



THIAGARAJAR COLLEGE MADURAI - 625009

(An Autonomous Institution, affiliated to Madurai Kamaraj
University)

(Re-Accredited with 'A' Grade by NAAC)

Department of Zoology & Microbiology

**B.Sc., Microbiology
(Aided & SF)**

M.Sc., Zoology

M.Sc., Microbiology

M. Phil., Zoology

B.Sc., Microbiology

(Aided & SF)

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Bachelor of Science (B.Sc.) –Microbiology
(Revised syllabus from 2017-2018 batch onwards)
Semester – I

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	P111	Ikkala Ilakkiyam	6	3	90	25	75	100
Part II	P211	Communicative English- I	6	3	90	25	75	100
Core 1	MI11	General Microbiology	4	4	60	25	75	100
Core 2	MI12	Cell Structure and Dynamics	4	4	60	25	75	100
Core lab 1	MIL11	Lab in General Microbiology	2	1	30	40	60	100
Generic elective	AC11	General Chemistry – I	4	4	60	25	75	100
Generic elective lab	ACL11	General Chemistry lab	2	-	30	-	-	-
EVS	ES	Environmental Studies	2	2	30	15	35	50
TOTAL			30	21				

Semester – II

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	P121	Tamil	6	3	90	25	75	100
Part II	P221	English	6	3	90	25	75	100
Core	MI21	Biochemistry	4	4	60	25	75	100
Core 4	MI22	Medical Microbiology	4	4	60	25	75	100
Core lab 2	MIL21	Lab in Biochemistry	2	1	30	40	60	100
Generic elective	AC21	Chemistry	4	4	60	25	75	100
Generic elective lab	ACL21	Chemistry lab	2	2	30	40	60	100
AECC	MIAEC 21	Personality development	2	2	30			
TOTAL			30	23				

Semester –III

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	P131	Tamil	6	3	90	25	75	100
Part II	P231	English	6	3	90	25	75	100
Core 5	MI31	Bioinstrumentation	4	4	60	25	75	100
Core 6	MI32	Microbial Physiology	4	4	60	25	75	100
Core lab 3	MIL31	Lab in Bioinstrumentation	2	1	30	40	60	100
Generic elective	AB31	Plant life Forms and Utilization & Pathology	4	4	60	25	75	100
Generic elective lab	ABL41	Plant life Forms and Utilization & Pathology lab	2	-	30	40	60	100
NME1	MINME 31	Health Education	2	2	30	15	35	50
TOTAL			30	21				

Semester – IV

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	P141	Tamil	6	3	90	25	75	100
Part II	P241	English	6	3	90	25	75	100
Core 7	MI41	Molecular Biology	4	4	60	25	75	100
Core 8	MB42	Microbial Genetics	4	4	60	25	75	100
Core lab 4	MIL41	Lab in Molecular Biology and Microbial Genetics	2	1	30	40	60	100
Generic elective	AB41	Plant Pathology	4	4	60	25	75	100
Generic elective lab	ABL41	Plant life Forms and Utilization & Pathology Lab	2	2	30	40	60	100
SEC I	MISEC 41	IPR/ Bioethics and Biosafety/ Bioenergy	2	2	30	15	35	50
TOTAL			30	23				

Semester --V

Course	Code No	Subject	Hrs/Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Core 9	MI51	Agricultural Microbiology	5	5	75	25	75	100
Core 10	MI52	Food Microbiology	5	5	75	25	75	100
Core 11	MI53	Clinical Lab Technology	5	5	75	25	75	100
Core lab 5	MIL51	Lab in Agricultural Microbiology	2	1	30	40	60	100
Core lab 6	MIL52	Lab in Food Microbiology	2	1	30	40	60	100
Core lab 7	MIL53	Lab in Clinical Lab Technology	2	1	30	40	60	100
M Elective	EMI51	Environmental Microbiology	5	5	75	25	75	100
NME II	MINME51	Sericulture	2	2	30	15	35	50
VE	VE	Value Education	2	1	30	15	35	50
TOTAL			30	26				

Semester VI

Course	Code No	Subject	Hrs	Cred	Total Hrs	Max Mark CA	Max Marks SA	Total
Core 12	MI61	Immunology	5	5	75	25	75	100
Core 13	MI62	Industrial Microbiology	5	5	75	25	75	100
Core 14	MI63	Genetic Engineering and Biotechnology	5	5	75	25	75	100
Core lab 8	MIL61	Lab in Immunology	2+1*	1	45	40	60	100
Core lab 9	MIL62	Lab in Industrial Microbiology	2	1	45	40	60	100
Core Lab 10	MIL63	Lab in Genetic Engineering & Biotechnology	2+1*	1	45	40	60	100
M Elective	EMI61	Biostatistics and Bioinformatics	5	5	75	25	75	100
SEC II	MISEC 61	Stem Cell Biology/ Nanotechnology/Forensic Science	2	2	30	15	35	50
Part V		Part V	-	1		75	25	100
TOTAL			30	26				

- **Chemical Preparation**

A) Consolidation of contact hours and credits: UG

Semester	Contact Hrs/ Week	Credits
I	30 hrs	21
II	30 hrs	23
III	30 hrs	21
IV	30 hrs	23
V	30 hrs	26
VI	30 hrs	25
Part - V	-	01
Total	180 hrs	140
V	Additional credit (Self study paper)	5

B) Curriculum Credits: Part wise

		No of papers	Credits per paper	Total credits
Part I	Tamil	4	3	12
Part II	English	4	3	12
	Core Theory	14	4/5	72
	Core lab	10	1	10
	Core Elective	2	5	10
	Generic Elective Theory	4	4	16
	Generic Elective Practical	2	2	4
Part IV	AECC	2	2	4
	NME	2	2	4
	SEC	2	2	4
	VE	1	1	1
Part V (NSSNCC/Physical Education)				1
Grand total				140

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Course	: B.Sc. Microbiology (Core 1)	Int. Marks	: 25
Year & Sem.	: I Year; I Semester	Ext. Marks	: 75
Sub. Code	: MI 11	Max. Marks	: 100
Hours/Week	: 4	No of Credits	: 4
Title of the Paper : General Microbiology			

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the history and development of microbiology
- understand and explore the world of microorganisms which would lead them towards progressive advancement of the subject

Unit I:

History of Microbiology - Discovery of microorganisms (Robert Hooke & Leeuwenhoek). Contributions of Francesco Redi, John Needham, Spallanzani, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich, Alexander Fleming, Dubos and Winogradsky. Classification based on Carl Woese (The three domains) 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, nucleoid, capsule, flagella, fimbriae, spores and cysts; Growth of bacterial culture – Physical & Chemical requirements for growth; Phases of growth.

Unit III

Types of growth media- natural, synthetic, complex, enriched, selective and anaerobic Growth media - definition with example, pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Control of microbes- Sterilisation, disinfection, antiseptic, tyndallisation, pasteurization: Physical- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter and Chemical methods.

Unit IV:

Classification of viruses - General characteristics of viruses; General Morphology – Helical, polyhedral, enveloped, complex; Morphology and structure of TMV and Influenza virus. Brief study of Virions and Prions. Classification of Fungi (Alexopoulos and Mims). Distinguishing characteristics of Fungi – Filamentous, non-filamentous & dimorphic fungi; Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae*; Industrial uses of yeasts and molds.

Unit V:

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

Text Books

1. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, 5th edition. McGraw-Hill. Book Co. Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9th edition, Pearson Education, Singapore.

Reference Books

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

Course designer : Dr. N.K.Asha Devi

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Course	: B.Sc. Microbiology (Core Lab 1)	Int. Marks	: 40
Year & Sem.	: I Year; I Semester	Ext. Marks	: 60
Sub. Code	: MIL11	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1

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

General Microbiology

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

Reference Books

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

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Course	: B.Sc. Microbiology (Core 2)	Int. Marks	: 25
Year & Sem.	: I Year; I Semester	Ext. Marks	: 75
Sub. Code	: MI 12	Max. Marks	: 100
Hours/Week	: 4	No of Credits	: 4
Title of the Paper : Cell Structure and Dynamics			

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the fundamental concepts of cellular function
- depict the dynamic structure of cell organelles
- explain the role of membranes in cell communication

Unit I

Discovery of cell and Cell theory. Ultrastructure of plant, bacterial and animal cells. Cell types –epithelial cells, endothelial cells and Nerve cells. Specialization of cells into tissues and colonies.

Unit II

Microfilaments, Microtubules, Cilia, Flagella, Pili, Capsule, Plasma membrane models - Davson-Danielli and Fluid mosaic. Transport of molecules – active, passive and diffusion.

Unit III

Structure, types and functions of: Mitochondria, Chloroplast, Ribosome, Peroxisomes, Endoplasmic reticulum (rough and smooth), Golgi apparatus, Lysosome, Nucleus – Nucleolus, Chromosome – Eukaryotic and prokaryotic, Histones and Plasmids

Unit IV

Extra Cellular Matrix (ECM), Cell Adhesion, Cell migration, Cell Junctions & Cell-cell Communication, Vesicle formation- fission and fusion, Quorum sensing, Intracellular signaling- calcium, receptors- G protein, MAPK

Unit V

Stages of cell cycle, regulation of cell cycle, Phases and significance of Mitosis, Meiosis, Apoptosis, Necrosis and Oncogenesis. Introduction to Stem cells

Text Books:

1. Powar, C.B. 2009. Cell Biology. Himalayan Publishing House, New Delhi.
2. Paul, A. 2009. Cell and Molecular Biology. Books and Allied (P) ltd, India.

References:

1. Alberts, B. *et al.*, 1994. Molecular Biology of the Cell (3rd edition). Garland Publishing, Inc., New York
2. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach (6th Edition). Sinauer Associates, Inc
3. De Roberties E.D.P and E.M.F.De Roberties. 2011. Cell and Molecular Biology. 8th edition. B.I. Publicatons Pvt. Ltd., India

4. Karp G. 2013. Cell and Molecular Biology Concepts and Experiments. John Wiley & Sons, Inc
5. Lodish et al. Molecular Cell Biology. 6th Ed., W.H. Freeman & Co. 2008
6. Stephen R. B, Jeremy S. H, *et.al.*, Cell Biology a short course, 2nd Edition, a John wiley & sons, Inc., publication – (e- book)

Course Designers: Dr. T S Ramyaa Lakshmi Dr. C. Ravi

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Course	: B.Sc. Microbiology (AECC1)	Int. Marks	: 15
Year & Sem.	: I Year; I Semester	Ext. Marks	: 35
Sub. Code	: ES	Max. Marks	: 50
Hours/Week	: 2	No of Credits	: 2
Title of the Paper	: Environmental Studies		

Course Outcomes:

On the successful completion of the course, students will be able to

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

Unit I

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

Unit II

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

Text Book

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

Reference Books

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

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Course	: B.Sc. Microbiology (Core 3)	Int. Marks	: 25
Year & Sem.	: I Year; II Semester	Ext. Marks	: 75
Sub. Code	: MI21	Max. Marks	: 100
Hours/Week	: 4	No of Credits	: 4
Title of the Paper : Biochemistry			

Course Outcomes:

On the successful completion of the course, students will be able to

- know the structure and properties of various biomolecules
- understand the role of enzymes and vitamins

Unit I

Biomolecules - Interaction and bonding. Water – Molecular structure and properties (Thermal, solvent, colligative) dissociation and ionization of water, pH and buffers (bicarbonate, phosphate and acetate); Henderson-Hasselbach equation. pKa.

Unit II

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

Disaccharides – Structure and biological importance of maltose, sucrose and lactose

Polysaccharides: Homo polysaccharides- Starch and Glycogen

Hetero polysaccharides: Structural characteristics and functions of peptidoglycan and agar.

Unit III

Structure and classification of amino acids based on polarity of ‘R’ group- properties and chemical reactions-Zwitter ion – Isoelectric pH,

Proteins – classification, properties and biological importance- levels of organization: primary, secondary – Ramachandran Plot, tertiary and quaternary structure.

Unit IV

Lipids: Classification, properties and biological importance. Structure and function of phospholipids, Biosynthesis of fatty acids and cholesterol, Beta oxidation and lipid peroxidation.

Enzymes: Classification and mechanism of action (lock and key and induced fit theories).

Enzyme kinetics – Michael’s Menten equation, Factors influencing enzyme activity, Enzyme inhibition- competitive, non competitive and allosteric.

UNIT-V

Nucleic acids: Nucleoproteins, nucleosides, Nucleotides, chemical structure of DNA, synthesis of nucleic acids- Salvage and De-novo pathways. Fat and water soluble vitamins – source, significance and deficiency.

Text Books

1. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, New Delhi.
2. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books & Allied Pvt. Ltd., Kolkata.

Reference Books

1. Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil, 2011. Harpers Illustrated Biochemistry , 30th Edition The McGraw-Hill Education.
2. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) ltd. New Delhi.
3. Deb, A.C. 2011. Fundamentals of Biochemistry, 10th Edition, New Central Book Agency Pvt. Ltd., Kolkata.
4. Nelson, D.L., and M.M.Cox, 2010, Lehninger Principles of Biochemistry, 5th edition, Worth Publishers, New York.
5. Rastogi, S.C.2010. Biochemistry, 3rd Edition, Tata McGraw Hill Edition, New Delhi.
6. Ramarao, A.V.S.S. and Suryalakshmi, A 2009. Textbook of Biochemistry for Medical Students, 11th UVS Publishers Distributors Pvt. Ltd., New Delhi.
7. Stryer, L., 2000. Fourth edition Biochemistry, W.H. Freeman and Company, New York.

Course Designers

Dr.S.Selvarani

Dr.C.Balasubramanian

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Course	: B.Sc. Microbiology (Core4)	Int. Marks	: 25
Year & Sem.	: I Year; II Semester	Ext. Marks	: 75
Sub. Code	: MI 22	Max. Marks	: 100
Hours/Week	: 4	No of Credits	: 4
Title of the Paper : Medical Microbiology			

Course Outcomes:

On the successful completion of the course, students will be able to

- Realize the importance of the microorganisms in human health.
- understand the important diseases by body system with reference to the etiology, mode of transmission, pathogenesis, lab diagnosis and prevention.

Unit I:

Normal flora of human body- Skin, throat, gastrointestinal tract, urogenital tract; opportunistic infections; Host-pathogen interactions; Concept of epidemic, endemic and pandemic, acute, chronic, morbidity, mortality, prevalence, incidence, Modes of transmission - Reservoirs, Carrier, vector.

Unit II:

Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of Bacteria:

Gram negative bacteria – *Vibrio cholerae*, *Salmonella typhi*;

Gram positive bacteria - *Streptococci*,

Acid Fast- *Mycobacterium tuberculosis*

Anaerobic – *Clostridium tetani*

Unit III:

Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of

DNA viruses –Herpes simplex virus, Hepatitis B virus

RNA viruses –Retrovirus – HIV, Polio

Viral zoonoses - Rabies

Unit IV:

Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of

Filamentous fungi – *Aspergillus niger*, Ringworm infections -*Tinea* sp.

Non- filamentous fungi – *Candida albicans*

Morphology, life cycle, pathogenesis, lab diagnosis, and prevention of Protozoan

Intestinal Parasites - *Entamoeba histolytica*

Malarial Parasite - *Plasmodium vivax*

Unit V:

Morphology, life cycle, pathogenesis, lab diagnosis, and prevention of Intestinal Nematodes : a) *Ascaris lumbricoides*, b) *Taenia solium*

Tissue Nematode : a) *Wuchereria bancrofti*

Classification and mechanism of action of antimicrobial agents: bacteria, viruses, fungi and parasites. Methods of testing drug sensitivity.

Text Books:

1. Ananthanarayanan and Jeyaram Paniker C.K. 2009. Text Book of Microbiology, 8th Edition, Orient Longman, Chennai.
2. Chakraborty P., 1995. A Text Book of Microbiology, New Central Book Agency (P) Ltd., Calcutta.

Reference Books

1. Collee, J.G., A.G.Fraser, B.P.Marmion, A.Simmons, 1996. Mackie and McCartney, Practical Medical Microbiology, 40th edition, Churchill Livingstone.
2. 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.
3. Dimmock, N.J., A.J. Easton, K.N.Leppard. 2008. Introduction to modern virology. Blackwell Science.U.K.
4. Greenwood D. 2007. *Medical Microbiology* 4th Ed., I.K. International.
5. Jawetz E., J.C. Melnic and E.A. Adelberg, 2001, Review of Medical Microbiology, Prentice Hall International Inc., USA.
6. Rajan, S. 2009. Medical Microbiology, 1st edition, MJP Publishers, Chennai.

Course Designers

Dr. N.K.Asha Devi

Dr.M.Thiruvalluvan

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Course	: B.Sc. Microbiology (Core Lab 2)	Int. Marks	: 40
Year & Sem.	: I Year; II Semester	Ext. Marks	: 60
Sub. Code	: MIL 21	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1
Title of the Paper : Lab in Biochemistry			

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

Reference Books:

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

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Course	: B.Sc. Microbiology (AECC 2)	Int. Marks	: 15
Year & Sem.	: 1 Year; II Semester	Ext. Marks	: 35
Sub. Code	: MIAEC21	Max. Marks	: 50
Hours/Week	: 2	No of Credits	: 2

Title of the Paper: **Personality Development**

Course Outcomes

On the successful completion of the course, students will be able to

- understand the underlying principle and working mechanism of various instruments
- be acquainted with the applications and handling of various instruments

Unit I

Life skill strategies- Effective communication, Creative thinking, Decision making, Goal setting, Problem solving, Resume writing.

Unit II

Attitude, Interpersonal Skills, self awareness, SWOT, Emotional Intelligence, Leadership development- Team building, Time, stress and conflict management.

Text books

N.Chockan 2011 Learn to understand others, Prodigy books, Chennai
Machakkalai, R and L. Saraswathi 2005. Personality development a need. Mangai Publishers, Madurai

Reference books

S.P.Sharma 2005. Youngsters guide for Personality development. Pustak Mahal, New Delhi
Sean Covey 1998. The 7 habits of highly effective teens. Fireside New York, USA.

