. Visit to Effluent Treatment Plant (ETP)
5. Paper deterioration by cellolytic microorganisms-Demonstration.
6. Sample Collection – Biodeterioration.
7. Isolation of Pesticide degrading microorganisms
8. Isolation of oil degrading microorganisms.

Unit:II Bioprocess Technology

1. Types of Fermentors & their uses.
2. Demonstration of fermentation using Kuhne's fermentation vessel.
3. Screening for antibiotic producers.
4. Production of Citric acid by *Aspergillus niger* using stale bread as substrate in a Solid State fermentation set up.
5. Demonstration of Citric acid production.
6. Production of protease by *Bacillus subtilis*
7. Yeast cell immobilization
8. Alcohol fermentation by *Saccharomyces cerevisiae*.
9. Estimation of alcohol using Potassium Di-chromate method.
10. Biogas (Methane) production.

Unit: III Clinical Laboratory Technology

1. Differential cell count
2. Total W.B.C. count & Total R.B.C. count
3. Bleeding time & Clotting time & E.S.R
4. Estimation of Haemoglobin
5. Estimation of Blood Sugar & Urea
6. Estimation of Serum Cholesterol
7. Urine sugar, Albumin, Ketone and bile salts Analysis
8. Urine – Microbial analysis – Culture and Sensitivity
9. Separation of Serum Protein (Electrophoretic protein pattern)
10. Semen analysis – Motility, Total count.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Skill Based Elective-5)	Int. Marks	: 15
Class	: IIIYear	Ext. Marks	: 35
Semester	: V	Max. Marks	: 50
Sub. Code	: SBE5	Hours/Week	:2
Paper	: Skill Based Elective	No of Credits	:2
Title of the Paper: Bioinformatics			

Course Objective

- Introduce basic in silico approaches to the students
- Learn “from sequence to structure prediction” –concept
- To introduce computational aspects in biology

Unit I

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

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

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

Unit II

Phylogenetic analysis- Phylogenetic Trees, types

Neighbor Joining method, Maximum parsimony.

Homology modeling Principles and steps in evaluation, 2D-GOR, Chou-Fasman, Hidden Markov method,

3D structure prediction RASMOL and SPDB viewer

Text Books

1. Attwood, T.K. and Parry, D.J – Smith, D.J. 2002. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd..
2. Twyman, R.H. 2003. Instant notes on Bioinformatics. Viva Books Pvt. Ltd., New Delhi

Reference Books

1. Baxevanis, A.D. and Quellerie, B.F.F. 2009. Bioinformatics. A practical guide to the analysis of genes and proteins. II edn. Wiley-Intern Science Publication, New York.
2. Mount, W. 2001. Bioinformatics sequence and genome analysis. Cold Spring harbour Laboratory Press, New York.
3. Pevsner 2003. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi.
4. Lesk, M.A. 2002. Introduction to Bioinformatics. Oxford Univ. Publishers.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Skill Based Elective-5)	Int. Marks	: 15
Class	: III Year	Ext. Marks	: 35
Semester	: V	Max. Marks	: 50
Sub. Code	: SBE5	Hours/Week	: 2
Paper	: Skill Based Elective	No of Credits	: 2
Title of the Paper: Genomics (Optional for Bioinformatics)			

Course Objectives

- To understand the basic concepts of genes and genomes
- To learn the principles of gene manipulation and mapping

Unit I

Gene – gene concept, open reading frame (ORF), expressed sequence tags (ESTs)

Organization and structure of genomes in prokaryotes and eukaryotes, Human genome project.

Genome mapping – RFLP – RAPD – VNTRs – SNPs – Fluorescent *in situ* Hybridization (FISH)

Unit II

Genetic mapping – Construction of cDNA library – Genomic library construction

Sequencing – Manual and Automated

Functional genomics – Hypothetical genes – putative genes – functional annotation –

Gene expression – SAGE; Microarray

Text books

1. Primrose, S.B and Twyman, R.M. 2007 Principles of gene manipulation and genomics. Seventh Edition, Blackwell publication, USA.
2. Brown, T.A. 2004. Genomes. John Wiley & Sons (Asia) Pvt. Ltd.

Reference Books:

1. Brown, T.A. 1999. Genomics. BIOS scientific Publishers. Oxford, USA.
2. Bregeron, B. 2003. Bioinformatics computing. Printice-Hall, India. New Delhi.
3. Hartl, D.L. and Jones, E.W. Genetics: Analysis of Genes and Genomes. 5th edn. Jones and Bartlett Publishers. USA.
4. Russel, P.J. 2002. Genomics. Benjamin Cummings. San Francisco, USA.
5. Kohane, I.S. Kho, A.T. and Buttle, A.J. 2004. Microarray for an Integrative Genomics. Ane Books. MIT Publication, New Delhi.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Self study paper-1)	Int. Marks	: 15
Class	: II Year	Ext. Marks	: 35
Semester	: V	Max. Marks	: 50
Sub. Code	: SS1		
Paper	: Self study paper	No of Credits	: 2
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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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Core Paper-11)	Int. Marks	: 25
Class	: III Year	Ext. Marks	: 75
Semester	: VI	Max. Marks	: 100
Sub. Code	: IMB61	Hours/Week	: 6
Paper	: Core	No of Credits	:5
Title of the Paper : Immunology			

Course Objective

- To introduce the basic principles and techniques of immunology
- To know the importance of immune system and vaccines

Unit I

History of Immunology: Contributions of Edward Jenner –Louis Pasteur – Elie Metchnikoff

Organs of immune system: Primary- thymus & Bonemarrow; 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, A,M,D,E- Characteristics – Idiotypes of Allotypes – Humoral mediated immunity – Antigen – Antibody interactions – Primary & secondary – Clonal selection Theory (N.K. Jerne) – Hybridoma Technology – Monoclonal Antibodies – Applications.

Unit III

Complement factors – Classical – Alternate Pathways

Cell mediated immunity – Cytokines – types – Network – Role in immune regulation.

Hypersensitivity reaction – Type I, II, III, IV.

Tolerance – definition – types - Autoimmunity – Aetiology & Examples.

Unit IV

MHC – HLA – Class I & Class II Antigens – Allograft rejection – GVHD – Prevention of graft rejection.

Tumor Antigens – Immunodiagnosis – Tumor imaging – Tumor phenotyping – Tumor therapy.

Unit V

Primary – B & T – Cell deficiencies – secondary – HIV – AIDS – AIDS Vaccines.

Vaccines: Types- Attenuated – Killed – Purified proteins (Toxoid) – Recombinant DNA Vaccines – subunit Vaccines – Edible Vaccines.

Immunization schedule, Active & Passive immunotherapy.

Text Books:

1. Benjamini, E., Coico,R., Sunshine,G 2000 Immunology – A short course IV edition. Wiley – Liss, New York.
2. Kubey, J. 2000. Immunology, Fourth 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. Goldsby, R.A., T.J. Kindt., & B.A. Osborne. 2000. Kuby Immunology. fourth edition. W.H. Freeman and Company,New York.
5. Roitt., Brostaff 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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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Core Paper-12)	Int. Marks	: 25
Class	: III Year	Ext. Marks	: 75
Semester	: VI	Max. Marks	: 100
Sub. Code	: IMB62	Hours/Week	: 6
Paper	: Core	No of Credits	:5
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

Conventional and Modern Biotechnology, Interdisciplinary aspects of Biotechnology.

Genetic engineering – restriction endonucleases – modifying enzymes – ligases – host vector system – E.coli as a host – Plasmids – Phage vectors – M13 – Cosmids – Phagemids – YACs – BACs – PACs – 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 – media – natural and defined media – suspension culture (short term lymphocyte culture) – fibroblast culture – development and maintenance of cell lines – cell hybridization – hybridoma and monoclonal antibody production – In vitro culture of oocytes/embryos – cell/embryo cryopreservation – stem cell isolation and culture

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 – anther and embryo culture – Hardening. Germplasm conservation, Gene bank, Seed bank, Pollen bank.

Bioethics- social issues

Unit V

Principles and applications of

PAGE, Agarose gel electrophoresis, blotting techniques.

DNA sequencing methods- DNA probes- DNA finger printing-

Polymerase chain reaction (PCR) technology- types of PCR

Microarray

Text Books:

1. Gupta, P.K., 1996, Elements of Biotechnology, Rastogi & Co., Meerut.
2. Primrose, S.B., 2001, Molecular Biotechnology, Second edition, Panima Publishing Corporation, New Delhi.
3. Turner,P.C., McLennan,A.G., Bates,A.D. and White,M.R.H. 1997. Instant Notes in Molecular Biology. BIOS Scientific Publishers, Oxford.
4. Satyanarayana V. 2010. Biotechnology,Books and Allied (P) Ltd. Kolkata, India

Reference Books:

1. Ignacimuthu, S.J., 2001, Methods in Biotechnology, Phoenix Publishing House Pvt., Ltd., New Delhi.
2. Jogdand, S.N., 1997, Gene Biotechnology, Himalaya Publishing House, New Delhi.
3. Old, R.W. and S.B. Primrose, 2001, Principles of Gene Manipulation, Blackwell Scientific, London.
4. Trevan, M.D., S.Boffey, K.H. Goulding and P.Stanbury, 1990, Gene Biotechnology – Himalaya Publishing House, New Delhi.
5. Brock,J.D. 1990. The emergence of Bacterial Genetics. Cold-Spring Harbor Laboratory Press, New York.
6. Brown,T.A. 1995. Gene Cloning: An introduction. III edn. Chapman & Hall, London.
7. Primrose,S.B. 1995. Principles of Genome Analysis. Blackwell Science, Oxford.
8. Darbeshwar Roy, 2010. Biotechnology .Narosa Publishing House, New Delhi.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Core Paper-13)	Int. Marks	: 25
Class	: III Year	Ext. Marks	: 75
Semester	: VI	Max. Marks	: 100
Sub. Code	: IMB63	Hours/Week	: 6
Paper	: Core	No of Credits	: 5
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 VAM, isolation, stock plants and inoculum production of VAM.

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, 1993, 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. Metting, Jr. F.B., 1993. Soil Microbial Ecology, Harcel Dekker Inc., New York.
4. Rangaswami,G., 1988. Diseases of Crop Plants in India, Third edition, Prentice-Hall of India Private Limited, New Delhi.
5. Somasegaran, P., and H.J. Hoben, 1994. Handbook for Rhizobia, Methods in Legume – Rhizobium Technology, Springer- Verlag, New York.
6. Subba Rao,N.S, 1995. Soil Microorganisms and Plant Growth, Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi.
7. Subba Rao. N.S., 1988. Biofertilizers in Agriculture, Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Practical- core paper -14)	Int. Marks	: 40
Class	: III Year	Ext. Marks	: 60
Semester	: VI	Max. Marks	: 100
Sub. Code	: IMBL61	Hours/Week	: 10
Paper	: Core	No of Credits	: 4
Title of the Paper: Immunology, Biotechnology and Agricultural Microbiology			

Unit: I Immunology

1. Single cell preparation from goat spleen and thymus.
2. Dissection and display of lymphoid organs of rat or chick.
3. Lymphocyte isolation from peripheral blood by density gradient centrifugation.
4. Serum electrophoresis.
5. Haemagglutination and Titration assay.
6. Immunodiffusion.
7. Immunization and bleeding techniques.

Unit: II Biotechnology

1. Isolation of Plasmid DNA
2. Isolation of eukaryotic genomic DNA
3. Purity determination and quantification of nucleic acids
4. Restriction enzyme analysis
5. Agarose gel electrophoresis of DNA
6. Demonstration of cloning
7. Pairwise sequence alignment (BLAST)
8. Multiple sequence alignment (CLUSTAL –X)
9. Transformation - Demonstration

Unit III: Agricultural Microbiology

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

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Skill Based Elective-6)	Int. Marks	: 15
Class	: III Year	Ext. Marks	: 35
Semester	: VI	Max. Marks	: 50
Sub. Code	: SE6	Hours/Week	: 2
Paper	: Skill Based Elective	No of Credits	: 2
Title of the Paper: Bionanotechnology			

Course Objective

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

Unit I

Bionanotechnology- Fundamental concepts, application, importance.

Fabrication of nanostructures: solid-state synthesis, vapour phase synthesis

Characterization of nanostructures: lithography techniques

Nanofluidics: polymers, surfactants, polymers emulsions and colloids

Nanoparticles: carbon nanotubes, silver, gold nano particles characterization and applications

Unit II

Biomedical applications

Bionanosensors: types and applications

Drug delivery: Encapsulation; liposomes as vehicles of drug delivery, Micelles for drug delivery, hydrogels for drug delivery

Quantum dot technique in cancer treatment

Nanorobots

Text Books

1. Subbiah, B. 2010. Nanobiotechnology. M.J.P. Publications, New Delhi.
2. Mark Ratner and Daniel Ratner, 2005. Nanotechnology: A Gentle Introduction to the Next Big Idea. Pearson Education, Inc.