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Course	: B.Sc. Microbiology (Core 5)	Int. Marks	: 25
Year & Sem.	: II Year & III Semester	Ext. Marks	: 75
Sub. Code	: MI 31	Max. Marks	: 100
Hours/Week	: 4	No of Credits	: 4

Title of the Paper: **Bioinstrumentation**

Course Outcomes

On the successful completion of the course, students will be able to

- understand the underlying principle and working mechanism of various instruments
- acquaint with the applications and handling of various instruments

Principle, working mechanism and applications of:

Unit I

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

Unit II

pH meter, Centrifuge (Clinical, Density gradient and Ultra) – sedimentation coefficient, RCF, RPM; Incubator, Autoclave, Quebec colony counter, GM counter, Liquid Scintillation counter, Sonicator, Lyophilizer and Filters (HEPA, membrane), micropipettes.

Unit III

Colorimeter – Beer & Lamberts law, Spectrophotometer (visible, ultraviolet and infrared), Flame Photometer and Atomic Absorption Spectrophotometer.

Unit IV

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

Unit V

SDS-PAGE, Agarose Gel Electrophoresis, 2D Gel Electrophoresis, Gel Documentation, Southern and Western blotting, PCR and FACS.

Text Books

1. Jeyaraman, J., 1985. Lab. Manual in Biochemistry, Wiley Eastern Ltd, New Delhi.
2. Veerakumari, L. 2009. Bioinstrumentation. MJP Publishers, Chennai.

Reference Books

1. Boyer, R.F. 1993. Modern Experimental Biochemistry. The Benjamin Cummings Publishing Company, Inc., New York.
2. Chatwal, G.R and Anand, S.K. 2009. Instrumental Methods of Chemical Analysis. Himalaya Publishing House, New Delhi.
3. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K. 2004. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Publishers Pvt. Ltd., New Delhi, India.

4. Palanichamy, S. and Shanmugavelu, M. 2011. Principles of Biophysics, 2nd Edition, Palani Paramount Publications, Palani.
5. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques. School of Biotechnology, Madurai Kamaraj University, Madurai.
6. Plummer, D.T. 2008. An Introduction to Practical Biochemistry. Tata McGraw Hill Publications, New Delhi.
7. Sawhney, S.K. and Singh, N. 2000. Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.
8. Warton, D.C. and McCarthy, R.E. 1972. Experiments and Methods in Biochemistry. MacMillan, New York.
9. Williams, B.L. and Wilson, K. 1983. A Biologist's Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold Publishers Ltd., London.
10. Wilson, K. and Walker, J. 2003. Principles and Techniques of Practical Biochemistry, 5th Edition Cambridge University Press, New York.

Course Designers

- 1. Dr. C. Ravi**
- 2. Dr. T.S. Ramyaa Lakshmi**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: B.Sc. Microbiology (Core 6)	Int. Marks	: 25
Year & Sem.	: II Year & III Semester	Ext. Marks	: 75
Sub. Code	: MI 32	Max. Marks	: 100
Hours/Week	: 4	No of Credits	: 4
Title of the Paper: Microbial Physiology			

Course outcomes

On the successful completion of the course, students will be able to happen

- understand the various physiological phenomena involved within microbes
- know the different types of transport across the cytoplasmic membrane

Unit I

Biochemical activities of membrane –Osmosis, Diffusion- Facilitated diffusion and active transport-Co-transport:-Uniport, symport and antiport-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 an-oxygenic types of photosynthesis-Photosynthetic microbes and their photosynthetic pigments-Light reaction in aerobic oxygenic phototrophic bacteria (Cyanobacteria)-Light reaction in anaerobic an-oxygenic phototrophic bacteria (Green and Purple bacteria)-CO₂ fixation – Calvin cycle.

Unit IV

Fueling reaction in aerobic heterotrophs –glycolysis, pentose phosphate pathwayPhosphoketolase pathway,Entner - Doudoroff pathway, the glyoxylate cycle-Fueling reaction in anaerobic heterotrophs – anaerobic respiration

Unit V

Fueling reaction in chemo – organotrophs: Acetogenesis and methanogenesis-Fueling reaction in chemolithotrophs: Hydrogen bacteria, sulphur bacteria, nitrifying bacteria. Methylotrophs and Methanotrophs. Gluconeogenesis and Glycogenesis – peptidoglycan biosynthesis. Stress response – Osmotic stress, oxygen, CO₂, pH, Temperature.

Text Books:

1. Moat, A.G., and J.W. Foster, 2009, Microbial Physiology-4th edition, John Wiley & Sons, New York.
2. Atlas, R.M. 1997, Principles of Microbiology, Second edition, WCB/McGraw-Hill Co., USA.

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. Madigan,M.T., J.M.Martinko and J.Parker, 2000, Brock- Biology of Microorganisms, Ninth edition, Prentice Hall International Inc, New Jersey.
7. Nelson, D.L., and M.M.Cox., 2000 Lehninger, Principles of Biochemistry, Third edition, Mac Millan Worth publishers.
8. Prescott, L.M., J.P.Harley and D.A. Helin, 2002, Microbiology, Fifth edition, McGraw Hill, New Delhi.
9. Schlegel, H.G., 1993, General Microbiology, Seventh edition, Cambridge University Press.
10. 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.
11. Madigan, Martinko, Dunlap, Clark 2009. Brock Biology of Microorganisms 12th Edition. Pearson Publication, New York.
12. SundaraRajan , S. 2003 Microbial Physiology, Anmol Publication, NewDelhi

Course Designers**1. Dr.C. Balasubramanian****2.Dr.T.S. Ramyalakshmi**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: B.Sc. Microbiology (Core Lab 3)	Int. Marks	: 40
Year & Sem.	: II Year; III Semester	Ext. Marks	: 60
Sub. Code	: MIL 31	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1
Title of the Paper	: Lab in Bioinstrumentation		

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

Reference Books:

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

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(For those joined B.Sc (other than Microbiology)/B.A/B.Com/BBA on or after June 2017)

Course	: B.Sc. Microbiology (NME -1)	Int. Marks	: 15
Year& Sem.	: IIYear; IV sem	Ext. Marks	: 35
Sub. Code	: MINME31	Max. Marks	: 50
Hours/Week	: 2	No of Credits	: 2

Title of the Paper : **Health Education**

[Non Major Elective paper for B.Sc(other than Microbiology)/B.A/B.Com/BBA/ BCStudents]

Course outcomes:

On successful completion of the course, the students will be able to

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

Unit I

Dimensions and Determinants of health,

Indicators of health – Characteristics of indicators, Types of indicators,

Disease agents – Classification of disease agents- water, air, vector borne

Nutrition – Classification and functions of food, sources and requirement of Carbohydrates,

Proteins, Fats, Vitamins and Minerals, Malnutrition – Protein energy Malnutrition (PEM),

Balanced diet – Composition of balanced diet

Unit II

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

Text Books:

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

Course Designer

Dr.N.K.Asha Devi.

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Course	: B.Sc. Microbiology (Core 7)	Int. Marks	: 25
Year & Sem.	: II Year; IV Semester	Ext. Marks	: 75
Sub. Code	: MI 41	Max. Marks	: 100
Hours/Week	: 4	No of Credits	: 4
Title of the Paper: Molecular Biology			

Course outcomes:

On successful completion of the course, the students will be able to

1. understand the chemical composition and structure of nucleic acids
2. learn the functioning of genetic materials
3. mechanism of molecular processes

Unit I:

DNA: Genetic material – Griffith, Chase experiments; chemical composition, Chargaff’s rule – Watson and Crick model, DNA conformations - A, B and Z; Physical organization of prokaryotic genome - Structure of nucleoid, positive and negative supercoiling; Properties - Melting curves, T_m value, cot ½ value, hypochromicity

Unit II:

RNA: Genetic material – Gierer and Schramm experiment; Genetic and non genetic RNA; Chemical composition, structure of mRNA, tRNA and rRNA; Genetic code: Deciphering genetic code, characteristics of genetic code

Unit III:

Prokaryotic replication: mode of replication - semiconservative mode, Meselson and Stahl experiment; Mechanism of replication - enzymology of DNA replication, origin of replication, initiation, elongation and termination; types - uni directional, bi directional and rolling circular

Unit IV:

Transcription: RNA polymerase - types and subunits; initiation – recognition of promoters, regulation by sigma factor, formation of open complex; elongation; termination rho dependent, rho independent, antitermination. Post transcriptional modifications

Unit V:

Translation: Initiation – binding of ribosomes and formation of initiation complex, Elongation – peptide formation – translocation – EF – Termination – Peptide termination – Releasing factors - posttranslational modifications. Epigenetics.

Text books:

1. Malacinski, G.M. 2015. Freifelder’s essentials of Molecular biology, 4th edn. Jones & Barlett learning, New Delhi
2. Channarayappa, 2015. Molecular Biology, University Press, Hyderabad.

Reference Books:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. 1994. Molecular Biology of the Cell, III Edn. Garland Publishing, Inc.,
2. De Robertis E.D.P and E.M.F.De Robertis 2011. Cell and Molecular Biology.VIII Edn. Lippincott Williams & Wilkins, Philadelphia.
3. Griffiths, A.J.F., Lewontin, R.C., Gelbart, W.M. and Miller, J.H. 2002. Modern Genetic Analysis. II Edn., W.H. Freeman and Company, New York.
4. Hardin J., Bertoni, G.P. and Lewis, J. 2011 Becker's World of the Cell VIII Edn. Pearson Education Inc., New York
5. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett
6. Lodish, H., Berk, A., Zipursky, S.L., Matsudara, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology, IV Edn. W.H.Freeman and Company, Newyork.
7. Watson, J.D., N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 2004. Molecular Biology of the Gene, IV Edn. Pearson Education Inc., New York.
8. Wolfe, L.S., 1993. Molecular and Cellular Biology, Wadsworth publishing company, California.

Course designers**DrN.Arun Nagendran****Dr.RM.Murugappan**

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Course	: B.Sc. Microbiology (Core 8)	Int. Marks	: 25
Year & Sem.	: II Year; IV Semester	Ext. Marks	: 75
Sub. Code	: MI 42	Max. Marks	: 100
Hours/Week	: 4	No of Credits	: 4

Title of the Paper: **Microbial Genetics**

Course Outcomes

On the successful completion of the course, students will be able to

- Understand mutation process in the genetic material and repair mechanisms
- Regulation of gene expression

Unit I:

Regulation of prokaryotic gene expression: Bacterial inducible and repressor system - lac operon, trp operon; attenuation and antitermination; Repressors of phage lambda – maintenance of lysogenic state and switching from lysogenic lytic infection

Unit II:

Genetic recombination in bacteria: Transformation, conjugation and transduction – generalized and specialized, homologous recombination – Holiday model; plasmid – types (F, R & Col), stringent and relaxed plasmids; amplification and copy number

Unit III:

Transposable elements in prokaryotes: IS elements and transposons – composite and non-composite transposans; transposable elements in plasmids and phage mu; mechanism of transposition – replicative and conservative transpositions

Unit IV:

Mutation: Types of mutations – spontaneous and induced mutations; Point mutation and chromosomal mutations; Molecular basis of mutations – base substitution, frame shift mutation and mismatch; DNA damage: lesions, dimerization, AP sites, oxidative damage, alkylation and genotoxic effects

Unit V:

DNA repair: Direct repair – photoreactivation and dealkylation, excision repair –base excision and nucleotide excision, mismatch repair, recombination repair and SOS repair.

Text books:

1. Malacinski, G.M. 2015. Freifelder’s essentials of Molecular biology, 4th edn. Jones & Barlett learning, New Delhi
2. Channarayappa, 2015. Molecular Biology, University Press, Hyderabad.

Reference Books:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. 1994. Molecular Biology of the Cell, III Edn. Garland Publishing, Inc.,
2. De Robertis E.D.P and E.M.F.De Robertis 2011. Cell and Molecular Biology.VIII Edn. Lippincott Williams & Wilkins, Philadelphia.
3. Griffiths, A.J.F., Lewontin, R.C., Gelbart, W.M. and Miller, J.H. 2002. Modern Genetic Analysis. II Edn., W.H. Freeman and Company, New York.
4. Hardin J., Bertoni, G.P. and Lewis, J. 2011 Becker's World of the Cell VIII Edn. Pearson Education Inc., New York
5. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett
6. Lodish, H., Berk, A., Zipursky, S.L., Matsudara, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology, IV Edn. W.H.Freeman and Company, Newyork.
7. Watson, J.D., N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 2004. Molecular Biology of the Gene, IV Edn. Pearson Education Inc., New York.
8. Wolfe, L.S., 1993. Molecular and Cellular Biology, Wadsworth publishing company, California.

Course designers**DrN.Arun Nagendran****Dr.RM.Murugappan**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: B.Sc. Microbiology (Core Lab 4)	Int. Marks	: 40
Year & Sem.	: II Year; IV Semester	Ext. Marks	: 60
Sub. Code	: MIL 41	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1
Title of the Paper	: Lab in Molecular Biology and Microbial Genetics		

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

Reference Books:

1. Ausubel, F.M., Roger, B., Robert E.Kingston, David A. Moore, Seidman J.G., John A. Smith and Kelvin, S. 1992. Thrid Edition, Short Protocols in Molecular Biology, John Wiley & Sons Inc., New York.
2. Berger, S.L. and Kimmel, R. 1987. Guide to Molecular Cloning Techniques, Academic Press, Inc., New York.
3. Brown, T.A. 1998. Molecular Biology Lab; Gene Analysis, Academic Press, London.
4. Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.
5. Miller, J.H. 1992. A Short Course in Bacterial Genetics: A Lab Manual & Hand Book for *E. coli* and related Bacteria. Cold spring Harbor Lab press, Cole Spring Harbar
6. Rajamanickam, C.2001 Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
7. Sambrook, I., Fritsch, E.F. and Maniatis, T. 1989. Second Edition, Molecular Cloning 1, 2, 3 - A Laboratory Manual, Cold Spring Laboratory Press, USA.
8. Anusha,B 2014. Biochemical Methods Apractical Approach .Narasa Publishing New Delhi

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Course	: B.Sc. Microbiology (Core Elective 1)	Int. Marks	: 25
Year & Sem.	: III Year; V Semester	Ext. Marks	: 75
Sub. Code	: EMI 51	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 5

Title of the Paper: **Environmental Microbiology**

Course outcomes:

On successful completion of the course, the students will be able to

- understand the diversity of microbes in different environments.
- learn the role of microbes in degradation of toxic substances and waste treatment

UNIT I

Microbial diversity in Normal environments: terrestrial (agricultural and desert soils), aquatic (fresh water and marine), atmospheric (stratosphere) and animal (cattle, termites). Microbial diversity in extreme environments: Oligotrophs, thermophiles, psychrophiles, barophiles, organic solvent and radiation tolerant, metallophiles.

UNIT II

Microbial ecology: Basic concepts, Types, microbial habitats and factors affecting microbial populations; Microbial interactions: competition, commensalism, mutualism, synergism and Parasitism. Population Ecology: Characteristics of population, Population growth curves ((r and k selection) and population regulations.

UNIT III

Bioaccumulation, Bio-magnification, Biodegradation of biopolymers (Xylan, lignin and polyhydroxy alkanates), Hydrocarbons (Kerosene & alkanes), halogenated and sulfonated compound. Pesticides degradation patterns and recent advancement in treating pesticide residues.

UNIT IV

Solid waste - Sources and types, methods of collection and transport; Components of solid wastes-Treatment methods-Landfill composting by aerated pile method, reactors and incineration. Liquid waste – sources, stages of treatment :Primary, secondary, and tertiary. Methods of treatment: Aerobic:-Activated sludge process (ASP), Biological filters (or) Fixed Film System (FFS); Anaerobic Contact digester (CD) and Packed Column Reactor (PCR); Tannery effluent Treatment

UNIT V

Microorganisms responsible for bioluminescence in marine environment; Mechanism of quorum sensing in *Vibrio fischeri*-Microbial indicators of marine pollution and control; Biofouling, biocorrosion, biofilms, biodegradation and bioremediation of marine pollutants-use of genetically engineered microorganisms in biodegradation.

Text Books:

1. Atlas, R.M., 1997, Principle of Microbiology, Second edition, WCB/Mc Graw-Hill Co., USA.
2. Jogdand, S.N.2010. Environmental Biotechnology (Industrial Pollution Management), Himalaya Publishing House.New Delhi

Reference Books:

1. Allsopp, D., and J.Seal, 1986, Introduction to Biodeterioration, Edward Arnold (Publishers), London
2. Chatterji, A.K. 2005.Introductionto Environmental Biotechnology,
3. Environmental Microbiology by A.H. Varnam& M.G. Evans, Manson Publishing Ltd., 2000.
4. Environmental Microbiology by R. Mitchel (2nd edition), Wiley-Blackwell, 2009.
5. Environmental Microbiology by Raina Maier, Ian Pepper, & Charles Gerba, Academic Press, 2008.
6. Manual of Environmental Microbiology by Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, ASM Press, 2007.
7. Microbial Ecology By Atlas R.M., Bartha R., Benjamin Cummings Publishing Co, Redwood City, CA, 1993.
8. Norris *et al.*, 1994, Handbook of Bioremediation, Lewis Publishers, London.

COURSE DESIGNERS

1. **Dr.C. Balasubramanian**

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Course	: B.Sc. Microbiology (Core 9)	Int. Marks	: 25
Year & Sem.	: III Year; V Semester	Ext. Marks	: 75
Sub. Code	: MI 51	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 5
Title of the Paper: Agricultural Microbiology			

Course outcomes:

On successful completion of the course, the students will be able to

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

Unit I

Plant-microbe interaction: commensalism, mutualism and parasitism. Rhizobium: root nodule formation, physiology of N₂ fixation (nod and nif genes), host-rhizobium interaction, mass cultivation, carrier-based inoculants. Biofertilizers: Types, advantages and limitation.

Unit II

Rhizosphere and Phyllosphere, root exudates, influence of rhizosphere on crop productivity, Plant growth promoting rhizobacteria. Azospirillum: host plant specificity, physiology of a-symbiotic N₂ fixation, carrier based inoculum. Azotobacter: host plant specificity, physiology of a-symbiotic N₂ fixation, crop response and mass cultivation.

Unit III

Cyanobacteria (Blue green algae): Anabaena-Azolla association - nitrogen fixation, factors affecting growth - mass cultivation, Application of Anabaena-Azolla in rice field. Mycorrhizal association: occurrence and distribution, phosphorus solubilisation, phosphate mobilisation, collection of AM spores, production of AM spores in stock plants.

Unit IV

Symptoms, transmission and mechanism of plant diseases: Viral – Tobacco-mosaic, Bunchy top-Banana, Tomato spotted wilt. Bacterial – Potato-Scab, Citrus-Canker, Blight. Fungal - Smuts, Rusts, Leaf spots. Factors affecting disease incidence.

Unit V

Chemical and Biopesticides: types, advantages and limitation.

Bacterial pesticides - *Bacillus thuringiensis*.

Fungal pesticides - *Beauveria bassiana*,

Viral pesticides - NPV, CPV, GV.

Phytochemicals - Neem extract

Text Books:

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

Reference Books:

1. Agrios, G.N., 1997. (Indian first print 2000), Plant pathology, fourth edition, Replica Press Pvt. Ltd., New Delhi.
2. Atlas, M., 2000. Microbiology-Fundamentals and Applications, Collier MacMillan Publication, London.
3. 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.
8. Blaine Meeting, F. 1993. Soil Microbial Ecology. Marcel Dekker Inc. New York.

Course designers

Dr.RM.Murugappan

Dr. C.Balasubramanian

Dr.T.Rajagopal

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Course	: B.Sc. Microbiology (Core Lab 5)	Int. Marks	: 40
Year & Sem.	: III Year; V Semester	Ext. Marks	: 60
Sub. Code	: MIL51	Max. Marks	: 100
Hours/Week	:2	No of Credits	: 2

Title of the Paper: Lab in Agricultural Microbiology

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

Reference Books:

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

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Course	: B.Sc. Microbiology (Core 10)	Int. Marks	: 25
Year & Sem.	: III Year; V Semester	Ext. Marks	: 75
Sub. Code	: MI52	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 5

Title of the Paper: **Food Microbiology**

Course Outcomes:

On the successful completion of the course, students will be able to

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

Unit I

Common Food borne Bacteria, Molds and yeasts.

Intrinsic and Extrinsic parameters of foods that influence microbial growth.

Microbes as food: Single cell protein (SCP) and edible mushrooms.

Prebiotics, Probiotics and Synbiotics – Benefits & applications

Unit II

Fermented dairy products: Buttermilk, Sour cream, Yoghurt & Cheese.

Fermented vegetables: Sauerkraut, Olives, Soy Sauce & Pickles

Microbial fermentation: Beer, Distilled liquors (Rum, Whisky & Brandy) & Wine.

Other food Products: Fermented meat, Idli batter & leavening of bread.

Unit III

Food spoilage: Spoilage of Milk & Milk products.

Spoilage of beer & wine,

Spoilage of vegetables, fruits, meat & canned food.

Unit IV

Pathogens associated with Food and Potable Water: Faecal coliforms, faecal streptococcal forms, *Salmonella*, *Staphylococcus* & *Pseudomonas*.

Food poisoning: *Aspergillus flavus* & *Clostridium botulinum*

Unit V

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

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

Text Books:

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

Reference Books:

1. Banwart,G.J., 1987, Basic Food Microbiology, CBS Publishers & Distributors, New Delhi.

2. Deak, T, and L.R.Beuchat, 1996, Hand Book of Food Spoilage Yeasts, CRC Press, New York
3. Garbutt,J., 1997, Essentials of Food Microbiology, Arnold-International Students“ edition, London.
4. Jay,J.M, 1996, Modern Food Microbiology, CBS Publishers & Distributors, ND
5. Joshi, V.K. and Ashok Pandey (Eds), 1999, Biotechnology: Food fermentation Vol.II, Educational Publishers and Distributors, New Delhi.
6. Kulshreshtha, S.K. 1994, Food Preservation, Vikas Publishing House Pvt. Ltd.,New Delhi

Course designers

Mrs. U.Soundarya.

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: B.Sc. Microbiology (Core Practical 5)	Int. Marks	: 40
Year & Sem.	: III Year; V Semester	Ext. Marks	: 60
Sub. Code	: MIL52	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1
Title of the Paper	: Lab in Food Microbiology		

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

Reference Books:

1. Aneja, K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
2. Cappuccino, J.H. and Sherman, N.2002. Microbiology – A Lab Manual, Third Edition, The Benjamin Publishing Company, Singapore.
3. Gunasekaran, P. 1995. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
4. Kannan, N. 1996. Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
5. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.

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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: B.Sc Microbiology (Core Paper-11)	Int. Marks	: 25
Year& Sem.	: III Year; V Sem	Ext. Marks	: 75
Sub. Code	: MI53	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 5

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

Course Outcomes:

On the successful completion of the course, students will be able to

- Gain ample knowledge about the routine functioning of the clinical laboratory and operational standards of laboratories.
- Familiar with specimen collection procedures and be aware of pre analytical, analytical, and post analytical stages of specimen processing and errors
- Familiar with principles of equipment maintenance, principles of laboratory safety and to the concept of quality assurance

Unit I

Laboratory designing, Code of conduct for Clinical Laboratory, SOP.

Personal hygiene for Laboratory Technologists.

National and International GLP and GMP- Biosafety levels.

Accidents-types and safety measures.

First Aid in laboratory and Precautions.

Unit II

Collection and processing of blood sample.

Determination of TC, DC, ESR, Hb, Bleeding time&Clotting time.

ABO Blood group system and determination of blood group.

Blood transfusion and Compatibility testing.

Determination of blood glucose, Urea, Cholesterol and Bilirubin.

VDRL and Widal test.

Blood culture and sensitivity.

Unit III

Collection, transport and Storage of Urine sample.

Physical properties of Urine.

Chemical examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies.

Microscopic Examination of Urine – Cast Crystals and Cells.

Pregnancy Test. Urine culture and sensitivity.

Unit IV

Stool Collection and transport. Macroscopic and Microscopic examination of stool.

Chemical examination of stool. Stool Culture and sensitivity.

Occult blood and its clinical significance

Unit V

Sputum Collection and transport of specimen. Macroscopic and Microscopic examination of sputum. AFB staining. Sputum culture and sensitivity.

Collection of semen. Semen analysis – motility, total count and abnormality.

Text Book:

1. Sood, R, 2010, Medical Laboratory Technology – Methods and interpretations – Seventh edition, Jaypee, New Delhi.
2. Mukherjee, L.K. 2010, Medical Laboratory Technology – 3 volumes – second edition – Hill Publishing Ltd., 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. Rapael, S.S., 1983, Lynch Medical Laboratory Technology, Fourth edition, W.B. Saunders Co, Singapore.
6. Woohan, I.D.P., Heather Freeman, 1990, Micro Analysis in Medical Biochemistry, sixth edition, Churchil Livingstone Publishing Ltd., USA.
7. Ochei, J and Kolkatkar, A. 2009. Medical Laboratory Science – Theory and Practice. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.

Course Designer

Dr.C.Binu Ramesh

THIAGARAJAR COLLEGE, MADURAI – 9.
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Course	: B.Sc. Microbiology (Core Lab 7)	Int. Marks	: 40
Year & Sem.	: III Year; V Semester	Ext. Marks	: 60
Sub. Code	: MIL53	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1
Title of the Paper: Lab in Clinical Lab Technology			

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

Reference Books

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

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Course : B.Sc., Microbiology (NME Paper-2)	Int. Marks : 15
Year& Sem. : IIIYear; V sem	Ext. Marks : 35
Sub. Code : MINME51	Max. Marks : 50
Hours/Week : 2	No of Credits : 2

Title of the Paper : **Sericulture**

[Non Major Elective paper for B.Sc., (other than Microbiology)/B.A/B.Com/BBA/BCA students]

Course Outcomes:

On the successful completion of the course, students will be able to

- Learn the techniques of silkworm rearing
- Venture into the sericulture industry as an entrepreneur

UNIT I:

History of sericulture - silk route; Types of silkworm – mulberry & non-mulberry; Univoltine, bivoltine and multivoltine races. *Bombyx mori* – Lifecycle; Requirements for ideal rearing house & rearing equipments; Rearing methods – shelf, shoot and floor rearing – advantages and disadvantages; feeding & bed clearing at different larval stages; Preparation for moulting - Mountages - types and advantages. Harvesting, preservation & transportation of cocoons.

UNIT II:

Silk reeling - Processing of cocoon, selection of cocoon for reeling, stifling methods, Cocoon cooking; Silk reeling methods; Composition and properties silk of silk fiber. Diseases of silkworm - causative agent, symptoms & control measures of pebrino, flacherie, NPV, green muscardine; Pests of silkworm – nature of damage & control measures - tachinid fly and dermestid beetle. . Quality control of silk - cocoon grading ,Silk grading, Silk Mark, Central Silk Board.

Textbooks:

1. Ganga,G and J. Sulochana Chetty 2010. Introduction to Sericulture, 2nd Ed. Published by Oxford & IBH Publishing Co. Pvt. Ltd.
2. Shukla,G.S and V.B. Upadhyay 2008. Economic Zoology 4th Ed Rastogi publications. New Delhi

References:

1. S. Omura, ,1980 Silkworm Rearing Techniques in the Tropics, Dr. Japan International Cooperation Agency.
2. S.R. Ullal and M.N. Narasimhanna 1987. Handbook of Practical Sericulture, CSB, Bangalore.
3. Krishnaswami, S., Narasimhanna, M. N., Suryanarayan, S. K.. Kumar Raj S. 1988.Sericulture Manual on Silkworm Rearing, , FAO,Oxford & IBh publishing co.pvt.ltd. New Delhi
4. Haung Guo Rui 1998. Silk Reeling, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Course designers**Mrs. U.Soundarya.**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: B.Sc. Microbiology (Core 12)	Int. Marks	: 25
Year & Sem.	: III Year; VI Semester	Ext. Marks	: 75
Sub. Code	: MI61	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 5
Title of the Paper	: Immunology		

Course outcomes:

On the successful completion of the course, students will be able to

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

Unit I

History of Immunology: Contributions of Edward Jenner –Louis Pasteur – Elie Metchnikoff
Types of immunity: Innate-anatomic, physiologic, phagocytic, and inflammatory–Acquired or Adaptive –antigenic specificity – diversity- Immunologic memory–self/nonself recognition
Humoral–Cell-mediated immunity
Organs of immune system: Primary- Thymus & Bone marrow; Secondary – spleen –lymph nodes – GALT & MALT. Cells: Lymphocytes (T& B) – Macrophages, NK cells – APCs - Role.

Unit II

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

Unit III

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

Unit IV

Transplantation antigens-Erythrocyte antigens-MHC – HLA – Class I & Class II Antigens – Immunologic Basis of Graft Rejection -Allograft rejection –cells involved– GVHD – Prevention of graft rejection.
Tumor Antigens –Immunity to tumor-Tumor evasion mechanisms-Immunodiagnosis –Tumor therapy.

Unit V

Immunodeficiencies- Primary – B & T Cell deficiencies, combined – secondary- acquired – HIV – AIDS.

Vaccines: Types- Attenuated – Killed – Purified proteins (Toxoid) – Recombinant Vaccines. Immunization schedule, Active & Passive immunization.

Text Books:

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

Reference Books:

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

Course Designers

Dr.M.Thiruvalluvan

Dr.C.Binu Ramesh

THIAGARAJAR COLLEGE, MADURAI – 9.
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Course	: B.Sc. Microbiology (Core lab 8)	Int. Marks	: 40
Year & Sem.	: III Year; VI Semester	Ext. Marks	: 60
Sub. Code	: MIL61	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1
Title of the Paper	: Lab in Immunology		

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

Reference books:

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

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: B.Sc. Microbiology (Core 13)	Int. Marks	: 25
Year & Sem.	: III Year; VI Semester	Ext. Marks	: 75
Sub. Code	: MI62	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 5
Title of the Paper : Industrial Microbiology			

Course outcomes:

On the successful completion of the course, students will be able to

- understand the applications of the microorganisms in fermentation process.
- learn upstream and downstream processes of fermentation, process optimization and strain development.

Unit I

Isolation of industrially important strains: Sources for sample collection, screening techniques: primary screening – crowded plate technique, Auxanography, enrichment technique, dye indicator and secondary screening. Strain development- mutation, selection of auxotroph, protoplast fusion, parasexual reproduction. Strain Maintenance.

Unit II

Basic design and components of fermentor. Types of fermentors- Tower, airlift, fluidized bed. Types of fermentation – solid state fermentation and submerged fermentation, Methods of fermentation- batch, fed-batch, continuous fermentation. Growth kinetics (Batch).

Unit III

Fermentation media: chemical composition, raw materials- saccharides (starch and cellulose), industrial wastes. Fermentation process control- media, pH, aeration, temperature, foam, computer automation. Media optimization- CCD – (Response surface methodology).

Unit IV

Production of antibiotic – Penicillin; vitamin (Riboflavin), enzymes (Amylase), solvent (Ethanol), organic acid (Citric acid), and Beverage (Wine).

Unit V

Downstream processing: Cell disruption-physical and chemical methods. Separation-Precipitation, filtration, centrifugation, solid liquid extraction, liquid-liquid extraction, chromatography, solvent extraction, drying and crystallization.

Text Books

1. Crueger, W. and A. Crueger, 2003. Biotechnology : A Test Book of Industrial Microbiology, 2nd edn. Panima Publishing corporation, New Delhi.
2. Patel, A.H. 1996. Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.

Reference books

1. Stanbury, P.F., A. Whitaker and S.J.Hall, 1999. Principles of Fermentation Technology, second edition, Aditya Book (p) Ltd., New Delhi.
2. Waites, M.J., Morgan, N.L., Rockey, J.S., and Higton, G. 2001. Industrial Microbiology: An Introduction, Blackwell Science, London.
3. Casida, L.E., 1991. Industrial Microbiology, fifth edition, Wiley Eastern Ltd., New Delhi.
4. Prescott, L.M., J.P. Harley and D.A. Helin, 2002. Microbiology, fifth edition, McGraw Hill, New Delhi.

Course designers

Dr. R.M. Murugappan
Mr. S. Kulanthaivel

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: B.Sc. Microbiology (Core Practical 9)	Int. Marks	: 40
Year & Sem.	: III Year; VI Semester	Ext. Marks	: 60
Sub. Code	: MIL62	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1

Title of the Paper: Lab in Industrial Microbiology

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

Reference Books

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

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Course	: B.Sc. Microbiology (Core 14)	Int. Marks	: 25
Year & Sem.	: III Year; VI Semester	Ext. Marks	: 75
Sub. Code	: MI63	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 5
Title of the Paper : Genetic Engineering and Biotechnology			

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the basic principles of genetic engineering.
- know the fundamental steps in gene cloning and manipulation
- learn the techniques in Biotechnology

Unit I:

Tools for Genetic engineering –restriction endonucleases, alkaline phosphatase, S1 Nuclease, PNAse, Ligase. Host cell types for recombinants- prokaryotes (bacteria) and eukaryotes (fungi, plants and animals). Structure and Properties of cloning vectors- Plasmids (PBR322, M13), Ti plasmids, bacteriophages (lambda phage) – Hybrid vectors (Cosmids, phasmids). Expression vectors (shuttle vectors, YACs, BACs).

Unit II:

Gene cloning strategies: Selection of desired DNA fragments, linkers and adapters, Transformation (heatshock, electroporation, microinjection) and transfection. Indirect transformation in plants (Ti plasmid based). Screening of recombinants (colony hybridization, antibiotic based, blue white screening, Immuno based). Construction of genomic and cDNA libraries.

Unit-III:

Animal cell culture: Primary and Continuous Cell culture, adherent and suspension cultures; functional characteristics of cultured cells. Composition of animal cell culture media. Cryopreservation of animal cells, Applications of animal cell culture. Animal cloning (Dolly – nuclear transfer method).

Unit-IV:

Plant cell and tissue culture (PTC), culture media, Types of plant tissue cultures (Callus, suspension, protoplast, anther & ovule cultures, somatic embryos and meristem cultures). Micropropagation and somatic embryogenesis. Applications of PTC: Massive plant production, virus free plants, Embryo rescue of endangered plants, Germplasm collection and seed conservation.

Unit –V:

PCR- Principle and its application, Reverse transcriptase-PCR, DNA finger printing (RAPD and RFLP), DNA sequencing methods-(Maxam Gilbert, Sanger’s and Automated). Microarray. Transgene, transgenesis, Transgenic animals (Sheep and fish) and Plants (Bt cotton, drought resistant plants and its applications. Animal bioreactors and molecular farming.

Text Books

1. Dubey R.C. 2009. A text book of Biotechnology. S. Chand & Company, New Delhi
2. Satyanarayana U. 2010 Biotechnology. Books and Allied (P) Ltd., Kolkata.

Reference books

1. Brown, T.A. 2006. Gene Cloning & DNA Analysis: An introduction. V edn. Blackwell publishing, USA .
2. Glick, R and Pasternak , J 1994.Molecular Biotechnology. Panima Publishers, New Delhi
3. Balasubramanian, D., C.F.A. Bryce, K.Dharmalingam, Y.Green, Kunthala Jeyaraman. 2004. Concepts in Biotechnology. Universities (P) ltd. Hyderabad.
- 4.Chawla, H.S.2000 Introduction to Biotechnology, Oxford & IBH Publishing Co. Pvt.Ltd.New Delhi.
5. Mitra,S.1996 Genetic Engineering Principles and Practice Macmillan India Ltd. India
6. Trehen, K.2002. Biotechnology, New Age International (P) Ltd. New Delhi
7. Trevan, M.D., S.Boffey, K.H. Goulding and P.Stanbury, 1990, Gene Biotechnology – Himalaya Publishing House, New Delhi.

Course designers

1. **Dr.Poornima Kkani**
2. **Dr. T.Rajagopal**

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Course	: B.Sc. Microbiology (Core Practical 10)	Int. Marks	: 40
Year & Sem.	: III Year; VI Semester	Ext. Marks	: 60
Sub. Code	: MIL63	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 1

Title of the Paper : **Lab in Genetic engineering and biotechnology**

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

Reference Books:

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

Course designers

1. Dr. Poornima Kkani

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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: B.Sc. Microbiology (Major Elective 2)	Int. Marks	: 25
Year & Sem.	: III Year; VI Semester	Ext. Marks	: 75
Sub. Code	: EMI61	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 5
Title of the Paper	: Biostatistics and Bioinformatics	No of Credits	: 5

Course outcomes:

On the successful completion of the course, students will be able to

- collect, organize, present and analyze the data using different statistical tools.
- retrieve the data from biological databases and analyse .

Unit : I

Data –types Collection, Organization and Presentation of data-Table –types and components, graph, diagram.