Reference Books

1. T. Pradeep, 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 .

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Course	: IMB (Skill Based Elective-6)	Int. Marks	: 15
Class	: IIIYear	Ext. Marks	: 35
Semester	: VI	Max. Marks	: 50
Sub. Code	: SE6	Hours/Week	:2
Paper	: Skill Based Elective	No of Credits	:2
Title of the Paper: Pharmaceutical Microbiology (Optional for Bionanotechnology)			

Course Objective

- To learn about the importance of antibiotics
- To know the mechanism of action of secondary metabolites

Unit – I

Antibiotics and synthetic antimicrobial agents- Aminoglycosides & β lactams.
Antifungal antibiotics, antitumor substances.
Peptide antibiotics, Chloramphenicol, Sulphonamides and Quinolone antimicrobial agents.
Chemical disinfectants, antiseptics and preservatives.

Unit – II

Mechanism of action of antibiotics - inhibitors of cell wall synthesis, nucleic acid and protein synthesis.
Bacterial resistance to antibiotics.
Mode of action of non – antibiotic antimicrobial agents.
Biosensors in pharmaceuticals.
Application of microbial enzymes in pharmaceuticals.

References

1. Bailey & Scott's Diagnostic Microbiology, 2007. Betty A. Forbes, Daniel F. Sahn and Alice S. Weissfeld, Elsevier Publications.U.K.
2. W.B.Hugo & A.D.Russell., 2009. Pharmaceutical Microbiology –Edt. by Sixth edition. Blackwell scientific Publications, U.K.
3. Greenwood, D., Slack, R.C.B and Peutherer, J.F. 2009. Medical Microbiology. Churchill Livingstone. U.K.

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(For those joined B.Sc IMB on or after June 2011)

Course	: IMB (Elective Paper-3)	Int. Marks	: 20
Class	: III Year	Ext. Marks	: 80
Semester	: VI	Max. Marks	: 100
Sub. Code	: E3	Hours/Week	:
Paper	: Elective	No of Credits	:5
Title of the Paper	: Project		

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Revised Ancillary Zoology Syllabus
For Botany and Chemistry Major Students – w.e.f. 2011 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	Lab in 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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(For those joined B.Sc on or after June 2011)

Course : II B.Sc., Chemistry & III B.Sc., Botany	Int. Marks : 25
Class : II & III Year	Ext. Marks : 75
Semester : III & V	Max. Marks : 100
Sub. Code : AOZ1 & AZ51	Hours/Week : 4
Paper : Allied	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

Seriulture

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 Books:

1. Santhanakumar,G. 1993. Aquaculture. JJ Publications, Madurai.
2. David, B.V. 2002 Elements of Economic Entomology, Popular Book Depot., Chennai.
3. Singh, R.A. 1984 Poultry production, Kalyani publishers, New Delhi

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(For those joined B.Sc on or after June 2011)

Course : III B.Sc., Botany	Int. Marks : 25
Class : III Year	Ext. Marks : 75
Semester : VI	Max. Marks : 100
Sub. Code : AZ61	Hours/Week : 4
Paper : Allied	No of Credits : 4
Title of the Paper : Insect Pests & Management	

Course Objectives

- To provide an idea about the pests of different crops and vectors
- To know different control measures

Unit I: Pests

Definition of pest, types of Pests based on seasons, feeding habits and mouth parts with examples.

Unit II: Vectors

Biology, Disease transmission and control of House fly and mosquitoes

Unit III: Pest of Cattle

Biology, mode of transmission, infestation and control measure of *Hypoderma lineatus*; *Tabanus striatus*; *Hippobosca equina*.

Unit IV: Agricultural pests

Biology, damage and control measures (Cultural, Physical, Chemical & Biological) of Rice stem borer, *Scirpophaga incertulas*, Cotton boll worm, *Helicoverpa armigera*, Sugarcane shoot borer, *Chilo infuscatellus*, Brinjal borer, *Leucinodes orbonalis*, Red flour beetle, *Tribolium castaneum* and Fruit borer, *Deodorix isocrates*

Unit V: Integrated Pest Management & IRM

IPM and IRM (Antibiosis, antigenosis and Tolerance) Concepts and tools (Cultural, Physical, Chemical & Biological) with reference to Cotton.

Text Books:

1. David, B.V., and T. Kumaraswami, 2000, Elements of Economic Entomology, Popular Book Depot, Chennai.
2. David, B.V., 1992, Pest Management and Pesticides: Indian Scenario, First edition, Namrutha Publications, Chennai.
3. Fenemore, P.G., and A. Prakash, 1992, Applied Entomology, Wiley Eastern Limited, New Delhi.
4. Horn J.D., 1988, Ecological Approach to Pest Management, Elsevier Applied Science Publication, USA.
5. Richards, O.W and Davies, R.G. 1977 Imm's General Textbook of Entomology, Tenth edition, Volume I & II: Structure, Physiology and Development, Chapman and Hall, London,

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(For those joined B.Sc on or after June 2011)

Course : B.Sc., Botany	Int. Marks : 40
Class : III Year	Ext. Marks : 60
Semester : VI	Max. Marks : 100
Sub. Code : AZL61	Hours/Week : 2
Paper : Allied Lab	No of Credits : 2
Title of the Paper: Lab in Economic Zoology and Insect Pests & Management	

Unit – I Economic Zoology

1. External Morphology of *Bombyx mori*
2. Silk gland –Dissection
3. Spiracle mounting
4. Identification of lac insects
5. Identification of type of honey bees
6. Bee hives - Model
7. Broilers and layers- types
8. Fabrication of fish tank

Unit II : 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

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(For those joined B.Sc on or after June 2011)

Course : B.Sc., Chemistry	Int. Marks : 25
Class : II Year	Ext. Marks : 75
Semester : IV	Max. Marks : 100
Sub. Code : AOZ2	Hours/Week : 4
Paper : Allied	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 of colourimeter, centrifuge, autoanalyzer and Thin layer chromatography

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 – 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 cholesterol (LDL and HDL) – liver function test (bilirubin) – serum protein separation

Unit V: Hormones and Enzymes

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.

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

(For those joined B.Sc on or after June 2011)

Course : B.Sc., Chemistry	Int. Marks : 40
Class : II Year	Ext. Marks : 60
Semester : IV	Max. Marks : 100
Sub. Code : AOZL1	Hours/Week : 2
Paper : Allied Lab	No of Credits : 2
Title of the Paper : Practical -1 Economic Zoology and Clinical Chemistry	

Unit – I Economic Zoology

1. External Morphology of *Bombyx mori*
2. Silk gland –Dissection
3. Spiracle mounting
4. Identification of lac insects
5. Identification of type of honey bees
6. Bee hives - Model
7. Broilers and layers- types
8. Fabrication of fish tank

Unit – II: 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)

Thiagarajar College (Autonomous), Madurai-9
Department of Zoology

Certificate Course
(For those admitted in June 2011 and later)

Class	Certificate / Diploma	Code	Sem	Title of the paper	Contact Hrs/W	Valuation Scheme		
						Int	Ext	Total
B.Sc	Certificate		3&4	Water Quality Analysis	2 / W 20/ Sem	25	75	100

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology

(For those joined B.Sc IMB on or after June 2011)

Class	: II Year B.Sc .IMB	Int.Marks	:25
Semester	:III & IV	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, carbonates, nitrate, silicate, phosphate, COD and BOD.

Unit II

Determination of microbial load and faecal contamination. – MPN test-Analysis of heavy metals – Lead, Copper and Mercury. Aquatic pollution indicators. Water purification techniques. Biofilters.

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, US.
6. Cole, G. A 1983. Textbook of Limnology 3rd edition, The C.V. Mosby company
7. Manivasakam, N. 2001. Chemical and Microbial analysis of mineral and packaged drinking waters. Sakthi Book Service, Coimbatore.
8. Michael, P. 1987. Ecological methods for field and laboratory investigations. Tata McGraw Hill Publishing Co., New Delhi.
9. Southwood, TRE. 1978. Ecological methods. ELBS. USA.
10. Trivedy, R.K., Goel, P.K. and Trishal, C.L. 1987. Practical methods in Ecology and Environmental science. Environmental publishers. Karad

Thiagarajar College (Autonomous), Madurai – 9
Re-Accredited with ‘A’ Grade by NAAC
Department of Zoology
M. Sc., Zoology
Course Structure (w.e.f. 2011 batch onwards)
I semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core	1PZ1	Biological Chemistry and Biophysics	6	5	90	25	75	100
Core	1PZ2	Microbiology	6	5	90	25	75	100
Lab	1PZL1	Lab in Biological Chemistry and Biophysics	6	4	90	40	60	100
Lab	1PZL2	Lab in Microbiology	6	4	90	40	60	100
Elect	1PZE1	Developmental Biology and Evolution/ Sericulture	6	5	90	25	75	100
		Total	30	23				

II Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core	2PZ1	Immunology	6	5	90	25	75	100
Core	2PZ2	Cell and Molecular Biology	6	5	90	25	75	100
Lab	2PZL1	Lab in Immunology	6	4	90	40	60	100
Lab	2PZL2	Lab in Cell and Molecular Biology	6	4	90	40	60	100
Elect	2PZE1	Biostatistics & Bioinformatics/ Genomics	6	5	90	25	75	100
		Total	30	23				

III Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core	3PZ1	Biotechnology	6	5	90	25	75	100
Core	3PZ2	Entomology	6	5	90	25	75	100
Lab	3PZL1	Lab in Biotechnology	6	4	90	40	60	100
Lab	3PZL2	Lab in Entomology	6	4	90	40	60	100
NMElect	3PZE1	Economic Zoology- (Non Major Elective)	6	4	90	25	75	100
		Total	30	22				

IV Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core	4PZ1	Animal Physiology	6	5	90	25	75	100
Core	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 and Biodiversity	6	4	90	40	60	100
Elect	4PZE1	Project	6	4	90	25	75	100
		Total	30	22				

Thiagarajar College (Autonomous), Madurai – 9
Re-Accredited with ‘A’ Grade by NAAC
Department of Microbiology
M. Sc., Microbiology

A) Consolidation of Contact Hours and Credits : PG

Semester	Contact Hrs / Week	Credits
I	30	23
II	30	23
III	30	22
IV	30	22
Total	120	90

B) Curriculum Credits

Core	-- 72 Credits
Major Elective	-- 18 Credits

Total	90 Credits

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc Zoology (Core Paper-1)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: I	Max. Marks	: 100
Sub. Code	: IPZ1	Hours/Week	:6
Paper	: Core	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, chitin and peptidoglycon.

Metabolism and its regulation: Glycolysis – Krebs cycle – gluconeogenesis, glycogenesis, glycogenolysis, HMP shunt. Disorders of carbohydrate metabolism.

Unit II

Amino acids: Basic structure and classification

Physical properties and chemical reactions

Unusual amino acids

Biosynthesis of amino acids

Proteins: Biological significance – Classification

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

Ramachandran plot.

Protein conformation – determination of amino acid composition and its sequence.

Metabolism: Transamination, deamination and transmethylation. Disorders of nitrogen metabolism

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. Disorders of fat metabolism

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

Role of hormones in signal transduction

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. Conn, E.E. Stumpf, P.K. Bruening, G and Doi, R.H. 1997. Outlines of Biochemistry. John Wiley & Sons Inc., Newyork
2. Shunmugam, A. 1998. Fundamentals of Biochemistry for Medical students. Published by the author.
3. Voet, A. and Voet, J.G. 1995. Biochemistry. II edition. John Willey & Sons Inc., Newyork.

Reference Books:

1. Bose, S. 1982. Elementary Biophysics. Vijaya Printers, Madurai.
2. Casey, E.J. 1969. Biophysics – Concepts and mechanism. East West Press. New Delhi.
3. McKee, T. and McKee, J.R. 1996. Biochemistry: An introduction – Wm.C. Brown Communication Inc., U.S.A.
4. Morris, J.G. 1974. A Biologist's physical chemistry. II edition. Edward Arnold – A division of Holder and Stoughton, London.
5. Nelson,D.L. Cox,M.M. 2002. Lehninger's Principles of Biochemistry. III edition. Macmillan Worth Publishers, New Delhi.
6. Stryer, L. 2000. Biochemistry. IV edition. W.H. Freeman Company
7. Weil,J.H. 1990. General Biochemistry. Wiley Eastern Limited. New Delhi.
8. Zubay, G. 1993. Biochemistry Vol I, II & III. III edition. Wm.C. Brown Communication Inc., USA.
9. Campell and Farrell 2008. Biochemistry Cengage Learning India (P) ltd,New Delhi

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Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc Zoology (Core Paper-2)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: I	Max. Marks	: 100
Sub. Code	: IPZ2	Hours/Week	:6
Paper	: Core	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 of Microorganisms –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, Fermentation, 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. 1986. Microbiology, fifth edition. McGraw-Hill. Book Co. Singapore
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2004. Microbiology: An Introduction. Pearson Education, Singapore
3. Dube, R.C. and Maheswari, D.K. 2000. General Microbiology. S Chand ,New Delhi.