Measures of central tendency; Mean, Median and Mode

Measures of Dispersion – Range, Standard deviation and variance

Unit : II

Correlation-types, Karl Pearson’s coefficient of correlation and Rank correlation

Regression – (X on Y, Y on X)

Unit III

Hypothesis Testing- Level of Significance, types of errors, region of acceptance and rejection-Chi-square test ,Student “t” test. Anova-one way

Application of MS-Excel for statistical analysis

Unit IV

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,

Unit V

Phylogenetic analysis- Phylogenetic Trees, types

Neighbor Joining method, Maximum parsimony.

3D structure prediction -Homology modeling Principles and steps in evaluation, Tool- SPDB viewer. Structure validation-Ramachandran plot-SAVES

Text books

1. Khan, I.A and Khanum, A., 2004, Fundamental of Bio- statistics, Ukaaz Publication, New Delhi.
2. Attwood, T.K. and Parry, D.J – Smith, D.J. 2002. Introduction to Bioinformatics. Pearson Education Pvt. Ltd..
3. Rastogi.S.C., Mendiratta, N and Rastogi, P.2009.Bioinformatics- Methods and Applications. 3rd Ed.PHI Learning Pvt.Ltd. New Delhi.

Reference books

- 1.Gupta, S.P., 1987, Statistical Methods, thirty third edition, Sulton Chand and Sons Publishers, New Delhi
- 2.Palanichamy, S. Manoharan,M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu.
3. Pandey, M. 2015 Biostatistics:Basic and Advanced. Viva Books Pvt. Ltd., New Delhi
- 4.Twyman, R.H. 2003. Instant notes on Bioinformtics. Viva Books Pvt. Ltd., New Delhi
- 5.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.
- 6.Mount, W. 2001. Bioinformatics sequence and genome analysis. Cold Spring harbour Laboratory Press, New York
- 7.Pevsner 2003. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi

Course designers

. Dr. RM.Murugappan

Skill based Electives

THIAGARAJAR COLLEGE, MADURAI – 9.
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Course	: B.Sc Microbiology (Skill based elective)	Int. Marks	: 15
Class	: II Year; IV Sem	Ext. Marks	: 35
Semester	: IV	Max. Marks	: 50
Sub. Code	: MISEC41(A)	Hours/Week	: 2

Title of the Paper : **Intellectual Property Rights**

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand basic in IPR, patent, copyright and trademark
- Learn the fundamentals of patenting of biological and biotechnological products

Unit-I

Intellectual Property Rights: concept, scope and economic importance. Types of intellectual property: origin and development. **Patent:** Patent Law, Patent Act 1970 with its amendment. Procedure for patent application and patent granting procedure. **Copyright:** Indian Copyright Act 1957 with its amendment; Ownership and duration of copyright; Need for protection of industrial design.

Unit-II

Trademark: Need for protection of trademarks, Indian Trademark Act 1999. **Patents of Biological materials in India:** Protection of plant varieties and farmers rights. Patenting - microbes, genes, traits, techniques. Plant and animal genetic protection right and implication of protection. WIPO, GATT, TRIP.

Text Book:

1. A. Raphael Miller, Micheal H. Davis 2000 Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers.
2. e-book: www.icsi.edu. Intellectual Property Rights-Law and Practices, Published by The Institute of Company Secretaries of India. New Delhi (2014).

Reference Books:

1. N.K. Acharya 2001 Textbook on intellectual property rights, Asia Law House .
2. K. Singh 2010 Intellectual Property rights on Biotechnology, BCIL, New Delhi
3. S. A. Stanley 2008 Bioethics, Wisdom educational service
4. F.K. Beier, R.S. Crespi, T. Straus 1985 Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi,
5. U. Sathyanarayana 2009. Biotechnology, Books and allied (p) Ltd, Kolkata
6. B.D. Singh 2009 Biotechnology, Kalyani publishers, New Delhi

Course designer

1. Dr. T. Rajagopal

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: B.Sc Microbiology (Skill based elective)	Int. Marks	: 15
Class	: II Year; IV Sem	Ext. Marks	: 35
Semester	: IV	Max. Marks	: 50
Sub. Code	: MISEC41(B)	Hours/Week	: 2
Title of the Paper : Bioethics and Biosafety			

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the ethical, social, legal aspects in biology and biocontainment.
- Learn the biological hazard and level of biosafety.

Unit-I

Introduction to Bioethics: Moral values on experimental animals, Human Genome Project and its implications. Detection of pre-symptomatic genetic diseases and its importance in healthcare. Ethical implication of biotechnological product and techniques. Institutional Animal Ethical Committee (IAEC).

Unit-II

Introduction to biosafety: Guidelines and regulation. Biosafety in laboratory: Laboratory associated infection and other hazards, Assessment of biological hazard and level of biosafety. Use of genetically modified organisms and their implications in environment. Institutional Biosafety Committee (IBSC).

Text Books:

1. Fleming,D.A. and D.L. Hunt.2001. Biological safety Principles & practices (3rd Ed.) ASM Press, Washington .
2. Rajmohan Joshi,2006. Biosafety and Bioethics, Gyan Publishing House, New Delhi

Reference Books:

3. Sathyanarayana U. 2009, Biotechnology, Books and allied (p) Ltd, Kolkata
4. Thomas,J.A. and R.L. Fush,2002 Biotechnology and Safety Assessment (3rd Ed.), Academic Press .
5. Sasson, A. 1988. Biotechnologies and Development, UNESCO publication

Course designers

1. **Dr. T. Rajagopal**

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: B.Sc Microbiology (Skill based elective)	Int. Marks	: 15
Year & Sem.	: II Year; IV Sem	Ext. Marks	: 35
Sub. Code	: MISEC41(C)	Max. Marks	: 50
Hours/Week	: 2	No of Credits	: 2
Title of the Paper: Bioenergy			

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the basic principle and application of bioenergy systems
- Know the fundamental concepts in bioconversion of biomass to energy
- develop designs for bioenergy conversion and scale up

UNIT I

Introduction to Renewable and non renewable energy resources; Biomass as a source of energy and its classifications; Trans esterification and combustion of biomass. Biofuels: Definition and Type – Ethanol & Methanol production using bagasse, Biodiesel from *Jatropha curcas* - Advantages and limitations

UNIT II

Microbial oil production from oleaginous microorganisms (Algae & Fungi) Advantages and Limitations. Microbial biogas production: methane & biohydrogen – Process design and Applications; Microbial Fuel Cell - Process design and Applications; National Biofuel policy

Text Books:

Rai G.D, (2007), Non-conventional energy sources, Khanna Publishers, New Delhi
Maheswari R. C. (1997) ; Bio Energy for Rural Energisation , Concepts Publication

Reference Book :

1. Caye M. Drapcho, Nghiem Phu Nhuan, Terry H. Walker. (2008) Biofuels Engineering Process Technology, The McGraw-Hill Companies
2. Ravindranath N. H. and D. O. Hall (1995); Biomass, Energy, and Environment: A Developing Country Perspective from India, Oxford University Press
3. Calle FR, de Groot P, Hemstock SL, Woods J (2007) The Biomass Assessment Handbook: Bioenergy for a sustainable environment, Earthscan, UK.
4. Lee S and Shah YT (2013) Biofuels and Bioenergy: Processes and Technologies, CRC Press, Boca Raton, FL, USA.
5. Viswanathan B (2006) An Introduction to Energy Sources- Indian Institute of Technology.

Course designer Dr.M.Karthikeyan

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: B.Sc Microbiology (Skill based elective)	Int. Marks	: 15
Class	: III Year VI Sem	Ext. Marks	: 35
Semester	: V	Max. Marks	: 50
Sub. Code	: MISEC61(D)	Hours/Week	: 2
Title of the Paper : Nanotechnology			

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the fundamental concepts of nanotechnology
- Understand the applications of nanostructures in biomedical science

Unit I:

Bionanotechnology: Fundamental concepts, scope and application. Different types of nanoparticles: Metallic nanoparticles: Gold, silver, titanium, Non metallic nanoparticles: carbon and silicon. Characterization of nanoparticles: UV-visible, FTIR, AFM, SEM, TEM and XRD.

Unit II:

Biomedical applications of nanoparticles: Targeted drug delivery- liposomes, nanoshells and hydrogels; Imaging technique-quantum dots and magnetic nanoparticles, Implants-orthopaedic and vascular, Bionanosensors-nanocantilevers based on single stranded DNA.

Activity: Lab Visit

Course designers

1. Dr. Poornima Kkani

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: B.Sc Microbiology (Skill based elective)	Int. Marks	: 15
Year & Sem.	: III Year; VI sem	Ext. Marks	: 35
Sub. Code	: MISEC61 (E)	Max. Marks	: 50
Hours/Week	: 2	No of Credits	: 2
Title of the Paper	: Stem cell biology		

Course Outcomes:

On the successful completion of the course, students will be able to

- explain the properties of stem cells and its importance
- understand the applications and social implications of stem cell therapy

Unit I

Definitions of stem cells, Pluripotency, Stem-cell plasticity, Regulators of pluripotency, Differences between adult and embryonic stem cells, Adult Stem Cell Niches, primordial germ cells as stem cells, common markers to identify stem cells, protocol for embryonic stem cells isolation.

Unit II

Introduction to Regenerative medicine, Clinical applications of hematopoietic stem cells, Stem cells in aging, Correlation between stem cells and cancer, Tissue regeneration, Stem cell banking, case study (spinal cord injury, cancer), Controversies on human embryonic stem cell research

References:

1. StemBook is an open-access (free) collection of original, peer-reviewed chapters covering topics related to stem cell biology. <http://www.stembook.org>.
2. Lodish et al. Molecular Cell Biology. 6th Ed., W.H. Freeman & Co. 2008
3. Stem cell biology, Daniel Marshak, Richard Gardner, David Gottleib, 2001. Cold spring Harbor Press. 0-87969-575-7/01 (e-book)

Course Designers:

- 1 **Dr. T S Ramyaa Lakshmi**
- 2 **Dr. C. Ravi**

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: B.Sc Microbiology (Skill based elective)	Int. Marks	: 15
Year & Sem.	: III Year; VI sem	Ext. Marks	: 35
Sub. Code	: MISEC61 (F)	Max. Marks	: 50
Hours/Week	: 2	No of Credits	: 2
Title of the Paper: Forensic Science (F)			

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the basic principles and application of forensic science
- Know the fundamental concepts in physical, chemical and biological methods of crime investigation

Unit I

Introduction to forensic Science –Development of Forensic science in India - Organization and functions of Forensic laboratory; Physical evidences - their classification and significance - Crime Scene examinations - documentation of crime scene- recognition, collection, preservation and transportation of physical evidence for laboratory examinations. Fundamentals of crime scene photography. Tool marks - identification - restoration of field off/erased marks.

Unit II

Foot and tyre impressions - examination of foot and tyre prints. Finger prints - Finger print patterns and classification – Toxicology - classification and mode of action of poisons - narcotic drugs - alcoholic beverages - Examination of biological fluids - blood, seminal and saliva stains - forensic characterization of the above stains - stain patterns of the blood, Examination of fibres, hair, bones, teeth and skull - DNA based paternity dispute analysis.

Text Books:

1. B.B. Nanda and R.K. Tiwari, 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi .
2. G.T. Duncan and M.I. 1997. Tracey in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton .

Reference Book :

1. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's (2013) Techniques of Crime Scene Investigation, CRC Press, Boca Raton .
2. S.H. James and J.J. Nordby (2005) Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton.
3. T. Bevel and R.M. (2008) Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton.
4. Poklis (1997) Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton.

Course designers

1. Dr. R.M. Murgappan 2. Dr. M. Karthikeyan

Allied papers (Generic Elective)

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after)

Revised Ancillary Zoology Syllabus

For Botany and Chemistry Major Students – w.e.f. 2017 June

Major	Year	Sem	Code	Title of the Paper	Cont Hrs/W	Credit
Botany	I	1	AZ11	Economic Zoology	4	4
		II	AZ21	Insect Pests and Management	4	4
		II	AZL21	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%

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after)
(For those joined B.Sc Chemistry and Botany on or after June 2017)

Course	: B.Sc Microbiology (Generic elective)	Int. Marks	: 35
Class	: Allied Chemistry & Botany	Ext. Marks	: 75
Semester	: II B.Sc., Chem (III Sem): I B.Sc., Botany (I Sem)	Max. Marks	: 100
Sub. Code	: AZ11 , AZ31	Hours/Week	: 4
Title of the Paper : Economic Zoology			

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the importance of beneficial insects and animals
- Study the rearing methods of beneficial organisms – an economic perspectives

Unit I Sericulture

Importance of sericulture, Sericulture industry in India. Moriculture: Morphology of mulberry plants, methods of propagation. Classification of mulberry silkworm and non-mulberry silkworm, life cycle of mulberry silkworm (*Bombyx mori*), rearing of silkworms, diseases of silkworm (maggot, pebrine, polyhedrosis, flacherie).

Unit II Lac culture

Economic importance, lac industry in India. Life history of lac insect, Host plants, rearing of lac insect, Processing of lac, composition of lac, Enemies of lac cultivation.

Unit III Apiculture

Classification of bee's (rock bee, Indian bee, little bee, European bee, dammer bee), social organization of honey bee, bee dance, life history of *Apis indica*, Composition of honey, bee keeping equipments. Methods of bee keeping: Indigenous and modern (Newton's Bee hive) methods. Economic importance of honey.

Unit IV Poultry

Poultry industry in India, choosing a commercial layers and broilers, poultry house (deep litter and cage systems), rearing of layers and broilers. Nutritional content: egg and flush. Diseases (Ranikhet, pullorum, Aspergillosis, Coccidiosis and their control).

Unit V Aquaculture

Qualities of culturable fishes, Culture of Indian major carps (Catla, Rohu) and cat fishes (Parhin, Tengra), fish farming (pond, riverine, dam, lake cultures), fish breeding (natural and induced), fish harvesting, preservation of fish, water quality management, ornamental fish culture and its economic importance.

Text Books:

1. Shukla, G.S. and V.B. Upadhyay, Economic Zoology, First edition, Rastogi publication, Meerut (1985).
2. Arumugam, N. 2001. Applied Zoology, Saras Publication,

Reference Books:

1. David, B.V., and T. Kumaraswami, Elements of Economic Entomology, Popular Book Depot, Chennai (2000).
2. Ravindranathan, K.R., A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi (2005).
3. Ahsan, J. and S.P. Sinha, A hand book on Economic Zoology, Third edition, S. Chand & company (P) Ltd., New Delhi (1985).
4. Kotpal, R.L., S.K. Agrawal and R.P. Khetarpal, Invertebrate Zoology, Sixth edition, Rastogi publication, Meerut (1985).
5. Nayar, K.K., T.N. Ananthakrishnan, and B.V. David, General and applied entomology. McGraw-Hill publishing company (Ltd.), New Delhi (1976).
6. Rathinasamy, G.K., Medical entomology and elementary parasitology, Viswanathan publication, Chennai (1999).

Course designers (Name of the staff)

1. Dr. T. RAJAGOPAL
2. Dr. P. SURESH

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))
(For those joined B.Sc Chemistry on or after June 2017)

Course	: Allied Chemistry	Int. Marks	: 25
Class & Sem	: II Year IV.Sem	Ext. Marks	: 75
Sub.Code	: AZ41	Max. Marks	: 100
Hours/Week	: 4	No.of Credits	: 4
Title of the Paper: Clinical Chemistry			

Course Outcomes:

On the successful completion of the course, students will be able to

- learn the principle and applications of analytical instruments
- understand the basis & clinical significance of the urine, blood, serum analysis

Unit I: Analytical instruments

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

Unit II: Urine analysis

Collection and preservation of urine sample- Physical properties of urine (total volume, specific gravity, colour, turbidity and odour) –Components of urine - Bile salts and Bile pigment, urea – Abnormal components of urine - proteins, sugar, ketone bodies - Diseases associated with abnormalities in urine

Unit III: Blood analysis

Blood composition - Collection of blood samples- anticoagulants – Haemoglobin & Anaemia – ESR as an indicator of infection- blood sugar & diabetes - blood urea & kidney function .

Unit IV: Serum analysis

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

Unit V: Hormones and Enzymes

Clinical significance of Thyroid hormones 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.

Reference books.

1. Park, J.E. and Park. 2000. Text book of preventive and social medicine, 17th Edition, Banarasidas Publishers, Jabalpur.
1. David, S. Jacobs, Wayne R. Demott, Paul R. Finley, 1994, Laboratory Test Hand Book, third edition, Key word index, Laxi-Compinc, Hudson.
2. Kathleenbecan, M.C., Bride, 1982, Text Books of Clinical Laboratory supervision, Century Crosts, New York.

3. Rapael, S.S., 1983, Lynch Medical Laboratory Technology, Fourth edition, W.B. Saunders Co, Singapore.
4. Ochei, J and Kolkatkar, A. 2009. Medical Laboratory Science – Theory and Practice. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.

Course Designers :Dr.Poornimakkani

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after)
(For those joined B.Sc Chemistry on or after June 2017)

Course : Allied Lab for B.Sc. Chemistry
Class& Sem : II Year & IV sem.
Sub. Code : AZL41/AZL21
: 100
Hours/Week : 2

Int. Marks : 40
Ext. Marks : 60
Max. Marks

No of Credits : 2

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

Economic Zoology

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

Clinical Chemistry

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

Reference Books

1. Ravindranathan, K.R., 2005, A text book of Economic Zoology, Dominant publisher and distributors (P) Ltd., New Delhi.
2. Shukla, G.S and V.B. Upadhyay, 1985, Economic Zoology, First edition, Rastogi publication, M
3. Sood, R, 1999, Medical Laboratory Technology – Methods and Interpretations – Fifth edition, Jaypee, New Delhi.

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after)
(For those joined B.Sc Botany on or after June 2017)

Course	: B.Sc Microbiology (Generic elective)	Int. Marks	: 35
Class	: Allied Botany	Ext. Marks	: 75
Semester	: I B.Sc., Botany (I Sem)	Max. Marks	: 100
Sub. Code	: AZ21	Hours/Week	: 4
Title of the Paper : Insect Pest Mangement			

Course Outcomes:

On the successful completion of the course, students will be able to

- Provide an idea the pest of agricultural, cattle, house hold and vectors
- Know different control measures

Unit I:

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

Unit II:

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

Unit III:

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

Unit IV

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

Unit V

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

Text Books:

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

Reference Books:

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

Course designers

1. Dr. T. Rajagopal
2. Dr. P. Suresh

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))
(For those joined B.Sc Botany on or after June 2017)

Course	: Allied lab for B.Sc., Botany	Int. Marks	: 40
Class& Sem	: I Year & II sem.	Ext. Marks	: 60
Sub. Code	: AZL21	Max. Marks	: 100
Hours/Week	: 2	No of Credits	: 2

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

Economic Zoology

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

Insect Pests & Management

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

Reference Books:

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

M.Sc., Zoology

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after)
M. Sc., Zoology Course Structure (w.e.f. 2017 batch onwards)

I semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max MarkSE	Total
Core1	1PZ1	Biological Chemistry & Biophysics	5	4	75	25	75	100
Core2	1PZ2	Microbiology	5	4	75	25	75	100
Core3	1PZ3	Genetics & Evolution	5	4	75	25	75	100
Core Elective1	1PZE1	Animal Biology	6	5	90	25	75	100
Lab1	1PZL1	Lab in Biological Chemistry and Biophysics	3	2	45	40	60	100
Lab2	1PZL2	Lab in Microbiology	3	2	45	40	60	100
Lab3	1PZL3	Lab in Genetics & Evolution	3	2	45	40	60	100
		Total	30	23				

II Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	MaxMark CA	Max MarkSE	Total
Core4	2PZ1	Entomology	5	4	75	25	75	100
Core5	2PZ2	Cell & Molecular Biology	5	4	75	25	75	100
Core6	2PZ3	Bioinstrumentation	5	4	75	25	75	100
Core Elective2	2PZE1	Biostatistics	6	5	90	25	75	100
Lab4	2PZL1	Lab in Entomology	3	2	45	40	60	100
Lab5	2PZL2	Lab in Cell & Molecular Biology	3	2	45	40	60	100
Lab 6	2PZL3	Lab in Bioinstrumentation	3	2	45	40	60	100
		Total	30	23				

III Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Maxmark CA	Max MarkSE	Total
Core7	3PZ1	Genetic Engineering & Biotechnology	5	4	75	25	75	100
Core8	3PZ2	Animal Physiology	5	4	75	25	75	100
Core9	3PZ3	Developmental Biology	5	4	75	25	75	100
Core Elective3	3PZE1	Applied Zoology	6	5	90	25	75	100
Lab 7	3PZL1	Lab in Genetic Engineering and Biotechnology	3	2	45	40	60	100
Lab 8	3PZL2	Lab in Animal Physiology	3	2	45	40	60	100
Lab 9	3PZL3	Lab in Developmental Biology	3	2	45	40	60	100
		Total	30	23				

IV Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core10	4PZ1	Immunology	5	4	90	25	75	100
Core11	4PZ2	Ecology and Biodiversity	5	4	90	25	75	100
Core 12	4PZ3	Bioinformatics	5	4	90	25	75	100
Lab 10	4PZL1	Lab in Immunology	3	2	45	40	60	100
Lab11	4PZL2	Lab in Ecology & Biodiversity	3	2	45	40	60	100
Lab12	4PZL3	Lab in Bioinformatics	3	2	45	40	60	100
Elect	4PZE1	Project	6	3	90	50	50	100
		Total	30	21				

Contact hrs and credit distribution

Semester	Contact Hrs/ Week	Credits
I	30 hrs	22
II	30 hrs	22
III	30 hrs	22
IV	30 hrs	24
Total	180 hrs	140

	No of papers	Credit/ paper	Total Credit
Core Theory	12	4	48
Core Lab	12	2	24
Elective	3	5	15
Project	1	3	03
Total			90

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with 'A' Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Zoology (Core Paper-1)	Int. Marks	: 25
Year & Sem	: I Year; I Sem	Ext. Marks	: 75
Sub. Code	: 1PZ1	Max. Marks	: 100
Hours/Week	:5	No of Credits	: 4
Title of the Paper	: Biological Chemistry and Biophysics		

Course Outcomes:

On the successful completion of the course, students will be able to

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

Unit I

Water: Molecular structure of water–Non-covalent bonding: Hydrogen bond, electrostatic interaction–Van de Waals forces thermal, solvent properties ionization of water – colligative properties of aqueous solution–Calculations of pH mixture-dissociation of water-pH- dissociation of weak acids–Henderson-Hasselbalch equation – Buffer solutions- Physiological buffers (Carbonate and phosphate buffers)

Carbohydrates: Classification-Structure, properties glucose, fructose, galactose, lactose, maltose, sucrose, starch, glycogen, cellulose and chitin and their biological importance. Metabolism and its regulation: Glycolysis – Kreb's cycle – gluconeogenesis, glycogenesis, glycogenolysis, HMP shunt.

Unit II

Nucleic acid structure: RNA and DNA, synthesis and metabolism (De nova and Salvage Pathway)- Amino acids: Basic structure and classification- Physical and chemical properties-Biosynthesis of amino acids. Proteins: Classification -Levels of organization – primary, secondary (Molecular α -helix and β -pleated sheets, tertiary and quaternary. Ramachandran plot. Metabolism: Transamination, deamination and transmethylatation.

Unit III

Lipids: Classification-Structure of triglycerol, waxes, phospholipids, cholesterol and terpenes
Properties and reactions- Biological importance. Biosynthesis of fatty acids and cholesterol
Degradation of fatty acids and cholesterol-Ketone bodies and lipid peroxidation.

Unit IV

Vitamins: Structure, occurrence and biochemical functions
Enzymes: Properties, classification, enzyme action- regulation (Genetic control, Covalent modification, allosteric regulation, compartmentation) , enzyme kinetics: Michaelis-Menten-Lineweaver-Burk plots, enzyme inhibitors/activators Coenzyme, isoenzyme, allosteric enzyme, abzyme and ribozyme

Unit V

Diffusion – Fick's laws, constant laws– osmotic gradient–osmotic coefficient – Gibbs Donnan equilibrium – Active transport-Laws of thermodynamics – Concept of free energy and entropy – exergonic and endergonic reaction – rate of reactions – energy activation – Arrhenius expression-Bioenergetics – Role of ATP – biological oxidation reduction reaction – redox potentials in biological system – respiratory chain and oxidative phosphorylation – high energy compounds.

Text Books

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

Reference Books:

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

Course designers

1. Dr.C. Balasubramanian

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Zoology (Lab-1)	Int. Marks	: 40
Year & Sem	: I Year; I Sem	Ext. Marks	: 60
Sub. Code	: 1PZLI	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2
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 Titration of weak acid and strong base (titration curve)
5. Colorimeter: Quantitative estimation of
 - i) Carbohydrates
 - ii) Proteins
 - iii) Lipids
6. Quantitative estimation of ascorbic acid
7. Enzymes: Analysis of amylase activity
 - i) Effect of substrate concentration
 - ii) Effect of pH
 - iii) Effect of temperature
8. Osmosis – Haemolysis and Plasmolysis
9. Demonstration of Hill reaction
10. Verification of Thermodynamic laws

Reference Books:

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

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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Core Paper-2)	Int. Marks	: 25
Year & Sem	: I Year; I Sem	Ext. Marks	: 75
Sub. Code	: 1PZ2	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4
Title of the Paper	: Microbiology		

Course Outcomes:

On the successful completion of the course, students will be able to

- Know the history and development of Microbiology and to get fundamental knowledge about microbes
- Understand and explore the world of microorganisms in different spheres of life

Unit-I

Microbes in our lives

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

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

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

Unit-II

Microbial Growth – Physical & Chemical requirements; Phases of growth

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

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

Distinguishing characteristics of Fungi –Filamentous, non-filamentous and dimorphic fungi; Morphology and structure of *Aspergillus niger* and *Saccharomyces cerevisiae*.

Unit-III

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

Unit-IV

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

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

Unit-V

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

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

Text Books

1. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. 2009. Microbiology, 5th edition. McGraw-Hill. Book Co. Singapore
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9th edition, Pearson Education, Singapore

Reference Books

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

Course designers

Dr.N.K. Asha Devi

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Lab-2)	Int. Marks	: 40
Year & Sem	: I Year; I Sem	Ext. Marks	: 60
Sub. Code	: 1PZL2	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2
Title of the Paper : Lab in Microbiology			

General Microbiology

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

Reference Books

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

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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology Core-3	Int. Marks	: 25
Year & Sem.	: I	Ext. Marks	: 75
Sub. Code	: 1PZ3	Max. Marks	:100
Hrs/ week	:5	Total Credits	:4
Title of the Paper : Genetics and Evolution			

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the principles of genetics, inheritance, sex determination, chromosomal anomalies
- Understand the concept of evolution, nature’s selection, adaptation mechanism

Unit I:

Historical Background of Genetics: Vapour and fluid theories, Preformation theories, Epigenetic theory and Particulate theories. Application of Genetics. Mendel’s Study of Heredity: Monohybrid Crosses (pea plant), Mendel’s laws of Dominance and Segregation, Dihybrid Crosses (pea plant), Mendel’s laws of Independent Assortment (guinea pig). Deviations from Mendelian Inheritance: Incomplete Dominance (flower color in snapdragons and Punnet’s gametic check board method). Multiple Allelic Inheritance: Blood group inheritance in Humans and Inheritance of coat colour in rabbits.

Unit II:

Linkage: Theories and kind of linkage, Autosomal linkage in Sweet pea flowers. Crossing over: characteristics, types and mechanism. Chromosome mapping: Determination of map distance (two points test cross), Determination of gene order (three point test cross). Sex determination: by environment, hormone and genetically controlled sex determining mechanisms (genic balance mechanism, Haplodiploid mechanism, single gene control of sex). Sex Linked inheritance: X-Linked Inheritance (eye colour in Drosophila, colour blindness and haemophilia in humans), Y-linked inheritance (hairy pinna in males).

Unit III:

Chromosomal changes: Numerical changes in chromosomes (euploidy, haploidy, polyploidy and aneuploidy). Structural changes in chromosomes: Inversion, Translocation, Deletion, Duplication. Syndromes: Down, Edward, Turner syndrome and Klinefelter Syndromes. Detection of chromosomal anomalies: Pedigree analysis, Human Karyotyping, Prenatal diagnostics (Amniocentesis, Chorionic Villus sampling). Genetic counseling for human welfare.

Unit IV:

Origin of life: Theory of special creation, theory of spontaneous generation and modern concept of origin of life. Evidences for evolution: Homologous and analogous structures, vestigial organs, embryological evidences, physiological & biochemical and fossil evidences. Theories of organic evolution: Lamarckism and Neo Lamarckism, Darwinism and Neo-Darwinism. Mutation Theory, Concepts of Natural Selection: Three modes of Natural

Selection (stabilizing, directional & disruptive selection), Selection in action - Industrial Melanism, adaptive radiation in Darwin's Finches, mimicry & colouration.

Unit V:

Hardy Weinberg equilibrium: Hardy Weinberg law and Genetic drift. Speciation: Species concept, types of speciation, mechanism of speciation, Isolation Mechanisms: Geographical and Reproductive isolation. Evolution of Man: Australopithecus, Neanderthal, *Homo habilis*, *Homo erectus*, *Homo sapiens*. Geological time scale.

Textbooks:

1. Verma, P.S and V.K. Agarwal. 2016. Genetics, 9th Edition, S.Chand Publications. New Delhi.
2. Peter J. Russell. 2010. Genetics: A Molecular Approach, 3rd Edt, Pearson Publications, USA
3. D. Peter Snustad, Michael J. Simmons, 2015. Principles of Genetics, 7th Edition, John Wiley & Sons, Inc.,

References:

1. Peter E. Rosenbaum. 2010. Volpe's Understanding Evolution, McGraw-Hill, New York.
2. Dodzhansky, T., Francisco J. Ayala, G.L. Stebbins, James W. Valentine. 1977 Evolution, W.H. Freeman & Company, San Francisco.
3. Ledyard Stebbins, G. 1966. The process of Organic Evolution, Prentice – Hall, New Jersey.
4. Edward O. Dodson. 1960. Evolution: Process and Product, Reinhold Publishing Corporation, New York .
5. Gardner Eldon, J., D. Peter Snustad. 2006. Principles of Genetics, 8th Edition. John Wiley & Sons,

Course Designer

Mrs. U. Soundarya

Dr. T. Rajagopal

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Lab-3)	Int. Marks	: 40
Year & Sem	: I Year; I Sem	Ext. Marks	: 60
Sub. Code	: 1PZL3	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2

Title of the Paper : **Lab in Genetics and Evolution**

1. Identification of Colourblindness among the students using Ishihara's colour chart.
2. Survey of Mendelian traits among the students.
3. Study of polygenetic inheritance among the students using finger print.
4. Study of Hardy-Weinberg Equilibrium using two different colour beads.
5. Action of Natural Selection in population using colour beads.
6. Genetic drift in a small population using colour beads.
7. Chi-square test using colour beads to demonstrate population genetics.
8. Statistical investigation of continuous variation using seed pods (Mean, Median, Mode, Standard deviation and Standard Error).
9. Demonstration/Models/Spotters:
 - (a) Monohybrid and Dihybrid crosses
 - (b) Down Syndromes,
 - (c) Turner syndrome,
 - (d) Edward Syndromes
 - (e) Klinefelter Syndromes
 - (f) Homologous structure: fore limb skeleton of vertebrates
 - (g) Living fossil: Peripatus
 - (h) Animal fossil: *Physa princepii*
 - (i) Adaptation in beak and feet of birds
 - (j) Batesian and mullerian mimicry

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Course	: M.Sc Zoology (Elective-1)	Int. Marks	: 25
Year & Sem.	: I year & I sem.	Ext. Marks	: 75
Sub. Code	: 1PZE1	Max. Marks	:100
Hrs/ week	:6	Total Credits	:5

Title of the Paper: Animal Biology

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the basics of animal biology
- have a comparative knowledge on the organization in various animal groups

Unit I

Origin of life – unicellular to multicellular organization – significance of metamerism and symmetry – Acoelom, pseudocoelom and eucoelom; Classification of animals up to class level and their general characteristics – Binomial nomenclature - Affinities and systematic position of cephalochordate, hemichordate and urochordata.

Unit II

Types of gills and lungs – tracheal system - respiratory pigments – accessory respiratory organs – types of respiration in frog. Circulatory system – open and closed – two, three and four chambered heart – hemolymph and blood – anatomy of artery, vein and capillary. Excretory organs – flame cells, nephridium, malphigian tubules - renal, rectal, antennal and coxal glands and kidneys.

Unit III

Nerve net in hydra, ladder like structure in flat worms, segmented nervous system in annelids, ganglia in insects, comparison of brain in vertebrates. Locomotion, reproduction and economic importance of protozoa; canal system in sponges – asconoid, syconoid, leuconoid and rhagon types, spicules in sponges.

Unit IV

Comparison of reproduction in Obelia and Aurelia, polymorphism in coelenterates, Peripatus and its evolutionary significance, metamerism in Annelida, foot, torsion and filter feeding in Mollusca, mechanism of pearl formation, Limulus and its significance, Crustacean larval forms – nauplius, metanauplius, zoea, cypris, mysis, megalopa, phyllosoma and alima; affinities of Peripatus and water vascular system in Echinodermates.

Unit V

Feeding in Amphioxus, retrogressive metamorphosis in Ascidian, comparison between Lampreys and Hag fishes, placoid scales of Shark, parental care and migration in Fishes, parental care in Amphibians, poison apparatus and biting mechanism in Snakes, key for identification of poisonous and nonpoisonous Snakes, significance of Archaeopteryx, flight adaptation and migration in Birds, placentation and adaptive radiation in Mammals, egg laying mammals.

Text Books

1. Barnes, R.D. 1982. Invertebrate Zoology, IV Ed., Holt Saunders International Edition.
2. Barrington, E.J.W. 1979. Invertebrate structure and functions, II Ed., ELBS & Nelson.
3. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
4. Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar, India

Reference Books

1. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
2. Ekambaranatha Iyer, M. and Ananthakrishnan, T.N. 2003. A Manual of Zoology. Viswanathan Publications, Chennai.
3. Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.
4. Hyman, G.H. The Invertebrates, Vol. I to VII, McGraw Hill Book Co., Inc., New York.
5. Kotpal, R.L. 2005. Invertebrate Zoology, Rastogi Publications, Meerat.
6. Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra - 282 003, 477 pp.
7. Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp
8. Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan & Co., New York, 587 pp.

Course Designer

1. **Dr. C. Ravi**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Core Paper-4)	Int. Marks	: 25
Year & Sem	: I Year; II Sem	Ext. Marks	: 75
Sub. Code	: 2PZ1	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4
Title of the Paper: Entomology			

Course Outcomes:

On the successful completion of the course, students will be able to

- Classify the insects and will be able to identify the different insects
- Learn 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: Apteriygota- Pterygota: Exopterygota (Hemimetabolous): Paleopteroid, Orthopteroid, Hemipteroid orders -Endopterygota (Holometabolous): Coleopteroid, Neuropteroid, Panorpoid and Hymnopteroid orders-Studies on molecular evolutionary relationship between different groups of insects

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 difference, aediagus; Female –panoistic, meroistic, telotrophic, polytrophic ovaries, spermatheca, -Endocrine system: Structure of Corpora cardiac(CC), Carpora allata (CA) and neurosecretary cells(NSC); ecdysone, neuropeptides, prothoracicotropic hormone (PTTH), ATH, JH and JH analogues

Unit III

Pests and Pest Management –Economic threshold level, Pests: Pests of Cotton (*Pectinophora gossypiella*, *Aphis gossypii*, and *Helicoverpa armigera*) Paddy (*Scirpophaga incertulus*, *Aphis dorsalis*, *Nephotettix virescense*), Sugarcane *Chilo infuscatellus* and *Alerolopus parodonsis*). Ground nut (*Amsacta albistiga*, *Cnephalocrocis medinalis* and *Aphis craccivora*, Tomato (*Amrasca bigutalla biguttala*, *Aphis sp.*) Brinjal- (*Leucinodes orbanals*, *Phemberules affinis*)- IPM concept, methods and tools (Case study on cotton)-Chemical control: Insecticide – Classification, nomenclature, toxicity, mode of entry, mode of action, synergistic – formulations, repellents, attractants- law and regulations.