Reference Books

1. Alcamo, I.E. 1999. 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. Black, J.G.2005. Microbiology-principles and explorations, fourth edition. John Wiley & Sons, Inc. New York
4. Prescott, L.M., J.P. Harley and D.A. Helin. 2002. Microbiology. fifth edition.McGraw Hill, New Delhi.
5. Prescott, L.M., Harley, J.P. and Klein, D.A. 2006. Microbiology (7th edition) McGraw Hill, Newyork.
6. Madigan, M.T., Martinkl, J.M. and Parker, J. 2000. Brock Biology of Microorganisms, 9th Edition, MacMillan Press, England.
7. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. 1991. General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.
8. Atlas, R.A. and Bartha, R. 2000. Microbial Ecology . Fundamentals and Application, Benjamin Cummings, New York.

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Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc Zoology (Lab-1)	Int. Marks	: 40
Class	: I Year	Ext. Marks	: 60
Semester	: I	Max. Marks	: 100
Sub. Code	: IPZL1	Hours/Week	: 6
Paper	: Lab	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. Colourimeter: a. Principle and working mechanism
 - b. verification of Beer's law
 - c. Quantitative estimation of
 - i) Carbohydrates
 - ii) Proteins
 - iii) Lipids
6. Chromatography: a. Principle, types and applications
 - b. Paper chromatography
 - c. TLC
 - d. Column chromatography
7. Electrohoresis: Principle, types and applications – PAGE
8. Centrifuge: Principle, types and applications
 - Density gradient centrifugation
9. Quantitative estimation of ascorbic acid
10. Enzymes: Qualitative analysis of amylase activity.
 - Quantitative analysis of amylase activity
 - Effect of substrate concentration & temperature on amylase activity
11. Osmosis – Plasmolysis
12. Demonstration of Hill reaction

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Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc Zoology (Lab-2)	Int. Marks	: 40
Class	: I Year	Ext. Marks	: 60
Semester	: I	Max. Marks	: 100
Sub. Code	: IPZL2	Hours/Week	: 6
Paper	: Lab	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. A septic transfer of microorganisms
6. Isolation of single colonies on solid media – Slant, Streak –Simple and Quadrant
7. Enumeration of bacterial numbers by serial dilution and plating
8. Isolation of Bacteria, actinomycetes and fungi from soil
9. Microscopic observation of bacteria –Simple and Differential staining
10. Flagella staining
11. Spore staining
12. Biochemical test –IMViC TEST, Oxidase and catalase
13. Slide culture technique and fungal staining –Yeast and filamentous fungi
14. Microscopic observation of Algae- Nostoc and Spirullina
15. Measurement of the size of the bacterial cell
16. Cultivation aerobic and anaerobic culture

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Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc Zoology (Elective Paper-1)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: I	Max. Marks	: 100
Sub. Code	: IPZE1	Hours/Week	: 6
Paper	: Elective	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. Berril, N.J.1976. Developmental biology, Tata Mc.Graw Hill Pub.Co.Ltd.
3. Dobzhansky, T.1973. Evolution.Surjeet Pub.New Delhi

Reference books

1. Minkoff,E.1984. Evolutionary Biology.Addison-Wesley publishingCompany,California, USA
2. Theodore, H and Eaton .1970. Evolution.Thomas Nelson and Sons Ltd. Nairobi
3. Gillbert. S.F.1994. Developmental Biology. Sinauer Associates Inc. Massachusetts, USA.
4. Adams W.1986. Genetic Analysis of Animal Development. A Wiley InterSciencePublication. USA.
5. Arora M.P.2009. Embryology ,Himalaya Publishing House, New Delhi

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Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc. Zoology (Elective Paper-1)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: I	Max. Marks	: 100
Sub. Code	: IPZE1	Hours/Week	:6
Paper	: Elective	No of Credits	:5
Title of the Paper : Sericulture (Optional for Developmental Biology and Evolution)			

Course Objectives

- To know the history and development of sericulture in India
- To learn the method of rearing silkworm ,reeling silk and marketing

Unit I

History and scope of Sericulture – Silk producing organisms, Unique properties and silk and its uses; History of sericulture in India, World silk out put, International silk trade, Role of Central Silk Board.

Silkworm seed technology – training facilities available in sericulture and for sericulturists; National Sericulture project – future scope of sericulture industry.

Unit II

Distribution of mulberry plant – classification and varieties of mulberry, morphology of mulberry plant, preparation of land, planting material, planting season and planting systems; Propagation of mulberry plant – seedling, vegetative, cutting, grafting, layering, new micro propagation methods, tissue culture, embryo culture, endosperm culture, protoplast culture and somatic hybridization, genetic engineering.

Unit III

The Mulberry Silkworm, *Bombyx mori*: Taxonomic position of *Bombyx mori*, Life cycle of *Bombyx mori*, Classification of *Bombyx mori*, Morphology of *Bombyx mori*; Silkworm diseases – Viral, Bacterial, Fungal and Protozoan; Pests of Silkworm – Uzi fly, Bacon beetles, ants and nematodes

Unit IV

Grainage technology and silkworm rearing: Silkworm breeding – breeding methods, silkworm races in different countries; Production of reproductive seeds – germplasm banks, rearing pure breeds; Incubation of silk worm eggs – methods of incubation, black boxing, wrapping before hatching, incubation methods followed in different countries; Basic requirements for silk worm rearing – outdoor and indoor rearing; Disinfectants; Rearing – chawki rearing, mature worm rearing, mounting and harvesting.

Unit V

Reeling – stifling, storage of cocoons, sorting cocoons, cocoon deflossing, riddling, blending, cooking and brushing; Marketing – cocoon and silk; Byproducts of sericulture and their utility.

Text Books

1. Ganga,G. and Sulochana chetty,J. 1997. Introduction to Sericulture. II Edn, Oxford and IBH publishing Co Pvt. Ltd.
2. Ullal, D.R. and Narashimhanna, M.N. 1981. Hand book of Practical Sericulture. II Edn CSB. Bangalore.

Reference Books:

1. Ganga,G. Comprehensive Sericulture Vol I and II.
2. Sonwalkar,T.N. 1991. Hand Book of Silk Technology. Wiley Eastern limited
3. Koshy, T.D. Silk Exports and Development. Ashish Publishing House
4. Rui, H.G. Silk Reeling. Oxford and IBH publishing Co. Pvt. Ltd.
5. Tazimav. 1978. (Ed). The silkworm – An important Laboratory Tool Kodansha Ltd., Tokyo, Japan.

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Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc Zoology (Core Paper-3)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: II	Max. Marks	: 100
Sub. Code	: 2PZ1	Hours/Week	:6
Paper	: Core	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 and acquired, Humoral and Cell mediated response, Cells and organs of the immune system – Ontogeny and development of Immune cells – immunogenicity – Haptens – Adjuvants – immunoglobulin isotypes- structure and function.

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– cross reactivity.

Unit III

Immune effector mechanisms – Cytokines – functional properties; Complement system – components, activation, regulation; 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

Autoimmunity – organ specific autoimmune diseases, systemic autoimmune diseases, Immunodeficiency diseases – Phagocytic,complement deficiencies, humoral, cell mediated, combined immunodeficiencies, 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. Benjamini,E., Coico,R., Sunshine,G 2000 Immunology – A short course IV edition. 2000. Wiley – Liss, New York.
2. Nandhini Shetty. 1993. Immunology – Introductory Text Book, Wiley Eastern Limited, New Delhi.
3. Kuby,J. 2000. Immunology. IV edn. W.H. Freeman and Company, New York.

Reference Books:

1. Abbas, A.K., Lichtman, A.H. and Pober, J.S.2000. Cellular and molecular immunology, IV edn., W.B.Saunders Company, London.
2. Benjamini,E. Coico,R. and Sunshine,G. 2000. Immunology – A short course. IV edn. Wiley – Liss, New York.
3. Coleman, R.M. Lombard,M.F. and Sicard,R.E. 1992. Fundamental Immunology. II edn. Wm.C.Brown Publishers, U.S.A.
4. Cruse, J.M. and Lewis, R. 1999. Atlas of Immunology, CRC Press, New York.
5. Janeway, Jr. C.A. and Travers, P. 2001. Immunobiology, V edn. Garland Publishing, London.
6. Roitt,I., Brostoff,J. and Male,D. 2001. Immunology VIth edn. Mosby, London.

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Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc Zoology (Core Paper-4)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: II	Max. Marks	: 100
Sub. Code	: 2PZ2	Hours/Week	:6
Paper	: Core	No of Credits	:5
Title of the Paper : Cell and Molecular Biology			

Course Objectives:

- To understand the structure and functions of cell and cell organelles
- To know about gene organization and regulation

Unit I

Cell theory-difference between prokaryotic and eukaryotic cells.

Plasma membrane-structure,chemical composition, Danielli-Davson model and fluid mosaic model, Permeability.

Cell organelles –Golgi complex, endoplasmic reticulum, lysosomes, mitochondria, Ribosomes, lysosomes- structure-composition,functions.

Cell division-mitosis and meiosis.

Unit II

Nucleus, Chromosomes-structure,variation and modification,giant chromosomes.

Nucleic acids: structure and chemical constituents of DNA and RNA,types , forms and physical properties.

Mutation-molecular mechanism of mutations and types.mutagens-base analog, chemical, ionizing and non ionizing radiation, detection.

Cancer cells- characteristics, carcinogens.

Unit III

DNA repair mechanism-Light dependent and Independent

Replication of DNA-linear,circular role of enzymes

Protein synthesis-transcription in prokaryotes and eukaryotes, post transcriptional changes.

Translation-code and characteristics, synthesis of protein, initiation, elongation and termination, post translational modifications.

Unit IV

Gene regulation:lac,trp and ara operon model and expression.

Plasmids-types, replication, copy number, amplification.

Genetic recombination-holliday model-double strand break initiation-rec enzymes.

Unit V

Gene transformation- discovery,experiments, uptake mechanism and mapping based on transformation, conjugation in bacteria, mapping, lytic and lysogenic.

Transduction-generalized and specialized transduction, mapping by transduction, jumping gene-terminology, Barbara experiments, detection and transposition in bacteria, transposons-tn3 and tn10 and phage Mu.

Text Books

1. Frifelder,D 2000. Molecular Biology II edn.Narosa Publishing House,New Delhi.
2. Power,C.B. Cell Biology Himalayan Publishing House, New Delhi.

Reference Books

1. 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.
2. Wolfe, L.S., 1993 Molecular and Cellular Biology, Wadsworth publishing company.
3. Lewin, B., 2000, Genes-VII, Oxford University Press Inc., New York.
4. Prakash S.L. 2007.Cell and Molecular Biology.M.J.P. publishers,Chennai
5. De Roberties E.D.P and E.M.F.De Roberties 2011. Cell and Molecular Biology 8th Edition. B.I.Publicatons Pvt.Ltd.India
6. Becker, Reece and Poenic 1991. The world of the cell. 3rd Editon. The Benjamin Cummings Publishing Company , New York
7. Ajay Paul 2009. Cell and Molecular Biology ,Books and Allied (P) ltd, India.
8. Lodish, Berk, Zipursky, Matsudara, Baltimore and Darnell.1999. Molecular Cell Biology, Fourth Edition, W.H.Freeman and Company, Newyork.