Unit IV

Biological Control: Parasitoids (Egg, larval, pupal and adult parasitoids) and predators – Genetic Control - Breeding insect resistance host; Ecological control – Cultural and mechanical; microbial control – Bacteria – *Bacillus thuringiensis*-Fungi – *Metarhizium anisopliae*, *Beauveria bassiana*- Virus – nuclearpolyhedral virus (NPV) and Granulosis virus (GV)-Protozoans: *Nozema locustae* Nematode: *Stenernema sp.*, and *Heterorhbdidis sp.*

Unit V

Bombyx mori –Biology and silk secretion-Grainage technology- Silkworm rearing-Pests and Disease management-Biology and silk production of non-mulberry silkworm: Eri, Muga and Tasar-Silk reeling and marketing

Text books

1. David, B.V.2002 Elements of Economic Entomology. Popular Book Depot, Madras.
2. Dungston Ambrose P. The Insects.

Reference Books

1. Chapman, R.F. 2008. The insects: Structure and Function. ELBS.
2. Chapman, R.F. and Joern, A. 1990. (eds.). Biology of Grasshoppers. John Wiley & Sons, New York.
3. Tembhare, D.B. 2009 Modern Entomology, Himalaya publishing house, Mumbai.
4. Romoser,W.S., Stoffolano Jr, J.G .1998, Entomology, fourth edition, WCB Mc Graw Hill Publishing Co.
5. David, B.V and. Ananthakrishnan, T.N. 2004. General and Applied Entomology. Tata Mc Graw Hill Publishing Co.
6. Pedigo, L.P. 2009. 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
10. Ganga, G. and Sulochana chetty,J. 1997. Introduction to Sericulture. II Edn, Oxford and IBH publishing Co Pvt. Ltd.

Course designers

1. **Dr.P.Suresh**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Lab-4)	Int. Marks	: 40
Year & Sem	: I Year; II Sem	Ext. Marks	: 60
Sub. Code	: 2PZLI	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2

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

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

Reference books

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

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

Course Outcomes:

On the successful completion of the course, students will be able to

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

Unit I

Microscopy: Working mechanism and applications of light, phase-contrast, fluorescent, electron (TEM & SEM) and confocal microscopy

Cell theory ; Ultrastructure of plant and animal cells.

Structure and function of organelles - Nucleus, endoplasmic reticulum, golgi complex, mitochondria, ribosomes, lysosomes, cytoskeletal structures

Unit II

The cell membrane & its properties ; Fluid mosaic model of Plasma membrane; Integral & peripheral membrane proteins.

Cell junctions- gap junctions, tight junctions & anchoring junctions

Transport of molecules across the membrane- diffusion & facilitated diffusion & active transport(Sodium Potassium ATPase pumps).

Intracellular Vesicular Trafficking

Structural organization of Eukaryotic Chromosome ; giant chromosomes.

Unit III

Cell signalling- G-protein coupled and TGF β receptor system

JAK/STAT, Ras and MAP kinase pathway

Cell cycle & its regulation- mitosis and meiosis

Molecular and biochemical characteristics of cancer cells

Cell ageing, Cell death and its regulation

Unit IV

Experimental evidence for DNA as genetic material

DNA- structure, types, replication (both prokaryotes and eukaryotes) and Holliday model of recombination

RNA –structure, types and function

Mutation- types & repair mechanisms

Unit V

Transcription of mRNA prokaryotes and eukaryotes & post transcriptional modification

Translation in prokaryotes and eukaryotes & Post translational modifications

Bacterial Genetics- Regulation of gene expression - prokaryotes: lac and trp operon

Plasmids – types and function

Mechanisms of Gene transfer in bacteria - transformation, conjugation and transduction

Mobile Genetic Elements

Text Books

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

Reference Books

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

Course designers

Mrs. U.Soundarya

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Zoology (Lab-5)	Int. Marks	: 40
Year & Sem.	: I Year; I sem.	Ext. Marks	: 60
Sub. Code	: 2PZL2	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2

Title of the Paper : Lab in Cell and Molecular Biology

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

Reference Books

1. Brown, T.A. 1998. Molecular Biology Lab; Gene Analysis, Academic Press, London.
2. Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.
3. 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
4. Rajamanickam, C.2001 Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
5. S.Janarthanan and S.Vincent 2007.Practical Biotechnology, Methods and Protocols. Univrersity Press, Hyderabad., India
6. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Zoology (Core Paper-6)	Int. Marks	: 25
Year & Sem	: I Year; II Sem	Ext. Marks	: 75
Sub. Code	: 2PZ3	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4

Title of the Paper: **Bioinstrumentation**

Course Outcomes:

On the successful completion of the course, students will be able to

- learn the theoretical principles of the various analytical instruments used in biology
- have a thorough understanding on the working mechanism of various instruments
- apply and handle the various instruments for their routine laboratory and project work

Principle, working mechanism and applications of:

Unit I

Basic principles of light rays – Reflection, Refraction, Diffraction, Dispersion and Polarisation. **Principle, working mechanism and applications of:**

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

Unit II

Principle, working mechanism and applications of:

pH meter, Centrifuge (Clinical, Density gradient and Ultra) – preparative and analytical - sedimentation coefficient, RCF, RPM; Incubator, Hot air oven, Autoclave, Quebec colony counter, GM counter, Liquid Scintillation counter, Sonicator, Lyophilizer, Micropipettes and Filters (HEPA, membrane).

Unit III

Principle, working mechanism and applications of:

Colorimeter – Beer & Lamberts law, Spectrophotometer (visible, ultraviolet), FTIR, Flame Photometer, Atomic Absorption and Mass Spectrophotometer. ELISA reader, Sphygmomanometer.

Unit IV

Principle, working mechanism and applications of:

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

Unit V

Principle, working mechanism and applications of:

SDS-PAGE, Native PAGE, Agarose Gel Electrophoresis, 2D Gel Electrophoresis, Gel Documentation, Southern, Northern and Western blotting, PCR and FACS.

Text Books

1. Jeyaraman, J., 1985. Lab. Manual in Biochemistry, Wiley Eastern Ltd, New Delhi.
2. Roy, R.N. 1996. A Textbook of Biophysics. New Central Book Agency (P) Ltd. Calcutta.
3. Veerakumari, L. 2009. Bioinstrumentation. MJP Publishers, Chennai.

Reference Books

1. Alonso, A., and Arrondo, J.L.R. 2006. Advanced Techniques in Biophysics. Springer, UK.
2. Boyer, R.F. 1993. Modern Experimental Biochemistry. The Benjamin Cummings Publishing Company, Inc., New York.
3. Chatwal, G.R and Anand, S.K. 2009. Instrumental Methods of Chemical Analysis. Himalaya Publishing House, New Delhi.
4. Ghatak K.L. 2011. Techniques and Methods in Biology. PHI Learning Pvt. Ltd. New Delhi
Gupta A. 2009. Instrumentation and Bio-Analytical Techniques. PragatiPrakashan, Meerut.
5. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K. 2004. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Publishers Pvt. Ltd., New Delhi, India.
6. Palanichamy, S. and Shanmugavelu, M. 2011. Principles of Biophysics, 2nd Edition, Palani Paramount Publications, Palani.
7. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques. School of Biotechnology, Madurai Kamaraj University, Madurai.
8. Plummer, D.T. 2008. An Introduction to Practical Biochemistry. Tata McGraw Hill Publications, New Delhi.
9. Sandhu, G.S. 1990. Research Techniques in Biological Sciences. Anmol Publications, New Delhi.
10. Sawhney, S.K. and Singh, N. 2000. Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.
11. Warton, D.C. and McCarthy, R.E. 1972. Experiments and Methods in Biochemistry. MacMillan, New York.
12. Williams, B.L. and Wilson, K. 1983. A Biologist's Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold Publishers Ltd., London.
13. Wilson, K. and Walker, J. 2003. Principles and Techniques of Practical Biochemistry, 5th Edition Cambridge University Press, New York.

Course Designers

- **Dr. C. Ravi**
- **Dr. T.S. Ramyaa Lakshmi**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Lab-6)	Int. Marks	: 40
Year & Sem.	: I Year; II sem.	Ext. Marks	: 60
Sub. Code	: 2PZL3	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2

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

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

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Elective Paper-2)	Int. Marks	: 25
Year & Sem	: I Year; 2 Sem	Ext. Marks	: 75
Sub. Code	: 2PZE1	Max. Marks	: 100
Hours/Week	: 6	No of Credits	: 5
Title of the Paper: Biostatistics			

Course Outcomes:

On the successful completion of the course, students will be able to

- Recognise the type of variables, summarise the data and construct suitable graphical representation of data and understand the basics of experimental design including randomization, and control
- Set and interpret significance levels (P value) for datasets and explain the probability background of the hypothesis tested
- Understand the conditions which determines the choice of statistical tests and conclude the experimental results with statistical conclusions
- Use Microsoft excel to perform summary statistics and inferential statistics

Unit I- Descriptive statistics

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

Unit II-Summary statistics

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

Unit III-Hypothesis testing-I

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

Unit IV-Hypothesis testing-II

Single factor ANOVA; basic assumptions under ANOVA, loss of replications, ANOVA with two treatments. Tests for A posteriori comparisons/Multiple comparisons- Tukey test. Practical training using MS-Office excel.

Unit V- Bivariate analysis

Correlation – types, methods of correlation – graphical method, mathematical method; Karl Pearson’s Rank; Regression analysis – equation, estimation of unknown value from known value; Mann-Whitney U test, Chi-square test, test of independence; Data transformations. Arcsine, logarithmic and square root transformations.

Text Books

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

Reference Books

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

Course Designer

Dr.C.Binu Ramesh

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Zoology (Core Paper-7)	Int. Marks	: 25
Year & Sem	: II Year; 3 Sem	Ext. Marks	: 75
Sub. Code	: 3PZ1	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4
Title of the Paper : Genetic Engineering and Biotechnology			

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the basic principles of genetic engineering
- learn the fundamental steps in gene cloning and manipulation
- know the popular techniques used in biotechnology

Unit I:

Tools for Genetic engineering – restriction endonucleases – modifying enzymes – ligases, alkaline phosphatase, S1 Nuclease, PNKase. Properties of cloning vectors, Vectors used in cloning: recombinant Plasmids -PBR322, PUC, plant plasmid vector-Ti plasmids, Phage vectors -lambda ; hybrid vectors- Cosmids – Phagemids, Expression vectors –pET and shuttle vectors- YACs , BACs, animal viral vectors -adeno

Unit II:

Cloning strategies: Steps involved in producing recombinant clones, Preparation of Genomic and cDNA libraries. Methods of gene transfer to: bacterial host- (direct transformation- heatshock and electroporation), plants- (indirect transformation (*A.tumefaciens* based, physical delivery methods-PEG mediated, microinjection, particle gun). Gene transfer methods in animals (transfection)- using fertilized eggs and cultured stem cells)

Unit-III:

Selection of recombinants using antibiotic sensitivity, blue white screening and Molecular probes (DNA and antibody based). Radioactive and non-radioactive probes. Expression and purification of cloned products. Applications of animal cell culture as models for microbial biotechnology, genetic studies, drug testing, gene therapy, pharmaceutical products. Animal bioreactors and molecular Pharming.

Unit-IV:

Animal cell culture: Primary and Continuous Cell culture, adherent and suspension cultures; functional characteristics of cultured cells. Composition of animal cell culture media. Cryopreservation of animal cells, Organ culture, whole embryo culture and tissue engineering (artificial skin and cartilage). Transgene, transgenesis, Animal cloning (nuclear transfer method -Dolly). Transgenic animals (Sheep and fish) and Plants (Bt cotton, drought resistant plants and its applications.

Unit –V:

Basic Techniques in Biotechnology: PCR-(Nested, RT PCR) DNA finger printing (RAPD and RFLP), DNA sequencing methods- (Maxam Gilbert, Sanger’s, Automated and NGS), Advanced techniques: DNA microarray, RNA interference, Gene editing-Crispr cas-9.

Text Books

1. Gupta P.K. 2010, Elements of Biotechnology, 2nd edition, Rastogi publications, New Delhi
2. Dubey R.C. 2009. A text book of Biotechnology. S.Chand & Company, New Delhi

Reference Books

1. Brown, T.A. 2006. Gene Cloning & DNA Analysis: An introduction. V edn. Blackwell publishing USA.
2. Glick, R and Pasternak , J 1994. Molecular Biotechnology. Panima Publishing Corporation, New Delhi
3. Balasubramanian, D., C.F.A. Bryce, K.Dharmalingam, Y.Green, Kunthala Jeyaraman. 2004. Concepts in Biotechnology. Universities (P) ltd. Hyderabad.
4. Chawla, H.S.2000 Introduction to Biotechnology, Oxford & IBH Publishing Co. Pvt.Ltd.New Delhi.
5. Crueger, W. and A. Crueger, 2000. Biotechnology: A Test Book of Industrial Microbiology, 2nd edn. Panima Publishing Corporation, New Delhi.
6. Mitra,S.1996 Genetic Engineering Principles and Practice Macmillan India Ltd. India
7. Trehen, K.2002. Biotechnology, New Age International (P) Ltd. New Delhi
8. Trevan, M.D., S.Boffey, K.H. Goulding and P.Stanbury, 1990, Gene Biotechnology – Himalaya Publishing House, New Delhi.
- 9.<https://www.neb.com/tools-and-resources/feature-articles/crispr-cas9-and-targeted-genome-editing-a-new-era-in-molecular-biology?device=pdf>

Course designers

- **Dr.Poornima Kkani**
- **Dr. M.Thiruvalluvan**

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Zoology (Lab-7)	Int. Marks	: 40
Year & Sem	: II Year; III Sem	Ext. Marks	: 60
Sub. Code	: 3PZL1	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2

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

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

References

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

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Zoology (Core Paper-8)	Int. Marks	: 25
Year & Sem	: II Year; 3 Sem	Ext. Marks	: 75
Sub. Code	: 3PZE1	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4
Title of the Paper : Animal Physiology			

Course Outcomes:

On the successful completion of the course, students will be able to

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

UNIT-I

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

UNIT- II

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

Circulation-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

UNIT- III

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-types of muscles, ultra structure of striated muscle fiber, 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, structure and physiology of hearing and vision.

Endocrine system- structure and function of endocrine glands (pituitary, thyroid parathyroid, adrenal glands, Islets of Langerhans, thymus) reproduction in vertebrates-mammals

UNIT-V

Animal Behaviour: Definitions of Ethology, history of animal behaviour and significance of study of animal behaviour. Approaches and methods in study of animal behaviour.

Behaviour Patterns: (1) Stereotyped behavior - Fixed action patterns in goose and building of spider's orb web; (2) Acquire behavior - Associate learning behaviour (e.g., Pavlovian learning, Operant conditioning learning and cognition) and Non-associate learning behaviour (e.g., habituation and sensitization). **Foraging behavior:** Habitat selection and optimality in

foraging. **Social behaviour:** characteristics of altruism, dominance and territoriality.
Reproductive behaviour: mating system, courtship behavior and parental care.

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.

Reference books

1. V.K. Agarwal, 2009, Animal Behaviour (Ethology), S. Chand & Company Ltd, New Delhi.
2. Renganathan, T.S. 2002. A text book of Human Anatomy. VI edn. S. Chand and Company Ltd., New Delhi.
3. Hoar W.S 2004. General and Comparative Physiology. Prentice-Hall of India (P) Ltd. New Delhi
4. Singh, H.R and Neeraj Kumar 2009. Animal Physiology and Biochemistry. Vishal Publishing Co, New Delhi.
5. Bentley, P.J. 1998. Comparative Vertebrate Endocrinology (3rd edn). Cambridge University Press
6. Chatterjee, C.C. 1997. Human Physiology. Medical allied agency, Calcutta.

Course designers

1. **Dr.S.Selvarani**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course : M.Sc Zoology (Lab-8)

Year & Sem : II Year; III Sem

Sub. Code : 3PZL2

Hours/Week : 3

Title of the Paper : **Lab in Animal Physiology**

Int. Marks : 40

Ext. Marks : 60

Max. Marks : 100

No of Credits :2

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

Reference books:

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

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Core Paper-9)	Int. Marks	: 25
Year & Sem	: II Year; 3 Sem	Ext. Marks	: 75
Sub. Code	: 3PZE3	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4
Title of the Paper	: Developmental Biology		

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the basis of development
- learn the stages of organ development

Unit I

Historical thoughts and concepts, scope of embryology. Gametogenesis: primordial germ cells, origin of primordial germ cells. Spermatozoan: sperm - structure, types and spermatogenesis; egg - morphology (size, shape and egg membranes) and organization (yolk, pigments and egg cortex), types and oogenesis.

Unit II

Fertilization: Approximation of gametes - Chemotaxis, fertilizing-antifertilizing reaction, acrosome reaction, cortical reaction and physiological changes in fertilization. **Parthenogenesis:** types (natural and artificial) and significance. **Cleavage:** salient features, planes of cleavage, patterns of cleavage and factors affecting cleavage. **Gastrulation:** salient features, metabolic and molecular changes during gastrulation, gastrulation in amphioxus.

Unit III

Fat-map: construction of fate-map in amphibians – artificial and natural markings. **Organogenesis:** development of brain, heart and kidney in frog. **Placentation:** classification (based on the types of foetal membrane involved, distribution of villi and types of tissues involved) and physiology of placenta.

Unit-VI

Differentiation: types, processes and factors causing (induction, competence, determination). **Metamorphosis:** amphibian metamorphosis – ecological, morphological and physiological and chemical changes. **Regeneration:** types, events in regeneration and factors influencing regeneration. **Teratogenesis:** Malformation and disruption, gene-phene relationship, autophene, allophene and teratogenic agents (retinoic acid, pathogens, alcohol, drugs and heavy metals).

Unit V

Male Reproductive System in human: testes, seminiferous tubules, epididymis, spermatic cord, ejaculatory ducts, auxiliary male genital glands (prostate gland and bulbourethral or cowper's glands). Female Reproductive System in human: ovary, oviduct, genital duct and uterus. Sexual cycle: estrous and menstrual cycle, hormonal regulation of ovulation. Assisted Reproductive Technology: Artificial insemination (AI), In-vitro fertilization (IVF), Embryo transfer (ET), Contraceptive devices and vaccines.

Text books

1. Balinsky, B.I 1981. An Introduction to embryology. W.B.Saunders and Co.London
2. Arumugam.N, Embryology, Saras Publications

Reference books

1. Berril, N.J.1976. Developmental biology, Tata Mc.Graw Hill Pub.Co.Ltd.
2. Gillbert. S.F.1994. Developmental Biology. Sinauer Associates Inc. Massachusetts, USA.
3. Adams W.1986. Genetic Analysis of Animal Development. A Wiley InterScience Publication. USA.
4. Arora M.P.2009. Embryology , Himalaya Publishing House, New Delhi

Course Designers

Dr. T S Ramyaa Lakshmi

Dr. T Rajagopal

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Zoology (Lab Paper-9)	Int. Marks	: 40
Year &Sem	: II Year; 3 Sem	Ext. Marks	: 60
Sub. Code	: 3PZL3	Max. Marks	: 100
Hours/Week	:3	No of Credits	:2
Title of the Paper	: Lab in Developmental Biology		

1. Observation of different stages of chick blastoderm (24, 48,72 and96 hrs)
2. Temporary mounting of chick blastoderm(24, 48,72 and96 hrs)
- 3, Regeneration in tadpoles.
- 4, Observation of bull spermatozoa.
5. Observation of frog-egg, sperm, cleavage, blastula,gastrula and neurula-Slide
- 6.T.S. of testis and ovary of mice-slide
7. Human eye and ear- model
8. in vitro culture of chick embryo
9. Microtome technique –demonstration
10. Effect of thyroxine and iodine in Amphibian metamorphosis
11. Observation of endocrine glands in chick.

Reference books

Tyler .M.S2008. Developmental biology- A guide for experimental study. Sinauer Associates ,Sunderland, Massachusetts USA.

Arora M.P.2009. Embryology , Himalaya Publishing House, New Delhi

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc., Botany (Inter Disciplinary)	Int. Marks	: 25
Year & Sem	: II Year; III Sem	Ext. Marks	: 75
Sub. Code	: 3PZE1	Max. Marks	: 100
Hours/Week	: 6	No of Credits	:5

Title of the Paper : **Applied Zoology**

Course Outcomes:

On the successful completion of the course, students will be able to

- Learn about some economically important insects
- Familiar with the different types of animal cultures

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Text Books:

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

Reference Books:

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

Course designers**Dr.N.Arun Nagendran**

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Core Paper-10)	Int. Marks	: 25
Year & Sem	: II Year; 4 Sem	Ext. Marks	: 75
Sub. Code	: 4PZ1	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4

Title of the Paper : **Immunology**

Course Outcomes:

On the successful completion of the course, students will be able to

1. acquire in depth knowledge on immunity and immune system
2. learn about the importance of immunodiagnosis, immunotherapy and vaccination.

Unit I

Introduction and Overview – Historical perspective, Types of immunity – Innate: anatomic, physiologic, phagocytic, and inflammatory–Acquired or Adaptive: antigenic specificity–diversity- Immunologic memory–self/non self recognition, Humoral–Cell-mediated immunity, Cells and organs of the immune system – Ontogeny and development of Immune cells – immunogenicity – Antigen – characteristics, classes of antigens-Haptens –Adjuvants. Antibody types – Isotypes & its subtypes, Allotypes, Idiotypes, and Antibody structure& functions. Generation of antibody diversity;

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, Agglutination ,C activation, Cell lysis, Opsonization, Neutralization and cross reactivity.

Unit III

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

Unit IV

Tolerance and Autoimmunity – organ specific autoimmune diseases, systemic autoimmune diseases, Immunodeficiency diseases – Phagocytic, complement deficiencies, humoral, cell mediated, combined immune deficiencies, Acquired Immunodeficiency. Immune system in health – Microbiome, Immunization –active and passive, vaccine induced immunity, Types of Vaccines – Organism vaccines – recombinant antigen & vector vaccines – DNA /RNA vaccines – synthetic peptide vaccines, edible vaccines. Tumour immunology –Tumour antigens,Tumour immune surveillance and immune evasion. Tumour immuno diagnosis and Cancer vaccines.

Unit V

Transplantation immunology –Types, Transplantation antigens, immunological basis of graft rejection, immunosuppressive therapy - Immunotechniques and Immunotechnology-Application of precipitation, agglutination, ELISA, RIA, Western blotting, immunofluorescence techniques. Hybridoma Technology, antibody engineering. Application of Monoclonal antibodies Immunoinformatics-Basics, immunological databases, Epitope prediction, computational vaccinology – Reverse vaccinology .

Text Books:

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

Reference Books:

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

Course designers

Dr..Thiruvalluvan

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Lab Paper-10)	Int. Marks	: 40
Year & Sem	: II Year; 4 Sem	Ext. Marks	: 60
Sub. Code	: 4PZL1	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2
Title of the Paper	: Lab in Immunology		

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

Reference books:

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

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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Core Paper-11)	Int. Marks	: 25
Year & Sem	: II Year; 4 Sem	Ext. Marks	: 75
Sub. Code	: 4PZ2	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4

Title of the Paper: Ecology and Biodiversity

Course Outcomes:

On the successful completion of the course, students will be able to

Understand the concepts and components of ecosystems

Learn about biodiversity and different indices

Unit I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Unit II

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. **Population Ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations. **Species Interactions:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit III

Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. **Applied Ecology:** Environmental pollution (causes, effects and mitigation measures of air, water, land, noise and nuclear hazards); global environmental change (eutrophication, biomagnifications, green house effect, acid rain and ozone depletion).

Pollution monitoring/measurement: plant and animal test systems in bioassays, cell biology (cytogenetic bioassay and Ames test), molecular biology (DNA probes and immunoassay) and biosensors (BOD and Gas biosensors) in environmental monitoring.

Unit IV

Biological diversity: characteristics of biodiversity; levels of diversity – genetic, species and ecosystem; values of biodiversity; patterns of diversity – alpha, beta and gamma; diversity indices – Shannon, Simpson and Jaccard index. **Threats of biodiversity:** habitat loss, poaching of wildlife, man-wildlife conflicts; IUCN categories of threat, engendered and endemic species of India, red data book; Hot spots of biodiversity; India as a mega-diversity nation.

Unit IV

Wild Life/Biodiversity Conservation: Necessity for conservation; organization involved in wildlife conservation – UNEP, MAB, WWF, EPA, NWAP. **Types of conservation of Biodiversity:** *in-situ* (biosphere reserves, national parks, wild life sanctuaries, sacred grooves) and *ex-situ* conservation (Zoological and Botanical gardens, cryopreservation, tissue culture); Indian case studies on conservation/management strategy (Project Tiger and Elephant). **Environmental Legislation:** Wildlife (Protection) Act, 1972 and Environmental (Protection) Act, 1986.

Text Books

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

References

1. Briggs, D., Smithson, P., Addison, K. and Atkinson. K. 1997. Fundamentals of Physical Environment. II edn. Routledge. UK.
2. Chang, K. 2002. Geological Information system. Tata McGraw Hill publishers. New Delhi.
3. Kumaraswamy, K., Alagappa Moses, A. and Vasanthy, M. 2001. Environmental Studies. Bharathidasan University Publication, Tiruchirappalli.
4. Cunningham, W.P. and Saigo, B.W. 1999. Environmental science. Vth edn. Tata McGraw Hill publishing Co., New Delhi.
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. 8. Scanvic, J.Y. 1997. Aerspatial Remote sensing in Geology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Course Designers

Dr. T Rajagopal

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Lab-11)	Int. Marks	: 40
Year & Sem	: II Year; IV Sem	Ext. Marks	: 60
Sub. Code	: 4PZL2	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2

Title of the Paper : Lab in Ecology and Biodiversity

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

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Course	: M.Sc Zoology (Core Paper-12)	Int. Marks	: 25
Year & Sem	: II Year; IV Sem	Ext. Marks	: 75
Sub. Code	: 4PZ3	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4
Title of the Paper: Bioinformatics			

Course Outcomes:

On the successful completion of the course, students will be able to

- learn basic in silico approaches
- understand “sequence to structure prediction” –concept
- familiarize in applying bioinformatic tools in biomedical research.

Unit I

Internet concepts, Bioinformatics a multidisciplinary approach, Scope and applications of Bioinformatics. Biological databases- Nucleic acid databases (Genbank, DDBJ and EMBL) Protein databases - primary, composite, secondary ;Specialized databases-SGD, TIGR Structural databases -PDB, CATH ModBASE.

Unit II

Sequence similarity search (FASTA and BLAST). Significance of E-value. Introduction to ORF and primer designing. Secondary structure prediction: GOR, Chou –Fasman, Hidden Markov method

Unit III

Multiple sequence alignment (CLUSTAL W), conserved domain search (Motif). Phylogenetic analysis- phylogenetic tree construction (Neighbor Joining method and Maximum parsimony).

Unit IV

Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure. Data mining for drug designing and docking analysis. Structure visualization tool- RASMOL

Unit V

Genomics-scope and applications of structural, comparative and functional genomics, microarray technology
Proteomics scope and applications of structural and functional-2D gel electrophoresis, Mass spectroscopy and MALDI- TOF

Text Books

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

Reference Books

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

Course Designers

Dr. RM.Murugappan

Dr..M.Karthikeyan

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Lab-12)	Int. Marks	: 40
Year & Sem	: II Year; IV Sem	Ext. Marks	: 60
Sub. Code	: 4PZL3	Max. Marks	: 100
Hours/Week	: 3	No of Credits	: 2

Title of the Paper: Lab in Bioinformatics

1. Sequence retrieval and analyses
2. Database (homology) searches using different types of BLAST
3. Multiple sequence alignment using CLUSTAL W and Multalin.
4. Phylogenetic tree construction
5. Identification of Motif (eMotif)
6. Identification of restriction sites using NEB cutter.
7. Identification of protein cleavage site using pepcutter tool.
8. Protein structure prediction-Secondary and tertiary (Homology Modelling)
9. 3D visualization of structures using Rasmol and discovery studio viewer.
10. Molecular docking using Arguslab and Hex.

Reference books.

1. Pevsner, 2009. Bioinformatics and Functional Genomics. Wiley Dreamtech India Ltd., New Delhi.
2. Claverie, J and C.Notredame 2003. Bioinformatics A beginner’s guide. Wiley Publishing Inc. India.
3. Mani, K and N. Vijayaraj 2004. Bioinformatics a practical approach. Aparna Publishers, Coimbatore.

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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Zoology (Elective paper)	Int. Marks	: 50
Year & Sem	: 2 Year; 4 Sem	Ext. Marks	: 50
Sub. Code	: 4PZE1	Max. Marks	: 100
Hours/Week	: 6	No of Credits	: 3
Title of the Paper	: Project		

M.Phil., Zoology

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M.Phil., Zoology
Course Structure (w.e.f. 2017 batch onwards)

I semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core I	1MZ1	Research Methodology-I	6	4	120	100	100	200
Core II	1MZ2	Entomology	6	4	120	100	100	200
Core III	1MZ3	Research Methodology-II	6	4	120	100	100	200
						300	300	

II Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Project	PJ	Project Dissertation		4	-	-	100	100
		Viva Voce				50	50	100
		Total						200

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Course	: M.Phil, Zoology	Int. Marks	: 100
Semester.	: I Sem	Ext. Marks	: 100
Sub. Code	: 1MZ1	Max. Marks	: 200
Hrs/Week	: 6	TotalHours	:90

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

Course Outcomes:

At the end of the course, the students will be able to:

- comprehend the working principle and applications of various analytical instruments
- acquire knowledge on the theoretical part of various techniques in biology
- choose and use the exact instruments and techniques for their project work

Unit I

Working principle and applications of: Compound, Phase Contrast, Fluorescent, Polarised, Electron (Transmission and Scanning) and Confocal Microscopy; Micrometry, cytophotometry and flow cytometry; live cell imaging

Principles and techniques involved in histological and histochemical staining of animal tissues Microbial staining techniques – simple, differential, spore and capsule staining

Unit II

Working principle and applications of: pH meter, Centrifuge (Density gradient and Ultra) - preparative and analytical - sedimentation coefficient, RCF, RPM; GM counter, Liquid Scintillation counter, Sonicator, Lyophilizer and Micropipettes. Colorimeter, Spectrophotometer (visible, ultraviolet), FTIR, Flame Photometer, Atomic Absorption and Mass Spectrophotometer.

Unit III

Chromatographic techniques: Paper, Thin layer, Column, Gel filtration, Ion exchange, Gas and High Performance Liquid Chromatography.

Electrophoretic techniques: SDS-PAGE, Native PAGE, Agarose Gel Electrophoresis, 2D Gel Electrophoresis, Gel Documentation

Blotting techniques: Southern, Northern and Western blotting

Unit IV

Animal cell culture techniques: Media types, primary and secondary culture, cell lines, types of culture, culture of mammalian cells, tissues and organs, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture - *in vitro* testing of drugs and toxicity of pollutants - production of vaccines and pharmaceutical products; Stem cells – types – isolation - culture and applications

Unit V

PCR – working principle, types and applications; DNA sequencing methods – Maxam and Gilbert, Sanger and automation methods, next generation sequencing; protein sequencing; DNA and protein microarray

Immunotechniques: Agglutination and precipitation assays – immunoelectrophoresis – immunofluorescence – immunohistochemistry – ELISA – RIA - Hybridoma technology – Antibody engineering – Phage display techniques

Report submission: Protocols pertained to the above techniques

Reference Books

1. Boyer, R.F. 1993. Modern Experimental Biochemistry. The Benjamin Cummings Publishing Company, Inc., New York.
2. Chatwal, G.R and Anand, S.K. 2009. Instrumental Methods of Chemical Analysis. Himalaya Publishing House, New Delhi.
3. Jeyaraman, J., 1985. Lab. Manual in Biochemistry, Wiley Eastern Ltd, New Delhi.
4. Kubly, J. 2003, Immunology 5th edition , W.H. Freeman and Company, New York.
5. Lincoln PJ & Thomson J. 1998. Forensic DNA Profiling Protocols. Humana Press.
6. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K. 2004. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Publishers Pvt. Ltd., New Delhi, India.
7. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques. School of Biotechnology, Madurai Kamaraj University, Madurai.
8. Plummer, D.T. 2008. An Introduction to Practical Biochemistry. Tata McGraw Hill Publications, New Delhi.
9. Portner R. 2007. Animal Cell Biotechnology. Humana Press.
10. Primrose. S.B., Twyman R.M., Old. R.W. 2001. Principles of Gene Manipulation. Blackwell Science Limited.
11. Spinger TA. 1985. Hybridoma Technology in Biosciences and Medicine. Plenum Press.
12. Warton, D.C. and McCarthy, R.E. 1972. Experiments and Methods in Biochemistry. MacMillan, New York.
13. Williams, B.L. and Wilson, K. 1983. A Biologist's Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold Publishers Ltd., London.
14. Wilson, K. and Walker, J. 2003. Principles and Techniques of Practical Biochemistry, 5th Edition Cambridge University Press, New York.

Course Designer

Dr. C. Ravi

THIAGARAJAR COLLEGE, MADURAI – 9.
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Course	: M.Phil, Zoology	Int. Marks	: 100
Semester.	: I Sem	Ext. Marks	: 100
Sub. Code	: 1MZ2	Max. Marks	: 200
Hrs/Week	: 6	TotalHours	: 90

Title of the Paper: **Applied Entomology**

Course Outcomes:

On the successful completion of the course, students will be able to

- Classify the insects and will be able to identify the different insects
- Learn how to control the pests of different crops

Unit: I

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

Unit: II

Helpful insects

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

Harmful insects - Insects pests of crops and control measures

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

Unit: III

The idea of insect population

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

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

Unit: IV

Plant resistance and insects:

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

Application of artificial or direct method-Biological control

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

Unit: V

Insecticides classification of Insecticides

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

Plant production appliances:

Dusting and dusters-Aerosols-Spraying and sprayers- Vaporisers

Reference books:

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

Course Designers

Dr.C.Balasubramanian

THIAGARAJAR COLLEGE, MADURAI – 9.
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Course	: M.Phil, Zoology	Int. Marks	: 100
Semester.	: II Sem	Ext. Marks	: 100
Sub. Code	: 1MZ3	Max. Marks	: 200
Hrs/Week	: 6	TotalHours	: 90

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

Course Outcome

At the end of the course, the students will be able to:

- identify, design and execute research problems on their own
- search and collect relevant literature from various sources
- prepare research reports and thesis

Unit I

Objectives and significance of research, types of research - descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical; literature review - various sources of information; identification, defining and devising of research problem

Unit II

Hypothesis - null and alternate hypothesis - hypothesis testing; Exploratory and descriptive research design - concept, types and uses; Concept of independent and dependent variables; Sampling methods - sample, sampling frame, sampling error, sample size, non-response, simple random sample, systematic sample, stratified random sample and multi-stage sampling, determining size of the sample - practical considerations in sampling and sample size; Sample collection, transport, handling and preservation of microorganisms, planktons, insects, animals from natural and lab bred population; Biological models

Unit III

Observation and collection of data - methods of data collection; data Processing and analysis strategies - univariate analysis (frequency tables, bar charts, pie charts, percentages), measures of central tendency and dispersion; bivariate analysis - cross tabulations and chi-square test including testing hypothesis of association; Correlation, Regression, ANOVA – one and two way, DMRT, Tukey test; R software

Unit IV

Thesis writing - Introduction, Review of literature, Methodology, Results - illustrations and tables, Discussion, Bibliography, Foot notes and proof correction. Oral presentation - planning and preparation - use of visual aids - importance of effective communication; Publication of research articles – plagiarism – copyright violation – choosing the right journal; refereed journals, open access journals, citation, impact factor, SCI, H index, i10 index, referencing software

Unit V

Impact of research on environment - GMO; Biosafety measures – risk assessment and management - Institutional biosafety - ethical and animal welfare committee; Ethical, legal and social issues related to research; Ethical implications of biotechnological products and techniques; IPR - copy right - patent - patent law – patenting of biological process and products in India – trademark - WIPO; Reproduction of published material - Plagiarism - Acknowledgement

Reference Books

1. Day, R.A., 1992. How to Write and Publish a Scientific Paper, Cambridge University Press.
2. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
3. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An Introduction to Research Methodology, RBSA Publishers.
4. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
5. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
6. Martin. M.W. and Schinzinger.R. 2003. Ethics in engineering, III Edition, Tata McGraw-Hill, New Delhi.
7. Satarkar, S.V., 2000. Intellectual Property Rights and Copy right. Ess Ess Publications.
8. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
9. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, AtomicDog Publishing. 270p.
10. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Course Designer

Dr. C. Ravi

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

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

Title of the Paper: **Project**

M.Sc., Microbiology^(SF)