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Course	: M.Sc Zoology (Lab-3)	Int. Marks	: 40
Class	: I Year	Ext. Marks	: 60
Semester	: II	Max. Marks	: 100
Sub. Code	: 2PZL1	Hours/Week	: 6
Paper	: Lab	No of Credits	:4
Title of the Paper : Lab in Immunology			

1. In vivo method of delayed type Hypersensitivity
2. Separation and preservation of Serum/Complements
3. Demonstration of natural resistance to infection by bacterial killing of serum factors
4. Electrophoretic separation of serum proteins
5. Immunoelectrophoretic technique
6. Complement mediated haemolysis
7. Agar gel Ouchterlony double immunodiffusion
8. Mancini single radial immunodiffusion
9. Haemagglutination (or) Haemolysin titration assay
10. Direct agglutination to determine the erythrocyte transplantation antigens.
11. Rapid plasma regain flocculation test for serodiagnosis of syphilis
12. Display of Lymphoid organs of chicken
13. Display of Lymphoid organs of mice
14. Percentage occurrence of innate and adaptive immune cells.
15. Isolation and enumeration of lymphocytes from human blood .
16. Isolation of lymphocytes from sheep spleen
17. Isolation of thymocyte from mouse thymus
18. Isolation of macrophage from mouse peritoneal cavity
19. Determination of lymphocyte viability by Trypan blue dye exclusion test
20. Identification and enumeration of human T lymphocyte using E rosette technique

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Course	: M.Sc Zoology (Lab-4)	Int. Marks	: 40
Class	: I Year	Ext. Marks	: 60
Semester	: II	Max. Marks	: 100
Sub. Code	: 2PZL2	Hours/Week	: 6
Paper	: Lab	No of Credits	:4
Title of the Paper : Lab in Cell and Molecular Biology			

1. Replica Plating technique for isolation of mutants
2. Isolation of mutants by gradient plate technique
3. Bacterial transformation
4. Conjugation experiment.
5. Complementation test.
6. Phage titration
7. Quantitative estimation of DNA using colourimeter
8. Quantitative estimation of RNA using colourimeter
9. Determination of melting curve of DNA.
10. Polytene chromosomes – staining
11. Observation of different types of tissues
12. Observation of stages of mitosis
13. Observation of stages of meiosis

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Course	: M.Sc Zoology (Elective Paper-2)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: II	Max. Marks	: 100
Sub. Code	: 2PZE1	Hours/Week	:6
Paper	: Elective	No of Credits	:5
Title of the Paper : Biostatistics and Bioinformatics			

Course Objectives:

- To train the students to substantiate their findings with statistical analyses
- To gain basic knowledge on bioinformatic tools

Unit I

Statistical population and sample in biological studies, variables – qualitative and quantitative; 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, skewness and kurtosis; Probability – addition and multiplication rules, Bayes theorem; Probability distribution – binomial, Poisson and normal

Unit III:

Estimation theory – point estimation and interval estimation; Estimating the population mean; known and unknown; Testing of hypothesis – Null and alternate hypothesis, Wilcoxon signed Rank test, Student ‘t’ distribution, Chi-square test, test of independence, goodness of fit and homogeneity.

Unit IV:

Correlation – types, methods of correlation – graphic method, mathematical method; Karl Pearson’s Rank; Regression analysis – equation, estimation of unknown value from known value; ANOVA – One way and Two way classification.

Unit V:

Bioinformatics-Scope and applications, Biological databases- DNA and protein- primary 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

Text Books

1. Gupta S.P. 1987. Statistical Methods. Sulton Chand & Sons Publishers, New Delhi
2. Attwood, T.K. and Parry, D.J – Smith, D.J. 2002. Introduction to Bioinformatics. Pearson Education (Singapore) Ptc. Ltd..
3. Palanichamy, S. Manoharan,M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu..

Reference Books

1. Banergi, P.K. 2004 Introduction to biostatistics S Chand & company Ltd. New Delhi.
2. Gurumani, N. 2004. An introduction to Biostatistics. MJP publishers, Chennai
3. Misra, B.N. and Misra, B. K. 1998. Introductory practical Biostatistics. Naya Prakash, Calcutta.
4. Pillai, RSN. and Bagavathi, V. 1989. Statistics theory and practice. S Chand & Company Ltd. New Delhi.
5. Scheffler W.C. 1980. Statistics for the biological sciences. Addison-Wesley publishing company, New York.
6. Sokal, R.R. and Rohif, F.J. 1987. Introduction to Biostatistics. W.H. Freeman and company, New York
7. Sundar Rao, P.S.S. and Righard, J. 2002. An introduction to biostatistics. III edn. Prentice Hall of India, New Delhi.
8. Mount, W. 2001. Bioinformatics sequence and genome analysis. Cold Spring harbour Laboratory Press, New York
9. Pevsner 2003. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi

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Course	: M.Sc. Zoology (Elective Paper-2)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: I	Max. Marks	: 100
Sub. Code	: 2PZE1	Hours/Week	:6
Paper	: Elective	No of Credits	:5
Title of the Paper : Genomics (Optional for Biostatistics and Bioinformatics)			

Course Objectives

- To understand the basic concepts of genes and genomes
- To learn the principles of gene manipulation and mapping

Unit I

Gene – gene concept, Organization and structure of genomes in prokaryotes and eukaryotes, Human genome project. – Celera genomics and other agencies – applications.

Unit II

Modern concept of the gene – Open Reading Frame (ORF)
Generation of Polymorphism – Regulation of Gene Expression – analysis – expressed sequence tags (ESTs)

Unit III

Genome mapping – physical mapping - markers – RFLP – RAPD – VNTRs – SNPs – Microsatellites – Minisatellites – Fluorescent *in situ* Hybridization (FISH)
Genetic mapping – Construction of cDNA library – Genomic library construction
Sequencing – Manual and Automated – Shotgun sequencing, whole genome sequencing – assembly of contigs – case studies about whole genome sequencing.

Unit IV

Probes – Molecular probes – preparation of probes – nucleic acid probes - Radioactive and Non-radioactive labelling, application of molecular probes.
Global Gene expression analysis

Unit V

Functional genomics – Hypothetical genes – putative genes – functional annotation – Gene expression – SAGE; Microarray – components and architecture – Principles and Methodology – protein array.

Text books

1. Primrose, S.B and Twyman, R.M. 2007 Principles of gene manipulation and genomics. Seventh Edition, Blackwell publication, USA.
2. Brown, T.A. 2004. Genomes. John Wiley & Sons (Asia) Pte. Ltd.

Reference Books:

1. Brown, T.A. 1999. Genomics. BIOS scientific Publishers. Oxford, USA.
2. Bregeron, B. 2003. Bioinformatics computing. Printice-Hall, India. New Delhi. Hartl, D.L. and Jones, E.W. Genetics: Analysis of Genes and Genomes. 5th edn. Jones and Bartlett Publishers. USA.
3. Russel, P.J. 2002. Genomics. Benjamin Cummings. San Francisco, USA.
4. Kohane, I.S. Kho, A.T. and Buttle, A.J. 2004. Microarray for an Integrative Genomics. Ane Books. MIT Publication, New Delhi.

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Course	: M.Sc Zoology (Core Paper-5)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: 3PZ1	Hours/Week	: 6
Paper	: Core	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

Conventional and Modern Biotechnology, Interdisciplinary aspects of Biotechnology. Genetic engineering – restriction endonucleases – modifying enzymes – ligases – host vector system – E.coli as a host – Plasmids – Phage vectors – M13 – Cosmids – Phagemids – YACs – BACs – PACs – 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 – media – natural and defined media – suspension culture (short term lymphocyte culture) – fibroblast culture – development and maintenance of cell lines – cell hybridization – hybridoma and monoclonal antibody production – In vitro culture of oocytes/embryos – cell/embryo cryopreservation – stem cell isolation and culture

Plant tissue culture-callus culture-significance

Protoplast fusion technique its implications

Bioethics- social issues

Unit IV

Basic fermenter design and components-large scale culture of microbes-batch culture and continuous culture

Downstream processing

Commercial exploitation of microbes-immobilization-biomass production-waste treatment-ore leaching-production of primary and secondary metabolites- penicillin , protease.

Unit V

Principles and applications of

PAGE, Agarose gel electrophoresis, blotting techniques.

DNA sequencing methods- DNA probes- DNA finger printing-

Polymerase chain reaction (PCR) technology- types of PCR

Microarray

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
3. Mitra,S.1996 Genetic Engineering Principles and Practice Macmillan India Ltd. India

Reference Books

1. Brown,T.A. 2006. Gene Cloning & DNA Analysis: An introduction. V edn. Blackwell publishing USA
2. Crueger, W. and A. Crueger, 2000. Biotechnology : A Test Book of Industrial Microbiology, 2nd edn. Panima Publishing corporation, New Delhi.
3. Trevan, M.D., S.Boffey, K.H. Goulding and P.Stanbury, 1990, Gene Biotechnology – Himalaya Publishing House, New Delhi.
4. Trehen, K.2002. Biotechnology, New Age International (P) Ltd. New Delhi
5. Balasubramanian, D., C.F.A. Bryce, K.Dharmalingam, Y.Green, Kunthala Jeyaraman. 2004. Concepts in Biotechnology. Universities (P) ltd. Hyderabad.

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Course	: M.Sc Zoology (Core Paper-6)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: 3PZ2	Hours/Week	: 6
Paper	: Core	No of Credits	: 5
Title of the Paper : Entomology			

Course Objectives:

- To train the students for the identification of different insects
- Make them learn, when and how to control the pests of different crops

Unit I

Classification of Insects

General characteristics of class Insecta and classification up to Order level – characteristics of each order with examples.

Modern scheme of insect classification:

Apterygota

Pterygota: Exopterygota (Hemimetabolous): Paleopteroid, Orthopteroid, Hemipteroid orders

Endopterygota: (Holometabolous): Coleopteroid, Neuropteroid, Panorpoid and Hymenopteroid orders

Unit II

Anatomy and Physiology of Insects:

Respiratory system: Spiracle, tracheal gills, air sacs, trachea and tracheoles

Excretory system: in aquatic and terrestrial insects

Reproductive system: Male – accessory glands – vas efferense, vas deferens, aedeagus; Female – spermatheca, parovaginal, spermatheca, telotrophic, polytrophic

Endocrine system: Structure of Corpora cardiaca, Corpora allata and neurosecretory cells; ecdysone, neuropeptides, prothoracicotropic hormone (PTTH), ATH, JH and its analogue

Unit III

Pests and Pest Management

Pests: Any three major pests of Cotton, Paddy, Sugarcane, Ground nut, Brinjal, Tomato

Vectors: Insect vectors of plant pathogens and IPM: Aphids, leafhoppers, white flies

Chemical control: Insecticide – nomenclature, toxicity, mode of entry, mode of action, synergistic – formulations, law and regulations, repellents, attractants

Unit IV

Biological Control

Parasites and predators – Genetic Control - Breeding insect resistance host;

Ecological control – Cultural and mechanical; microbial control – Bacteria – *Bacillus thuringiensis* and *Erynia radicans*

Fungi – *Metrhizium anisopliae*, *Beauveria bassiana*

Virus – nucleopolyhedral virus (NPV) and Granulosis virus (GV)

Protozoans: *Nozema locustae*

Nematode: *Stenernema sp.*, and *Heterorhbdidis sp.*

Studies on molecular evolutionary relationship between different groups of insects,
& insect identification

Unit V

Bombyx mori –Biology and silk secretion

Grainage technology- Silkworm rearing-

Pests and Disease management

Biology and silk production of nonmulberry silkworm-Eri, Muga and Tasar

Silk reeling and marketing

Text books

1. David,B.D. and Kumarasamy,T. 1982. 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. 1982. The insects: Structure and Function. ELBS.
2. Champan,R.F. and Joern,A. 1990. (eds.). Biology of Grasshoppers. John Willey & Sons, New York.
3. David,B.D. and Kumarasamy,T. 1982. Elements of Economic Entomology. Popular Book Depot, Madras.
4. Kerkut,G.A. and Gilbert,L.I. 1985. (eds.). Comprehensive Insect Physisology, Biochemistry and Pharmacology. Pergamon, Oxford.
5. Nayar,KK., Ananthkrishnan,T.N. and David,B.V. 1976. General and Applied Entomology. Tata Mc Graw Hill Publishing Co.
6. Pedigo,L.P. 1996. Entomology and Pest Management. Prentice Hall of India, New Delhi
7. Regupathy,A., Palanisamy,S., Chandramohan,N. and Gunathilagaraj,K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.
8. Wigglesworth, V.B. 1972. The principles of Insect Physiology. Chapman & Hall, New York.
9. Dandin,S.B., J.Jayaswal and K.Giridhar 2003. Handbook of Sericulture Technologies. Central Silkboard, Bangalore

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Course	: M.Sc Zoology (Lab-5)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: III	Max. Marks	: 100
Sub. Code	: 3PZL1	Hours/Week	: 6
Paper	: Lab	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 animals
3. Restriction digestion of Plasmid DNA
4. SDS-PAGE
5. Agarose Gel Electrophoresis
 - a. Cloning a DNA fragment in a known vector
6. Demonstration of PCR amplification
7. Demonstration of Western Blotting
8. Monolayer Culture of Chick embryo fibroblast
9. Callus culture
10. Cell Immobilization
11. Biogas production-demonstration
12. Ethanol production

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Course	: M.Sc Zoology (Lab-6)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: III	Max. Marks	: 100
Sub. Code	: 3PZL2	Hours/Week	: 6
Paper	: Lab	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
10. Study on the development of resistance to pesticides – LC50 value
11. Study on the life history of vectors – Mosquitoes and housefly.
12. Sex discrimination in larvae & pupae
13. Dissection of silk gland
14. Pebrine identification

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Course	: M.Sc Zoology (Non Major Elective paper-1)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: 3PZE1	Hours/Week	: 6
Paper	: Core	No of Credits	: 4
Title of the Paper : Economic Zoology (NME)			

Course Objectives:

- To understand the economic aspect of animals
- To study on the beneficial and harmful insects and animals

Unit I

Protozoans and Helminthic parasites : *Plasmodium vivax*, *Entamoeba histolytica*, *Taenia solium*, *Ascaris lumbricoides* – life cycle, Disease caused, symptoms, treatments

Unit II

Major infectious and Communicable disease: Small pox, tuberculosis, cholera and AIDS – pathogens, symptoms, treatment and prevention.

Unit III

Aquaculture: Fish culture, pearl oyster culture, prawn culture
Vermiculture

Unit IV

Beneficial and Harmful insects: Apiculture, Sericulture, Lac culture.
Insect Pests of Crops – Paddy (*Scirpophaga incertulas*); Cotton *Helicoverpa armigera* and Sugarcane *Chilo infuscatellus*

Unit V

Veterinary parasites: Cattle and live stock disease, their pathogens (helminthus) and vectors (ticks and mites)

Text Book

1. Shukla,G.S and Upadhyay,V.B 2001. Economic Zoology, Rastogi Publications,Meerut ,India

Reference Books

1. Kotpal, R.L., S.K. Agarwal and RP.Khetarpal, 1985, Invertebrate Zoology, sixth edition, Rastogi Publishers, Meerut.
2. Park, J.E & K.Parrk., 1991, Text Book of Social and Preventive medicine, thirteenth edition, Banarsidas Bhanot Publishers, Jabalpur.
3. David, B.V., 1992, Pest Management and Pesticides: Indian Scenario, First edition, Namrutha Publication, Chennai.
4. Fenemore, P.G., and A.Prakash, 1992, Applied Entomology, Wiley Eastern limited, New Delhi.
5. Horn J.D., 1988, Ecological Approach to Pest Management, Elsevier Applied Science Publication, USA.

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Course	: M.Sc Zoology (Core Paper-7)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: IV	Max. Marks	: 100
Sub. Code	: 4PZ1	Hours/Week	: 6
Paper	: Core	No of Credits	: 5
Title of the Paper : Animal Physiology			

Course Objectives

- To understand the structural organization of different systems within body
- To learn their functions to maintain milieu interior

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- amphibian, reptilian, birds, 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. Begum, R.A. 1999. Text book of Foods, Nutrition and Dietetics – II revised Edn., Sterling, New Delhi
2. Clancy, J. and Mc Vicar, A.J. 1995. Physiology and anatomy. Edward Arnold, London.
3. Fox, S.I. 1999. Human Physiology. VI edn. Mc Graw-Hill Publications, 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. Tortora, G.J. 1994. Introduction to the human body: The essentials of anatomy and physiology. III edn. Harpers Collins College Publishers, New York.
8. 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.
9. Singh, H.R and Neeraj Kumar 2009. Animal Physiology and Biochemistry. Vishal Publishing Co, New Delhi.
10. Hoar W.S 2004. General and Comparative Physiology .Prentice-Hall of India (P) Ltd. New Delhi

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Course	: M.Sc Zoology (Core Paper-8)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: IV	Max. Marks	: 100
Sub. Code	: 4PZ2	Hours/Week	: 6
Paper	: Core	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 I

Ecosystem: Concept, components – trophic structure – food chain, food web, food web complexity, chain length, connectance and linkage density, food web patterns – ecological pyramids – energy flow – primary and secondary production – production and consumption efficiency, trophic level transfer efficiency, ecotone, edge effect, ecological succession – ecosystem services

Unit II

Pollution: Air, water, land, thermal, radioactive and noise pollutions – causes, effects and mitigation measures – Global climate change – its effects on environment, agriculture, disease outbreak – IPCC, Kyoto protocol, other national and international agencies on climate and current status

Unit III

Biodiversity – convention on biological diversity, patterns of diversity – genetic, species, ecosystem and guild diversity – alpha, beta and gamma diversity- diversity indices – dominance and evenness, landscape and its elements, endemism and hotspots, indicator species, key stone species, value of biodiversity, ecotourism

Unit IV

Biodiversity loss and conservation: Causes for biodiversity loss, biological invasion, IUCN categories of threaten species, red data book, Environmental Impact Assessment, Remote sensing in EIA – In situ conservation – biosphere reserves, national parks, wildlife sanctuaries, ex situ conservation – zoological and botanical gardens cryopreservation, role of traditional community in biodiversity conservation – in situ on farm conservation, sacred grooves

Unit V

Urban ecology: Demographic structure and characteristics, population explosion, urban settlements, central and extension areas, housing, transport, causes for urbanization – urban energy budget, non renewable energy resources, renewable energy resources – biomass, wind and solar energy – waste management – solid and liquid waste disposal

Text Books

1. Agarwal, K.C. 1999. Biodiversity. Agrobotanical Publishers. New Delhi.
2. Odum, E.P. 1996. Fundamentals of Ecology. Nataraj Publishers, Dehradun.

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.
8. Miller Jr, G.T. 1996. Living in the environment. IX edn.
9. Scanvic, J.Y. 1997. Aerspatial Remote sensing in Geology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
10. Stiling, P. 2004. Ecology – Theories and applications. Prentice Hall of India Pvt. Ltd., New Delhi.

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Course	: M.Sc Zoology (Lab-7)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: IV	Max. Marks	: 100
Sub. Code	: 4PZL1	Hours/Week	: 6
Paper	: Lab	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 albumin
11. Qualitative analysis of urine sugar
12. Qualitative analysis of ketone bodies
13. Qualitative analysis of bile salts
14. Qualitative analysis excretory products
15. Observation of human semen and its motility
16. Determination of sperm count

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Course	: M.Sc Zoology (Lab-8)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: IV	Max. Marks	: 100
Sub. Code	: 4PZL2	Hours/Week	: 5
Paper	: Lab	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

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Department of Zoology

(For those joined M.Sc Zoology on or after June 2011)

Course	: M.Sc Zoology (Elective paper)	Int. Marks	: 25
Class	: IIYear	Ext. Marks	: 75
Semester	: IV	Max. Marks	: 100
Sub. Code	: 4PZE1	Hours/Week	:6
Paper	: Elective Lab	No of Credits	:4
Title of the Paper : Project			

Thiagarajar College (Autonomous), Madurai-9
Department of Zoology

M.Sc., Zoology
Diploma Courses
(For those admitted in June 2011 and later)

Class	Certificate / Diploma	Code	Sem	Title of the paper	Contact Hrs/W	Valuation Scheme		
						Int	Ext	Total
M.Sc	Diploma		2	Introduction to Aquaculture	2 / W 30/ Sem	25	75	100
			3	Aquaculture Techniques	2 / W 30/ Sem	25	75	100

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Department of Zoology

(For those joined B.Sc IMB on or after June 2011)

Class	: I Year M.Sc .Zoology	Int.Marks	:25
Semester	: II	Ext. Marks	:75
Sub. Code	:	Max. Marks	:100
Hours/Week	: 2	Hrs/Sem	:30
Title of the Paper : Introduction to Aquaculture (Diploma Course)			

Course Objectives:

- To learn the history and fundamentals of Aquaculture
- To learn the importance & characteristic features of selected aquatic organisms

Unit I

History of aquaculture, importance of aquaculture, Types of culture - extensive, semi intensive, intensive, present status of aquaculture in India-

Shrimp culture, Morphology and general characteristic features, biology and economic importance of *Penaeus monodon* and *Penaeus indicus*. Fresh water prawn farming – *Machrobrachium rosenbergii*.

Unit II

History of pearl culture, Edible and pearl oyster culture, composition of pearl.

Morphology and general characteristic features, biology and economic importance of Indian major carps and *Oreochrombus mossambicus*

References

1. Biswas, S.P. 1993. Manual of Methods in Fish Biology. South Asian Publishers Pvt. Ltd., New Delhi.
2. Das and Jhingran. 1989. Fish Genetics in India. Today and Tomorrow Printers and Publishers, New Delhi. 263.
3. Govindan, T.K. 1985. Fish Processing and Technology, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Jhingran, V.J. 1991. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.
5. Pillai, T.V.R. 1995. Aquaculture Principles and Practices. Fishing New Books, Blackwell Science Ltd., Oxford.
6. Santhanam, R. 1990. Fisheries Science. Daya Publishing House, New Delhi. 174.
7. Shanmugam, K. 1990. Fishery Biology and Aquaculture. Leo Pathippagam, Chennai.

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Department of Zoology

(For those joined B.Sc IMB on or after June 2011)

Class	: II Year M.Sc .Zoology	Int.Marks	:25
Semester	: III	Ext. Marks	:75
Sub. Code	:	Max. Marks	:100
Hours/Week	: 2	Hrs/Sem	:30
Title of the Paper : Aquaculture Techniques (Diploma Course)			

Course Objectives:

- To learn the basic concepts in construction of a pond for rearing fishes
- To learn the methods for fish food preparation, disease prevention and marketing.

Unit I

Designing, construction and maintenance of ponds, Types of ponds. Water quality maintenance with reference to pH, salinity, alkalinity, dissolved oxygen, temperature, COD and BOD.

Artificial feed – Square and rectangular method of feed preparation – Live feed – Artemia, Daphnia, Tubifex and Microalgae. Energy budget.

Unit II

Harvesting methods – Handling and preservation of fishes – Processing of fishes – Fishery by products – Fish marketing and economics.

Fin and shell fish pathogens – management of fin and shell fish diseases – Probiotics

References

1. Biswas, S.P. 1993. Manual of Methods in Fish Biology. South Asian Publishers Pvt. Ltd., New Delhi.
2. Govindan, T.K. 1985. Fish Processing and Technology, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Jhingran, V.J. 1991. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi.
4. Pillai, T.V.R. 1995. Aquaculture Principles and Practices. Fishing News Books, Blackwell Science Ltd., Oxford.
5. Santhanam, R. 1990. Fisheries Science. Daya Publishing House, New Delhi. 174.
6. Shanmugam, K. 1990. Fishery Biology and Aquaculture. Leo Pathippagam, Chennai.
7. Srivastava, C.V.L. 1985. A Text Book of Fishery Science and Indian Fisheries. Kitap Mahal, Allahabad.
8. Thomas, P.C. 1998. Current and Emerging Trends in Aquaculture. Daya Publishing House, New Delhi.

Thiagarajar College (Autonomous), Madurai – 9
Re-Accredited with ‘A’ Grade by NAAC
Department of Zoology

M.Phil., Zoology
Course Structure (w.e.f. 2011 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

II Semester

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

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Zoology

(Revised Syllabus W.e.f-2011 batch)

Course	: M.Phil, Zoology	Int. Marks	: 100
Class	: I Year	Ext. Marks	: 100
Semester	: I	Max. Marks	: 100
Sub. Code	: 1MZ1		
Title of the Paper:	Research Methodology I	Hours	:120

Unit : 1

Bomb calorimeter – description of unit – operation and estimation of calorific values – Electrochemical methods – oxygen electrode – principles –types – operation and application of oxygen analyser. Microkjldhal method of estimating nitrogen content of biological samples – calculation.

Unit : II

pH meter- determination of pH –buffers – principle –operation and description of the apparatus. Dissociation constant of acids – titration of weak acid with a strong base. Colorimetry – Spectrophotometry – Beer and Lambert’s law –transmittance and absorbance. Principle and description of the apparatus – applications. Atomic Absorbance Spectrometry, Flame photometry – Principle - description– applications.

Unit : III

Chromatography – paper, column, thin layer, gas, liquid and ion exchange chromatography –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, phase contrast, fluorescent , interference and polarization microscopy – 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. DMRT. Reference work and preparation of dissertation – source – index card – details of popular magazine and periodicals – preparation of research paper –thesis – proof reading – bibliography.

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, A n 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. Williams, B.L. and Wilson , K. 1983. A Biologist Guide to Principles And Techniques of Practical Biochemistry, Edward Arnold Publishers Ltd. London .
7. Wilson, K. And Walker, J. 1995. Principle And Techniques of Practical Biochemistry IV th edn. Cambridge University Press, Cambridge.
8. Sawhney, S.K . and Randhir S. 2006. Indroduction to Practical Biochemistry, II nd edn. .. Narosa Publishing House Pvt. Ltd New Delhi.

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Department of Zoology

(Revised Syllabus W.e.f-2011 batch)

Course	: M.Phil, Zoology	Int. Marks	: 100
Class	: I Year	Ext. Marks	: 100
Semester	: I	Max. Marks	: 100
Sub. Code	: 1MZ2		
Title of the Paper:	Applied Entomology	Hours	: 120

Unit: I

An outline classification 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-Newer methods of pest control

Unit: V

Insecticides classification of Insecticides

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

Classification based on mode of nature

Plant production appliances:

Dusting and dusters-Aerosols-Spraying and sprayers- Vaporisers

Reference books :

1. Ananthkrishnan, T.A. 1982. Recent advances in Entomology in India.
2. S. Viswanathan Publishers.
3. Busvine, J.R. 1980. Insect and Hygiene. III edition, Chapman & Hall, New York.
4. Chapman, R.F. and Joern, A.1990.(eds.). Biology of Grasshoppers. John Wiley & Sons, New York.
5. Chapman, R.F. 1982. The insect: Structure and Function. ELBS.
6. David, B.D. and Kumarasamy, T.1982. Elements of Economic Entomology. Popular Book Depot, Madras.
7. Kerkut, G.A. and Gilbert, L.I. 1985.(eds.). Comprehensive Insect Physiology, Biochemistry and Pharmacology. Pergamon, Oxford.
8. Mani, M.S. 1982. General Entomology. Oxford and IBH Publishing, New Delhi.
9. Nayar, K.K. , Ananthkrishnan, T.N. and David, B.V. 1976. General and Applied Entomology. Tata McGraw Hill Publishing Co.
10. Pedigo, L.P. 1996. Entomology and Pest Management. Prentice Hall of India, New Delhi.
11. Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj, K. 1997. A guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore, India.
12. Richards, O.W. and Davies, R.G. 1977. Imm's General Text Book of Entomology. X edition. Chapman & Hall, London.
13. Wiggiesworth, V.B. 1972. The Principles of Insect Physiology. Chapman & Hall, New York.

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(Revised Syllabus W.e.f-2011 batch)

Course	: M.Phil, Zoology	Int. Marks	: 100
Class	: I Year	Ext. Marks	: 100
Semester	: II	Max. Marks	: 100
Sub. Code	: 2MZ1		
Title of the Paper:	Research Methodology - 2	Hours	:120

Course Objectives:

- To understand the structure and functions of biomolecules

Unit : 1

Cell size determination, Chromosomal staining (gram, fluorescence, giemsa)
Chromosomal preparation From bone marrow and testicular tissue karyotyping .
In situ hybridation, FISH, GISH.
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–PEGmediated, 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 with and without Hybridoma technique. 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. Hans.peter – Schmauder .2003. Methods in Biotechnology. Taylor &Francis. London.
2. Janarthanan , S and S.Vincent. 2007. Practical Biotechnology: Methods and Protocols. Universities press (India) Private Limited. Hyderabad.
3. Kalaiselvan P.T. 2005. Microbiology and biotechnology- A Laboratory Manual . MJP Publishers, Chennai.
4. Myers, R.L.1989. Immunology, a Laboratory manual, Wm. C.Brown Publishers, Dubuque, Iowa.
5. Rastogi, S.C.1996.Immunodiagnosics . Principle and Practice, New Age International Pvt. Ltd. New Delhi.
6. Sambrook, j. Fritsch, E.F. and Maniatis, T. 1989. Molecular Cloning-1,2,3 –A Laboratory Manual II edn. Cold Spring Laboratory Press, USA.
7. 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.
8. Talwer, G.P. 1983. A Handbook of Practical Immunology, Vikas Publishing House Pvt.Ltd. New Delhi.
9. Talwer, G.P and Gupta, S.K. 1992. A Handbook of Practical and Clinical Immunology, Vol. I-II, Publishers and Distributors, Delhi.
10. Attwood, T.K. and Parry, D.J – Smith, D.J. 2002. Introduction to Bioinformatics. Pearson Education (Singapore) Ptc. Ltd..
11. Baxevanis, A.D. and Quellette, B.F.F. 2001. Bioinformatics. A practical guide to the analysis of genes and proteins. II edn. Wiley-Intern Science Publication, New York.
12. Mount, W. 2001. Bioinformatics sequence and genome analysis. Cold Spring harbour Laboratory Press, New York
13. Pevsner 2003. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi
14. Lesk, M.A. 2002. Introduction to Bioinformatics. Oxford Univ. Publishers.

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology

(For those joined M.Phil Zoology on or after June 2011)

Course	: M.Phil, Zoology	Int. Marks	: 100
Class	: I Year	Ext. Marks	: 100
Semester	: II	Max. Marks	: 200
Sub. Code	:		
Title of the Paper	: Project		

Thiagarajar College (Autonomous), Madurai – 9
Re-Accredited with 'A' Grade by NAAC
Department of Microbiology
M. Sc., Microbiology Course Structure (w.e.f. 2011 batch onwards)
I semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core	S1PY1	Microbial Biochemistry and Physiology	6	5	90	25	75	100
Core	S1PY2	Microbial Diversity and Taxonomy	6	5	90	25	75	100
Lab	S1PYL1	Lab in Microbial Biochemistry and Physiology	6	4	90	40	60	100
Lab	S1PYL2	Lab in General Microbiology, Microbial Diversity and Taxonomy	6	4	90	40	60	100
Elective	S1PYE	General Microbiology / Microbial ecology	6	5	90	25	75	100
Total			30	23				

II Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core	S2PY1	Immunobiology	6	5	90	25	75	100
Core	S2PY2	Microbial Genetics	6	5	90	25	75	100
Core Lab	S2PYL1	Lab in Immunobiology	6	4	90	40	60	100
Core Lab	S2PYL2	Lab in Mol. Biology and Microbial Genetics	6	4	90	40	60	100
Elect	S2PYE	Molecular Biology / Bioinformatics	6	5	90	25	75	100
Total			30	23				

III Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core	S3PY1	Medical Microbiology	6	5	90	25	75	100
Core	S3PY2	Genetic Engineering	6	5	90	25	75	100
Core Lab	S3PYL1	Lab in Medical Microbiology	6	4	90	40	60	100
Core Lab	S3PYL2	Lab in Genetic Engineering	6	4	90	40	60	100
NMElect	S3PYE	Analytical Microbial Technology / Biostatistics	6	4	90	25	75	100
Total			30	22				

IV Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core	S4PY1	Bioprocess Technology	6	5	90	25	75	100
Core	S4PY2	Food, Agriculture and Environmental Microbiology	6	5	90	25	75	100
Core Lab	S4PYL1	Lab in Bioprocess Technology	6	4	90	40	60	100
Core Lab	S4PYL2	Lab in Food, Agriculture and Environmental Microbiology	6	4	90	40	60	100
Elect	S4PYE	Project	6	4	90	40	60	100
Total			30	22				

Proforma-3

Thiagarajar College (Autonomous), Madurai – 9
Re-Accredited with ‘A’ Grade by NAAC
Department of Microbiology
M. Sc., Microbiology

C) Consolidation of Contact Hours and Credits : PG

Semester	Contact Hrs / Week	Credits
I	30	23
II	30	23
III	30	22
IV	30	22
Total	120	90

D) Curriculum Credits

Core	-- 80Credits
Major Elective	-- 20 Credits
Total	90 Credits

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	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
- To study the physiological mechanisms within microorganisms

Unit I

Carbohydrates: Classification - structure and properties of monosaccharides and disaccharides. Properties of polysaccharides - starch, cellulose, agar- agar and peptidoglycan.

Metabolism and its regulation: Gluconeogenesis, glycolysis, kreb's cycle, pentose phosphate pathway or 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 over all 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, 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: Types. Vitamins as co - factors and co - enzymes.

Unit III

Growth of Bacteria: Phases of growth, growth kinetics - batch culture, continuous culture 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 hydroxyl propionate cycle. Nitrogen metabolism: Nitrogen cycle - ammonification, nitrification, denitrification, nitrogen fixation, nitrogenase enzyme, 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.

Reference Books:

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

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	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. Current thoughts on microbial evolution including the origin of life. 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 (artic and antartic regions), hyperthermophiles – terrestrial, volcanic habitats – sulfobales 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 Jerry.
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. Schlegal, H.G. 1995. General Microbiology, Seventh edition, Cambridge Univeristy 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.

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	Hours/Week	: 6
Title of the Paper: Lab in Microbial Biochemistry and Physiology			

1. pH metry.
 - i) Preparation of buffer
 - ii) Titration curve of glycine aminoacid - pK_A value – estimation.
2. UV visible spectrophotometry.
 - Wavelength scan.
 - Time scan.
3. 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 (Demonstration).
 - HPLC (Demonstration).
4. Carbohydrates:
 - Qualitative analysis of carbohydrate (mono, di and polysaccharides).
 - Quantitative estimation of glucose and glycogen from bacterial and yeast cell.
5. Proteins:
 - Qualitative analysis of proteins.
 - Quantitative estimation of protein from bacterial and yeast cell.
 - Protein confirmation changes – Effect of pH and temperature.
6. Enzymes:
 - Estimation of alkaline phosphatase activity.
 - Derivation of Michaelis – Menten constant, V_{max} of alkaline phosphatase.
 - Inhibitor of alkaline phosphatase
 - Determining the activity of enzyme saccharase in yeast.
7. Centrifugation - density gradient centrifugation – sucrose gradient (Demonstration).
8. FTIR spectroscopy (Demonstration).
9. Environmental factor:
 - Effect of temperature on bacterial growth.
 - Effect of pH on bacterial growth.
10. Physiological groupings of bacteria.
 - Isolation of saccharophilic microorganisms (starch hydrolysis).
 - Proteolytic activity of microorganisms (casein and gelatin hydrolysis).
 - Lipolytic activity of microorganisms.
11. Utilization of Unusual compounds:
 - Microbial degradation of azodyes
 - Measurement of cellulase activity
12. Extraction and estimation of photosynthetic pigments.
 - Investigation of Hill reaction.
13. Bioenergetics.
 - Cytochrome oxidase assay.
 - Catalase assay.
14. Nitrogen metabolism.
 - Nitrate reduction test.
 - Uptake of nitrate, nitrite and ammonia by microorganisms.
 - Acetylene reduction assay (Demonstration).

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. 1992. Microbiology – A Lab Manual, Third Edition, The Benjamin Publishing Company, Singapore.
3. David T. Plummer, 1992. 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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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	Hours/Week	: 6
Title of the Paper: Lab in General Microbiology, Microbial Diversity & Taxonomy			

1. Principle and methods of sterilization
2. Preparation of media: nutrient broth, nutrient agar plates, soft agar.
3. Pure culture techniques: streak plate, spread plate and pour plate.
4. Motility determination – Hanging drop method.
5. Isolation and enumeration of bacteria from different environmental samples.
6. Enumeration of bacterial / yeast - viable count (plate count), total count (Hemocytometer count)
7. Direct microscopic observation of fungal spores, mycelium and yeast budding.
8. Staining method: simple, negative, Gram's staining and spore staining.
9. Identification of microbes by biochemical tests.
10. Fungal slide culture.
11. Measurement of growth rate and generation time – direct hemocytometer count, viable count and turbidometry.
12. 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. Besitir, L. 1996. Microbiology in Practice, Sixth Edition, Adeland Wesley, Langman New York.
5. Cappuccino, J.H. and Sherman, N. 1992. Microbiology – A Lab Manual, Third Edition, The Benjamin Publishing Company, Singapore.
6. Gunasekaran, P. 1995. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
7. James, G.C. and Sharma, N. 1996. Microbiology: A Lab Manual, Fourth Edition, The Benjamin/Cumming Publishing Company, USA.
8. Kannan, N. 1996. Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
9. Reddy, S.W. and Reddy, R.S. 2000. Microbiology: A Laboratory Manual, BSC Publishers & Distributors, New Delhi.

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Elective	Hours/Week	: 6
Title of the Paper: General Microbiology			

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

Historical perspective of Microbiology: Bacterial taxonomy - classification and nomenclature - nutritional, biochemical, serological and chemotaxonomy. Molecular taxonomy – 16S r-DNA / r - RNA based sequence analysis, ribotyping similarity and dissimilarity index. Numerical taxonomy.

Unit II

Types and principles of different types of microscopes - compound, darkfield, phase contrast, fluorescence and electron (scanning and transmission). Ultra structure of prokaryotic cells: cell membrane, cell wall, capsules, slime layer, flagella, pili, fimbriae, L-forms, protoplast, spheroplast. Bacterial cysts and spores.

Unit III

Outline classification of viruses. Structure and lifecycle of viruses: bacterial viruses - T4, lambda and M13), animal viruses - pox, influenza and adeno, plant viruses – TMV and CMV, insect viruses - baculovirus. Mycophages and cyanophages.

Unit IV

Outline classification of fungi - characteristics of fungal classes (Alexopoulos, Mims and Blackwell). Distribution, importance, structure, nutrition and reproduction of fungi: Acrasiomycetes (*Dictyostelium*), Myxomycetes (*Physarum*), Oomycetes (*Saprolegina*), Zygomycetes (*Rhizopus* and *Mucor*), Ascomycetes (*Saccharomyces*, *Aspergillus* and *Penicillium*), Basidiomycetes (*Agaricus*), Deuteromycetes (*Fusarium*).

Unit V

Outline classification of algae (Chapman and Chapman). Distribution, importance, structure, characterization, nutrition and reproduction of Chlorophyta (*Chlamydomonas* and *Spirogyra*), Chrysophyta (*Chrysamoeba*), Pheophyta (*Sargassum*), Rhodophyta (*Gellidium*) and Pyrrhophyta (*Noctiluca*).

Lichens – structure and types.

Reference Books:

1. Alcamo, I.E. 1999. Fundamentals of Microbiology, Sixth Edition, Addison Wesley Longman, Inc. California.
2. Alexopoulos, E.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology, Fourth 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., Duclco, 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, New Delhi.
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. 2000. Twelfth Edition, Biology Microorganisms, Prentice Hall, New Jersey.
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.

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Elective	Hours/Week	: 6
Title of the Paper: Microbial Ecology (Optional paper for General Microbiology)			

Course Objectives:

- To focus on the structure, function of microbial communities and current methods in microbial ecology
- Underlying the principles that drive microbial population structure
- To understand the physiology and ecology of microbial communities

Unit I

History and scope of microbial ecology. Population ecology: properties of population – density, natality and fecundity, mortality, longevity and senescence, immigration and emigration. Microbial population ecology – population growth, density dependence and independence, r and k selection. Species concept – universal, biological, phenetical, evolutionary and phylogenetic. Speciation – bacterial, mismatch repair as a speciation mechanism, rapid speciation, operons, genome economization and speciation, hypermutation, genome reduction.

Unit II

Ecology of individuals – study of individual microorganism, genetic individuals, ramets ecological individual, niche; abiotic constraints (temperature, pH, nutrient source, electron acceptor, redox, pressure and light), metapopulation, dispersal, modularity, source and sinks, population ecology of genes. Source of phenotypic and genotypic, variation, gene ecology.

Unit III

Population and spatial stability: Uniformity of populations, adaptation, population in time. Bacterial communication : Quorum sensing – evolutionary implication of quorum sensing, cell – cell communication in bacteria, quorum sensing and evolution, disruption or manipulation of quorum sensing response, evaesdropping by bacteria, oligotrophic state of nature, starvation survival, ageing, senescence and death, dormancy or resting state and miniaturization.

Unit IV

Species interaction and processes: Species interaction, proliferation hypothesis. Negative relationship – parasitism, predation, bacteria and viral interaction, microbial loop and bacteria as predators. Neutral relationship, positive relationship – metabiosis and symbiosis. Biogeochemical cycle (carbon and sulphur).

Unit V

Community ecology: Water communities - hydrosphere ecology of fresh water, composition and activity of fresh water microbial communities, physical and chemical factors, estuaries and marine water environment; characteristics and stratification of the ocean, composition and activity of marine microbial communities, role of microbes in the aquatic environment and lithosphere. Soil communities - introduction to soil formation, rock and minerals, soil horizon, soil texture, organic matter, chemical properties of soil, soil microbial communities. Biofilm communities, phylogenetics and community ecology.

Reference Books:

3. Atlas, R.A. and Bartha, R. 2000. Microbial Ecology, Fundamentals and Application, Benjamin Cummings, New York.
4. J Vaun Mc Arthur, 2009. Microbial Ecology – An Evolutionary approach, Elsevier publications, Academic press.
5. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2000. Twelfth Edition, Biology Microorganisms, Prentice Hall, New Jerry.
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. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New York.
8. Saha, T.K. 2010. Ecology and Environmental Biology, Books and Allied Pvt. Ltd. Kolkata.
9. Tortora G.J., Funke, B.R. and Case, C.L. 2009. Microbiology, Ninth Edition, Dorling Kindersely (India) Pvt. Ltd., Noida.

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(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	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.

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. Lymphocyte activation – activation of CD4 and CD8 cells, B cells, T and B interaction, super antigen, T independent B cell activation. Macrophage activation. 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 - idio type network and autoimmune diseases. Mechanism of immune regulation – tolerance.

Unit IV

Immunity to infectious diseases – bacterial, viral, protozoan and parasitic diseases. 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, flow cytometry and immunofluorescence techniques.

Reference Books:

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

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	Hours/Week	: 6
Title of the Paper : Microbial Genetics			

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 and mutagenic agents. Detection of mutagen - ames test, in *vitro* mutagenesis. Molecular basis of mutation.

Unit II

DNA damage & repair: DNA damages, hit theory, UV radiation. DNA repair: post irradiation effects on survival levels - photo reactivation, liquid holding recovery.

Biochemical repair mechanism: excision, recombination and SOS repair.

Unit III

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

Unit IV

Plasmids: Types of plasmids - F, R & Col plasmids. Properties of plasmids – sex factors, drug resistant, colicinogenic, 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 and recombination: Transformation: Discovery - Griffith experiment, Avery *et al* experiment. Detection: standard plating test, 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 - homologous or general, site specific and random recombination, general recombination between homologous DNA- Holliday model, double strand model of general recombination, enzymes involved in recombination rec - proteins.

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. Lewin B. 2000. Gene VII, Oxford University Press Oxford.
6. Malacinski, G.M. and Freifelder, D. 1998. Essentials of Molecular Biology, Third Edition, Jones and Bartleft publishers, Boston.
7. Stanley R. Maloy, John E.C. and Freifelder, D.2008. Microbial Genetics, Narosa Publishing House, New Delhi.
8. Stryer, L. 1981.Biochemistry, Second Edition, W.H.Teeman and company, Sanfransisco.

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	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, Radial and Countercurrent)
10. Complement mediated haemolysis.

IV. Precipitin Techniques.

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

V. Agglutination Techniques.

13. Haemagglutination (or) Haemolysin titration assay.
14. Direct agglutination to determine ABO blood grouping.

VI. Visualisation and study of lymphoid organs from mice and chicken (model).

VII. Isolation of immune cells and enumeration.

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

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	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 spectrophotometer analysis.
 - b) Analysis of nucleic acids by agarose gel electrophoresis.
 - d) T_m 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. 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

17. One step growth curve.
18. Isolation of phage from septic tank.
19. Determination of P1 phage titre.
20. P1 phage lysate preparation.
21. 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. 1992. 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. 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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(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Elective	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.

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 and 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 1V

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, aminoacid activation, shine dalgarno sequences, initiation site. Elongation - elongation factors and translocation. Termination - termination factors, terminal codons. Role of rRNA in protein synthesis. 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. Benjamin Lewin, 2000. Genes VIII, Oxford University Press, New York.
2. David Freifelder. D. 2008. Microbial Genetics, Eighteenth Edition, Narosa Publishing House, NewDelhi.
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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(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	Hours/Week	: 6

Title of the Paper: **Bioinformatics**

(Optional paper for Molecular Biology)

Course Objectives:

- To have basic knowledge on bioinformatics tools
- To become familiar with structure prediction methods

Unit I

Introduction – Bioinformatics and databases – sequence, structure & domain – application and scope. Useful bioinformatics sites – gene and protein expression data – protein interaction data.

Unit II

Biological tools: Nucleotide sequence databases – protein expression databases – specialized sequence data bases. Data retrieval and analysis – sequence retrieval system.

Unit III

Sequence alignment: Types - local and global alignment. Alignment methods – dot plot / dot matrix - sequence similarity searches – statistical significance, amino acid substitution matrices, and data base searches: FASTA and BLAST, similarity searching scores and their interpretation.

Unit IV

Multiple sequence alignment – methods and softwares – CIUSTAL - W, databases for multiple alignment – phylogenetic tree analysis, role of phylogenetic analysis in evolutionary biology.

Unit V

Genomics – structural, comparative and functional genomics – gene expression analysis – micro array technology and its application. Proteomics – ESTs, protein visualization tool, modeling and computer aided drug designing.

Reference Books:

1. Arthur, M. Lesk, 2004. Introduction to Bioinformatics, Oxford University Press.
2. Attwood, T.K. and Parry – smith, 2001. Introduction to Bioinformatics, First Edition, Pearson Education Asia, New Delhi.
3. Baxevanis, A.D. and Ouellette, B.F.F. 2001. Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins, Wiley – Interscience Publication, New York.
4. Gibas, C. and Jambeck, P. 2001. An Introduction to Software tools for Biological Applications: Developing Bioinformatics Computer Skills, Shroff Publishers & Distributors Pvt. Ltd., Mumbai.
5. Mount, W. 2001. Bioinformatics sequence and genome analysis, Cold Spring harbour Laboratory Press, New York.
6. Pevsner, V.2003. Bioinformatics and Functional Genomics, Wiley Dreamtech India Ltd, New Delhi.
7. Rashidi, H.H. and Buehler, L.K. 2000. Bioinformation Basics: Applications in Biological Science and Medicine, CRC Press, USA.
8. Taxali, R.K. 1991. dBase III Plus – Made Simple, Tata Mc Graw – Hill publishing company Ltd, New Delhi.
9. Taxali, R.K. 2000. PC Software for Windows – Made Simple, Tata Mc Graw – Hill publishing company Ltd, New Delhi.

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	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 – safety in containment laboratory. Collection and transport of clinical samples. Microbiological examination of urine, blood, faeces, cerebrospinal fluid, throat swabs, sputum, pus and wound exudates. 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 and 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 and control measures of : Gram negative nonspore forming bacilli: Aerobic (*Bordetella*), small gram negative facultatively anaerobic bacteria – *Yersinia*, Enteric gram negative bacilli – *Vibrio*, 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 and control measures of : 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 – *Entamoeba histolytica* and *Ascaris lumbricoides*. Parasitic zoonoses – *Toxoplasma* and *Taenia*.

Unit V

Morphology, pathogenesis and 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 Metraindazole). Emerging and reemerging infections (Chikungunya, SARS - CoV, Q-fever). 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. 1996. 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 & Now Publishers, 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 Bennett's Principles and Practice of infectious diseases, 2000 vol. 1 & 2 Churchill Livingstone.
9. Rajan, S. 2007. Medical Microbiology, MJP Publishers, Chennai.

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(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	Hours/Week	: 6
Title of the Paper : Genetic Engineering			

Course Objectives:

- To expose the principles behind the genetic engineering
- To reveal various methods of gene manipulation
- To present an in-depth knowledge of recombinant DNA technology as the foundation of modern biotechnology

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 - p^{BR}322 and p^{UC}18, 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 and 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 – identification of types – Tn3, Tn5, Tn10. IS elements in maize and yeast. Mechanism of transposition – conservative and replicative.

Unit IV

Cloning of human insulin, interferon, somatostatin in *E.coli*. Recombinant vaccine development - HBs Ag in yeast. Immunotoxin of *Pseudomonas* to HIV. Cloning for commercial production of antibiotics (Penicillin). Biosteroid transformation.

Production of biopolymers - Xanthum gum. Melanin biosynthesis in *E.coli*, adhesive biopolymer in yeast.

Unit V

Gene silencing and antisense technology: Types and mechanism of gene silencing. Genetic factors of silencing, formation of antisense mRNA, inhibition of gene expression by antisense RNA. Gene silencing in crop plants: tomato and rice. Si RNA and disease control. Plant genetic engineering: Ti plasmid, CaMV vector, Direct DNA delivery methods – microprojectile bombardment, microinjection and electroporation. Gene therapy

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. 2000. Gene Cloning, Fourth 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. Lewin B. 2000. Genes VII, Oxford University Press, Oxford, UK.
8. Old R.W. and Primrose, S.B.1996. Principles of Gene Manipulations, Blackwell Science Publications, London.
9. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, Seventh Edition, Blackwell publishing, UK.
10. Sandhya Mitra, 1996. Genetic Engineering, Mac Millan India Ltd., New Delhi.
11. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
12. Symonds, N., Toussaint, A., Van De Putte, P. and Howe, M.M. 1987. Phage Mu. Cold Spring Harbor Laboratory.
13. Talwar, G.P., Rao, K.V.S. and Chauhan, V.S. 1994. Recombinant and Synthetic Vaccines, Narosa Publishing House, New Delhi.
14. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
15. 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.
16. Winnaker, E.L. 1987. From Gene to Clone: Introduction to Gene Technology, VCH Publications, Weinbeim Federal Republic German.
17. Young, M.M. 1992. Plant Biotechnology, Pergmen Press, Oxford London.

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(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	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*, *Clostridium*
 - ii) Capsule stain – positive stain – Hiss method; Negative stain Indian ink / Method of Maneval / Nigrosine staining.
Organism – *Bacillus*, *Pneumococcus* sp., *Enterobacter*, *Escherichia coli*.
 - C. Stain for Amoeba / Intestinal protozoa / Malarial parasites – Iron haematoxylin stain, 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, MBC.
10. Antimicrobial susceptibility test against yeast and other 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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(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	Hours/Week	: 6
Title of the Paper: Lab in Genetic Engineering			

1. Isolation of p^{BR} 322/ pbluescript by alkaline detergent method - A miniprep procedure
2. Agarose gel electrophoresis of undigested plasmid DNA
3. Recovery of DNA from gels.
4. Determination of fragment order of plasmid by single and double restriction digestion.
5. Acrylamide gel electrophoresis and silver staining of digested plasmid.
6. Cloning of DNA fragment in p^{BR}322 / pbluescript – insertion inactivation/ blue white selection.
7. Western blotting)
8. Transposition – Lamda :: Tn5 phage
9. Tn10 amber phages and demonstration of Transposition in suppressor free *E.coli*
10. Isolation of DNA from animal tissues.
11. PCR – RAPD (Demonstration)

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. 1989. Molecular Cloning – A lab manual. Vol. III – Second Edition CSH Press, Cold spring harbor.

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(For those joined M.Sc Microbiology on or after June 2011)

Course	: M.Sc Microbiology (Elective Paper-3)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: S3PYE	No. of credits	: 4
Paper	: Elective	Hours/Week	: 6
Title of the Paper: Analytical Microbial Technology			

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, *Clostridium perfringens*, yeast, mould and sulphide reducing anaerobes, viruses and bacteriophages, fungi and yeasts, protozoa and helminths. Methods of mineral water quality assessment – MPN test, membrane filtration technique.

Unit II

Preservation of pharmaceutical Products: Chemical preservatives – raw materials – equipment – 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 parenterals manufacture – pyrogen test – depyrogenation methods.

Unit IV

Rapid methods for detection of microorganisms in food – conventional and automated. Application of light pulse technology – principles of light pulse generation, mode of action, equipments, application of light pulses, effect of light pulses on foods and microorganisms, advantage and limitation of light pulse treatment. Quality control in fruits and vegetable processing. Risk assessment in food industry – physical, chemical and biological hazards.

Unit V

Assessment of microbial quality of marine foods: Conventional and recent development methods – flow cytometry, ATP estimation, radiometric, reflective colorimetry, LAL test, immunoassay, DNA based and microarray methods. Application of additives in food. Food safety and standard act for adulteration. Significance of barcode and its uses in food industry.

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. Endotoxins – Pyrogens, LAL Testing and Depyrogenation : III Edition by Kevin Williams (2007; Informa Press)
4. Journal of Beverage & Food World – August, 2008, Vol. 35, No. 8.
5. Journal of Beverage & Food World – December 2003, Vol. 30 No. 12.
6. Journal of Beverage & Food World – February 2008, Vol. 35, No.2.
7. Journal of Beverage & Food World – March, 2008, Vol. 35, No. 3.
8. Journal of Beverage & Food World – May 2006, Vol.33 No.5.
9. Journal of Beverage & Food World – November 2007, Vol. 34, No. 11.
10. Journal of Beverage & Food World – November, 2008, Vol.35, No. 11.
11. Manivasakam, N. 2001. Chemical and Microbial analysis of mineral and packaged drinking waters. Sakthi Book Service, Coimbatore.
12. Microbial Contamination Control in Parenteral Manufacturing by Kevin L. Williams
13. Microbial limit and Bioburden tests (Validation Approached and Global Requirements) by Lucia Clontz (Interpharm Press)
14. Microbiology in Pharmaceutical Manufacturing – II edition – Richard Prince.
15. The United States Pharmacopoeia (USP 32) NF 27 – Volume 1 (General Chapters)
16. 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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(For those joined M.Sc Microbiology on or after June 2011)

Course	: M.Sc Microbiology (Elective Paper- 3)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: S3PYE	No. of credits	: 4
Paper	: Non Major Elective	Hours/week	: 6
Title of the Paper: Biostatistics (Optional for Analytical Microbial Technology)			

Course Objectives:

- To enable them to collect, organize and analyze data
- To create knowledge of applying different statistical methods and packages in biological sciences

Unit I

Samples and population, variables in Biology. Sampling methods – probability and non probability methods. Data collection – primary and secondary data. Frequency distribution. Graphic representation of data - histogram, frequency polygon, frequency curve and ogives.

Unit II

Measures of central tendency – mean, median and mode. Measures of dispersion – range, mean deviation, standard deviation, variance. Probability – addition and multiplication rules – Bayes theorem. Probability distribution – binomial, poisson and normal. Student “t” distribution. Point estimation and interval estimation.

Unit III

Estimating the population mean; σ known and unknown. Wilcoxon signed Rank test. Null and alternate hypothesis. Two tailed and one tailed test. Chi – square test – test of independence, goodness of fit and homogeneity. Statistics related to epidemiology.

Unit IV

Correlation – definition, types and measurements of correlation. Regression analysis – equation, estimation of unknown value from known value.

Unit V

ANOVA – one way and two way classification – least significance difference (LSD).

Randomization – different ways of randomization – randomized blocks – latin squares. Randomized blocks versus latin square. Statistical packages – SPSS

Reference Books:

1. Bhaskararao, T. 2001. Methods of Biostatistics. Paras Publications, Hyderabad.
2. Gupta, S.P. 1987. Statistical Methods (Sulton Chand and Sons Publishers, New Delhi).
3. Khan, I. A. and Khanum A. 1994. Fundamentals of Biostatistics, Ukaaz Publication, New Delhi.
4. Reza Hoshmand, A. 1998. Statistical Methods for Agricultural Sciences, Timber Press, Oregon.
5. Scheffler W.C. 1980. Statistics for the Biological Sciences, Addison – Wesley Publishing Company, New York.
6. Sokal, R.R and Rohlf, F.J. 1987. Introduction to Biostatistics, W.H.Freeman and Company, New York.
7. Zar, J.H. 1996. Biostatistical Analysis, Prentice – Hall International, USA.

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(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	Hours/Week	: 6
Title of the Paper : Bioprocess Technology			

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

An introduction to fermentation process. Screening of industrial microbes – Detection and assay of fermentation products. Classification of fermentation types. Genetic control of fermentation. Strain selection and improvement, mutation - protoplast fusion, parasexual reproduction and recombinant DNA technique for strain development. Preservation of cultures after strain improvement programme.

Unit II

Types and design of bioreactors, packed / fluidized, fed, transport phenomena – mass transfer, newtonian and non - newtonian behavior of fluid – mass transfer coefficient, oxygen, viscosity, heat transfer and scale up. Mode of operation. Instrumentation and computer application in fermentation.

Unit III

Fermentation kinetics - yield factors - growth rate parameters- kinetics of growth and product formation in batch, chemostat and fed batch culture. Inoculum development, media formulation, optimization methods, media sterilization, statistical design for media formulation, optimization, contour Plot. Immobilization of cells and enzymes - methods and applications.

Unit IV

Fermentation of microbial Products – SCP. Anaerobic fermentation (beer, wine, industrial alcohol, lactic acid and glycerol). Aerobic fermentation (vinegar, citric acid, amino acid (Lysine, glutamic acid). Antibiotic fermentation (penicillin, streptomycin). Vitamins (B12, riboflavin), Hormone (gibberellic acid, IAA). Enzyme (amylase, protease). Biogas production.

Unit V

Downstream processing – cell disruption – physical and chemical methods. Precipitation, filtration-batch and continuous filters. Centrifugation - types, liquid-liquid extraction, chromatography, membrane process, drying, crystallization.

Quality control and evaluation of industrial products, packaging. Fermentation economics - market potential, process cost, recovery cost.

Reference Books:

1. Atlas, R.M. 1997. Principles of Microbiology, Second Edition, WCB/McGraw Hill Co., USA.
2. Casida, J.F. 2010. Industrial Microbiology, New Age International India Pvt. Ltd., New Delhi.
3. Crueger, W. and Crueger, A. 2000. Biotechnology: A Test 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. 1985. (Reprint, 1996), Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.
8. Pepler, H., and Pearman, D. 1979. Microbial Technology, 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. 1995 (Reprint 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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(For those joined M.Sc Microbiology on or after June 2011)

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
- To understand the relationship between and role of microorganisms in natural communities

Unit I

Production of fermented dairy products: Cheese, yoghurt, butter milk, sour cream
Fermented vegetables; Sauerkraut, pickles, olives and soy sauce. Fermented meat,
Fermented Indian foods - leavening of bread. 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 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 – *Pyricularia oryzae* (Blast
disease of Paddy) 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 characteristics, mass cultivation, carrier based inoculants, and quality control of *Rhizobium*, *Frankia*, *Azospirillum*, *Azotobacter*, *Cyanobacteria (Nostoc and Anabeana)*, *Phosphobacterium* and Mycorrhizae

Biopesticides: Bacterial pesticides: *Bacillus thuringiensis*, *Bacillus popilliae*, *Pseudomonas*. Viral Pesticides: Nuclear Polyhedrosis virus. Mycopesticides: - *Beaveria bassiana*.

Unit V

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 (Uranium and copper). Microbial deterioration - paper, leather, wood and paints.

Reference Books:

1. Adams, M.R. and Moss, M.O. 1996. 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. 1988. Food Microbiology (Reprint 1995), 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. Blalckie 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. 1995. Soil Microorganisms and Plant Growth, Third Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

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(For those joined M.Sc Microbiology on or after June 2011)

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 credit	: 4
Paper	: Core	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. Production and assay of sucrase from microbes.
8. Production and assay of gluconic acid from microbes.
9. Production and assay of glutamic acid from microbes.
10. Production and assay of pectinase acid from microbes.
11. Screening, production and assay of citric acid from microbes.
12. Enzyme Immobilization in sodium alginate gel.
13. Cell immobilization in calcium alginate gel.
14. Screening of antibiotic producing microbes.
15. Production and estimation of proline.
16. Production and estimation of alcohol.
17. Production and quantitative analysis of beer and wine.
18. Enzyme purification by acetone precipitation.
19. Estimation of biomass and substrate concentration in fermentation, determination of kinetic parameters (Yield, Productivity).
20. Preservation of industrially important bacteria by lyophilization.
21. Product concentration by vacuum concentrator.
22. Cell disruption for endoenzymes by sonication.

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.

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Department of Zoology

(For those joined M.Sc Microbiology on or after June 2011)

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
Paper	: Core	Hours/Week	: 6
Title of the Paper:	Lab in Food, Agriculture & Environmental Microbiology	Hours	: 90

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 Mycorrhizae from plant root
17. Isolation & enumeration of *Azospirillum* – an associative symbiotic nitrogen fixing bacteria.
18. Isolation & enumeration of *Azotobacter* – non symbiotic nitrogen fixing bacteria.
19. Isolation of Phosphate solubilizing Microorganisms from soil.
20. Mechanism of phosphate solubilization
 - i) Organic phosphate
 - ii) Inorganic phosphate
 - iii) pH variations
 - iv) Analysis of organic acids during solubilization
21. Production and estimation of Indole Acetic acid
22. Vermicomposting.
23. Development of Winogradsky column.
24. Physical, Chemical, Microbial assessment of water – Acidity, Alkalinity, BOD, COD.
25. Degradation of Phenol – Colorimetric Method.
26. 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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(For those joined M.Sc Microbiology on or after June 2011)

Course	: M.Sc Microbiology (Elective Paper- 4)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: IV	Max. Marks	: 100
Sub. Code	: S4PYE	No. of credits	: 4
Paper	: Core	Hours/Week	: 6
Title of the Paper:	Project Work	Hours	: 90

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M.Sc., Microbiology
Diploma Course
(For those admitted in June 2011 and later)

Class	Certificate / Diploma	Code	Sem	Title of the paper	Contact Hrs/W	Valuation Scheme		
						Int	Ext	Total
M.Sc	Diploma		2	Food Processing Technology	2 / W 20/ Sem	25	75	100
			3	Techniques in Food Processing	2 / W 20/ Sem	25	75	100

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(For those joined M.Sc Microbiology on or after June 2011)

Class : I Year M.Sc Microbiology
Semester : II
Sub. Code :
Hours/Week : 2 Hours/Sem : 30

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 dhall mix, preparation of yoghurt, quality analysis, product yield, chemical constituents, organoleptic qualities. Chickpea processed product – Fried Dhall, 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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(For those joined M.Sc Microbiology on or after June 2011)

Class : II Year M.Sc Microbiology

Int. Marks : 25

Semester : III

Ext. Marks : 75

Sub. Code :

Max. Marks : 100

Hours/Week : 2 Hours/Sem : 30

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.
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