THIAGARAJAR COLLEGE, MADURAI – 9.
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M.Sc., Microbiology – CBCS - Syllabus – 2017 – 2020
Semester – I

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core1	SIPY1	General Microbiology	5	4	90	25	75	100
Core2	SIPY2	Microbial Biochemistry	5	4	90	25	75	100
Core3	SIPY3	Microbial Physiology	5	4	90	25	75	100
Elective1	SIPYE1	Options given	5	5	90	25	75	100
Lab1	SIPYL1	Lab in General Microbiology, Microbial Diversity and Taxonomy	5	3	45	40	60	100
Lab2	SIPYL2	Lab in Microbial Biochemistry and Physiology	5	3	45	40	60	100
		Total	30	23				

Semester – II

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core4	S2PY1	Immunobiology	5	4	90	25	75	100
Core5	S2PY2	Molecular Biology	5	4	90	25	75	100
Core6	S2PY3	Microbial Genetics	5	4	90	25	75	100
Elective2	S2PYE1	Elective 2	5	5	90	25	75	100
Lab3	S2PYL1	Lab in Immunobiology	5	3	45	40	60	100
Lab4	S2PYL2	Lab in Molecular Biology and Microbial Genetics	5	3	45	40	60	100
		Total	30	23				

Semester – III

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core7	S3PY1	Medical Microbiology	5	4	90	25	75	100
Core8	S3PY2	Clinical Lab Technology	5	4	90	25	75	100
Core9	S3PY3	Genetic Engineering	5	4	90	25	75	100
Elective3	S3PYE1	Elective 3	5	5	90	25	75	100
Lab5	S3PYL1	Lab in Medical Microbiology	5	3	45	40	60	100
Lab6	S3PYL2	Lab in Genetic Engineering	5	3	45	40	60	100
		Total	30	23				

Semester – IV

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core10	S4PY1	Bioprocess Technology	5	4	90	25	75	100
Core11	S4PY2	Food and Agriculture Microbiology	5	4	90	25	75	100
Core12	S4PY3	Environmental Microbiology	5	4	90	25	75	100
Elective 4	S4PYE1	Elective- Project	5	3	90	25	75	100
Lab7	S4PYL1	Lab in Bioprocess Technology	5	3	45	40	60	100
Lab8	S4PYL2	Lab in Food, Agriculture and Environmental Microbiology	5	3	45	40	60	100
		Total	30	21				

A) Consolidation of Contact Hours and Credits: PG Microbiology

Semester	Contact Hrs/Week	Credits
I	30	22
II	30	22
III	30	22
IV	30	24
Total	120	90

B) Curriculum Credits

Core	- 75 Credits
Elective	- 15 Credits

Total	90 Credits

Elective papers offered (students has to choose 3 out of 5 offered)

- Microbial Diversity and Taxonomy
- Biological Techniques
- Forensic Science
- Cell biology
- Biostatistics

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Course	: M.Sc Microbiology (Core Paper -1)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: I	Max. Marks	: 100
Sub. Code	: S1PY1	No. of Credits	: 4
		Hours/Week	: 5

Title of the Paper: **General Microbiology**

Course Outcomes:

On the successful completion of the course, students will be able to

- acquire knowledge on fundamentals and classification of microorganisms.
- learn the structural organization, morphology and reproduction of microbes.

Unit I

History and scope of microbiology. Preparation of solutions, media. Principles, functioning and types of Biosafety cabinets. Common hazards in the laboratory : Electrical equipment, chemicals – corrosive, irritant, toxic, flammable, explosive, ionising radiations, infectious materials, gas, fire, and waste disposal. Personal safety measures and first aid.

Unit II

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

Unit III

Control of microorganisms - Physical agents - conditions influencing antimicrobial action, temperature, desiccation, osmotic pressure, radiation, filtration. Chemical agents -characteristics of an ideal antimicrobial agents, phenolic compounds, alcohol, halogens, heavy metals, dyes, synthetic detergents, quaternary ammonium compounds, aldehydes, gaseous agents. Evaluation of antimicrobial chemical agents.

Unit IV

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

Unit V

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

Textbooks:

1. 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.
2. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New York.

Reference Books:

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

Course Designers

- 1.Mr.S.Kulandaivel
- 2.Mrs.V.Ananthi

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course : MSc Microbiology (Core paper-2)	Int. Marks : 25
Class : IYear	Ext. Marks : 75
Semester: I	Max. Marks : 100
Sub.Code: S1PY2	No of Credits : 4
	Hours/Week : 5

Title of the Paper: **Microbial Biochemistry**

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the basic principles of Biochemistry
- Know the fundamental concepts in Biomolecules and their function

Unit I

Carbohydrates: Classification - structure and properties of monosaccharides (glucose, fructose) and disaccharides (lactose, maltose, sucrose), polysaccharides (starch, cellulose, and agar- agar). **Metabolism and its regulation:** Gluconeogenesis, glycolysis, kreb's cycle, hexose monophosphate shunt, glyoxylate cycle and Entner Doudroff pathway.

Unit II

Amino Acid: Classification based on structure, polarity, biological importance and reactivity, physical properties and chemical reactions, An overview of amino acid biosynthesis.

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

Unit III

Lipids: Classification and properties. Phospholipid and cholesterol synthesis in bacteria. Metabolism - α , β and ω oxidation of fatty acids and lipid peroxidation.

Unit IV

Enzymes: Classification, mechanism of enzyme action. Enzyme kinetics – Michaelis Menten equation, Lineweaver Burk plot. Factors influencing enzyme activity. Enzyme inhibition, active site, allosteric site. isozyme, ribozyme and abzyme.

Unit V

Nucleic acids: Structure, synthesis and degradation of purines and pyrimidines.

Vitamins: Classification, occurrence, structure, properties and biological importance- Water soluble vitamins (B & C) & Fat soluble vitamins (A, D, E & K).

Text books

1. Ambika Shanmugam, 1998, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras.
2. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd, New Delhi.
3. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books and Allied Pvt. Ltd., Kolkata

Reference Books:

1. Deb, A.C. 2006. Fundamentals of Biochemistry, New Central Book Agency Pvt. Ltd., Kolkata.
2. Donald Voet and Judith G. Voet, 1995. Biochemistry. Second Edition, John Wiley and Sons, Inc. New York.
3. Kuchel, P.W. and Ralston, G.B. 2003. Sehamans outlines of biochemistry, Second Edition, Tata McGraw Hill Edition, New Delhi.
4. Mckee, T. and Mckee, J.R. 1996. Biochemistry – An Introduction, Wm. C. Brown Communication Inc., USA.
5. Nelson, D.L. and Cox, M.M. 2002. Lehingers's Principles of Biochemistry, Third Edition, Mac Millan worth Publishers, New Delhi.
6. Srivastava, M.L. 2008. Microbial Biochemistry, Narosa Publishing House, New Delhi.
7. Stryer, L. 2000. Biochemistry, Fourth Edition, W.H. Freeman and Company, New York.
8. Voet, A. and. Voet J.G. 1995. Biochemistry, Second Edition, John Wiley & Sons Inc., New York.
9. Zubay, G. 1993. Biochemistry Vol.I & II, Third Edition, Wm. C. Brown Communication Inc., USA.
10. David, A. B. 2003. Nutritional biochemistry of Vitamins, Cambridge.

Course designer**1.Mrs. V.Ananthi****2.Dr.M.Karthikeyan**

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course : MSc Microbiology (Core paper-3)	Int. Marks : 25
Class : I Year	Ext. Marks : 75
Semester: I	Max. Marks : 100
Sub.Code: S1PY3	No of Credits :4
	Hours/Week : 5

Title of the Paper: **Microbial Physiology**

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the basic principles, microbial physiology mechanisms and response.

Unit I

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

Unit II

Bacterial Photosynthesis: Origin and Evolution ; Types of microbial photosynthesis - oxygenic and anoxygenic. Structure of photosynthetic pigments – bacteriochlorophyll, carotenoids and phycobilins. Photosynthetic bacteria - green sulphur and purple. Mechanism of photosynthesis - non-cyclic, cyclic, and photophosphorylation. Carbon assimilation - Calvin, reverse citric acid cycle and hydroxy propionate cycle.

Unit III

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

Unit IV

Microbial stress responses- Osmotic stress and osmoregulation, Aerobic to anaerobic transitions, oxidative stress, pH stress and acid tolerance, thermal stress and heat shock response, nutrient stress and starvation stress, stringent response, extremophiles.

Unit V

Endospore formation – characteristics of endospore forming bacteria, life cycle of *Bacillus* and stages of sporulation. Physiological and genetic aspects of sporulation, metabolic changes during germination. Life cycle of *Myxobacteria*- aggregation and fruiting body formation, Physiological and genetic aspects of sporulation (genes involved in signaling, aggregation, chemotaxis signal transduction system).

Text Books:

1. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2009. Twelfth Edition, Brock Biology of Microorganisms, Mac Millan Press, England.
2. Moat, A.G. and Foster, W. 1988. Microbial Physiology, Second Edition, John Wiley and Sons, New York.
3. Schlegel, H.G. 2008. General Microbiology, Seventh Edition, Cambridge University Press, Great Britain.

Reference books:

1. Satyanarayana, U. and Chakrapani, U. 2009. Biochemistry, Books and Allied Pvt. Ltd., Kolkata
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.
3. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New York.

Course designer

1. Mr. S. Kulandaivel
2. Dr. M. Karthikeyan

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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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	: 3
		Hours/Week	: 5

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

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

Reference Books:

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

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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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	: 3
		Hours/Week	: 5

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

1. Estimation of pK_a value.
2. Determination of λ max (Wavelength scan) using UV visible spectrophotometry.
3. Separation of aminoacids by Paper chromatography – circular
4. Separation of aminoacids and lipids by Thin layer chromatography
5. Separation of pigments by column chromatography
6. Qualitative and quantitative analysis of carbohydrate (mono, di and polysaccharides).
7. Qualitative and Quantitative analysis of proteins.
8. Determination of functional groups by FTIR spectroscopy
9. Effect of temperature on bacterial growth.
10. Effect of pH on bacterial growth.
11. Extraction and estimation of photosynthetic pigments (bacterial and blue green algae)
12. Measurement of bacterial growth rate and generation time –Turbidity and biomass

Reference Books:

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

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Core Paper- 4)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: II	Max. Marks	: 100
Sub. Code	: S2PY1	No. of Credits	: 4
		Hours/Week	: 5

Title of the Paper: **Immunobiology**

Course Outcomes:

On the successful completion of the course, students will be able to

- Acquire knowledge on immunity and immune system
- Understand the cells and organs in the immune system

Unit I

History of immunology. Types of immunity – innate, acquired (passive and active). Immune response – humoral and cell mediated immunity. Lymphoid organs – primary and secondary. Hematopoiesis -ontogeny and development of immune cells.

Unit II

Antigens and Immunogens – characteristics and types. Immunoglobulins – types, structure and functions. Mechanism of antigen recognition by T and B cells. Molecular biology of immunoglobulin synthesis - antibody diversity and isotype switching. Immunotechnology – hybridoma and monoclonal antibodies, antibody engineering – production of chimeric and hybrid monoclonal antibodies.

Unit III

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

Unit IV

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

Unit V

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

Text Books

1. Goldsby, R.A., T.J. Kindt, and B.A. Osborne, Kuby 2002. Immunology. Fourth edition. W.H. Freeman and Company, New York.
2. Arora, M.P. 2010. Immunology, Ane Books Pvt. Ltd., New Delhi.
3. Eli Benjamini, G. Sunshine and Lespowitz, 2000. Immunology – a short course, Fourth Edition, Wiley – Liss, New York.

Reference Books

1. Abbas, A.K., A.H. Lichtman and J.S. Pober, 2000. Cellular and Molecular immunology, Fourth Edition, W.B. Saunders Company, London.
2. Coleman, R.M., M.F. Lombard and R.E. Sicard, 1992. Fundamental Immunology, Second Edition, Wm.C. Brown Publishers, USA.
3. Cruse, J.M. and R. Lewis, 1999. Atlas of Immunology, CRC Press, New York.
4. David, M., B. Jonathan, B.R. David and R. Ivan, 2008. Immunology, Seventh Edition, Elsevier Publications.
5. Tizard, I.R. 2009. Immunology – An Introduction, Fourth Edition, Cengage Learning India Pvt. Ltd., New Delhi.
6. Janeway, Jr. C.A. and P. Travers, 2001. Immunobiology, Fifth Edition, Garland Publishing, London.
7. Khan, F.H. 2009. Elements of Immunology, Dorling Kindersley India Pvt. Ltd., India.
8. Roitt, I., J. Brostoff and D. Male, 2001. Immunology, Sixth Edition, Mosby, London.
9. Rao, C.V. 2008. Immunology, Second Edition, Narosa Publishing House, New Delhi.

Course Designers

1. Mr. S. Kulandaivel
2. Ms. S. Padmavathy

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with 'A' Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Core Paper 5)	Int. Marks	: 25
Class	: I Year	Ext. Marks	: 75
Semester	: II	Max. Marks	: 100
Sub. Code	: S2PY2	No. of Credits	: 4
		Hours/Week	: 5

Title of the Paper: **Molecular Biology**

Course Outcomes:

On the successful completion of the course, students will be able to

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

Unit I

Discovery of DNA. Molecular basis of DNA as genetic material. Elucidation of structure of DNA – A, B and Z. Forms of DNA – DNA heteroduplex, circular, twisted circle, superhelical DNA. Properties of DNA - denaturation, renaturation, melting curve, Cot ½ values, hyperchromicity. Structure and types of RNA – genetic and nongenetic (tRNA, mRNA & rRNA). Epigenetics - Histone proteins.

Unit II

Replication of DNA - semi conservative mode, Meselson - Stahl experiment. Enzymology of DNA replication - topoisomerase I & II, helicase, primase, SSB, DNA polymerase I, II & III, ligase. Molecular basis of DNA replication – origin, replication fork, Okazaki fragments. Types of replication – rolling circle and bidirectional.

Unit III

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

Unit IV

Genetic code: Deciphering genetic code, characteristics of genetic code.

Translation in prokaryotes and eukaryotes: Initiation - initiation factors, initiator tRNA, amino acid activation, shine dalgarno sequences, initiation site. Elongation - elongation factors and translocation. Termination - termination factors. Post translational modifications - post translational transport, signal hypothesis.

Unit V

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

Text Books

1. David Freifelder. D. 2008. Microbial Genetics, Eighteenth Edition, Narosa Publishing House, New Delhi.
2. Stanley R. E.C. Maloy, John and D. Freifelder, 2008. Microbial Genetics, Narosa Publishing House, New Delhi.
3. Rastogi, S.C. 2006. Cell and Molecular Biology, New Age International Pvt. Ltd., New Delhi.
4. Jeyanthi, G.P. 2009. Molecular Biology, MJP Publishers, Chennai.

Reference Books:

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

Course Designers

1. Ms. S. Padmavathy
2. Mrs. V. Ananthi

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course : MSc Microbiology (Core paper-6)	Int. Marks : 25
Class : IYear	Ext. Marks : 75
Semester: II	Max. Marks : 100
Sub.Code: S2PY3	No of Credits : 4
	Hours/Week : 5

Title of the Paper: **Microbial Genetics**

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the basic principles mutation and their effects in living system.
- Know the fundamental concepts of microbial genetics.

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Text Books

1. David Freifelder. D. 2008. Microbial Genetics, Eighteenth Edition, Narosa Publishing House, NewDelhi.
2. Freifelder, D. 2000. Molecular Biology, Second Edition, Narosa Publishing house. NewDelhi.

Reference Books:

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

Course designer

1. Mrs.V.Ananthi
- 2.Dr.M.Karthikeyan

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Lab-3)	Int. Marks	: 40
Class	: I Year	Ext. Marks	: 60
Semester	: II	Max. Marks	: 100
Sub. Code	: S2PYL1	No. of Credits	: 3
		Hours/Week	: 5

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

1. Protocols of immunization.
2. Preparation of soluble antigen – BSA & human serum
3. Preparation of cellular (particulate) antigen - bacterial antigen
4. Methods of antigen administration.
5. In vivo method of delayed type hypersensitivity.
6. Demonstration of natural resistance to infection by bacterial killing of serum factors.
8. Electrophoretic separation of serum proteins.
9. Immunoelectrophoretic technique (Rocket, counter - current)
10. Agar gel Ouchterlony double immunodiffusion.
11. Mancini single radial immunodiffusion.
12. Haemagglutination titration assay.
13. Direct agglutination to determine ABO blood grouping.
14. Visualization and study of Lymphoid Organs from mice and Chicken (Model).
16. Determination of differential leukocyte count.
17. Isolation and enumeration of lymphocytes from human blood.
18. Determination of lymphocyte viability by trypan blue exclusion test.
19. Identification and enumeration of human T – lymphocyte using E – rosette technique.

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 AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Lab-4)	Int. Marks	: 40
Class	: I Year	Ext. Marks	: 60
Semester	: II	Max. Marks	: 100
Sub. Code	: S2PYL2	No. of Credits	: 3
		Hours/Week	: 5

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

1. Isolation and estimation of genomic DNA from bacteria/yeast.
2. Isolation and estimation of RNA from bacteria/yeast.
3. Isolation and estimation of protein from bacteria/yeast.
4. Separation of Nucleic acids by agarose gel electrophoresis.
5. Determination of melting temperature of DNA
6. Detection of proteins by SDS-PAGE.
7. Determination percentage of killing of bacterial cells by UV rays.
8. Plotting of UV survival curve.
9. Plotting of dark repair mechanism.
10. UV sensitivity of Rec A+ and Rec A-.
11. Reversion of auxotroph.
12. Isolation of streptomycin resistant mutants using gradient plate technique.
13. Isolation of petite mutant.
14. Detection of mutagen - AMES test.
15. Isolation of auxotrophic mutant.
16. Isolation of bacteriophage from septic tank.

References Books:

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

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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Core Paper- 7)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: S3PY1	No. of Credits	: 4
		Hours/Week	: 5

Title of the Paper: **Medical Microbiology**

Course Outcomes:

On the successful completion of the course, students will be able to

- Know the mechanisms by which bacteria, fungi, parasites and viruses attack the body to cause disease
- 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

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

Unit II

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

Unit III

General characteristics, pathogenesis and laboratory diagnosis: Yeast – *Cryptococcus neoformans*. Yeast like fungus– *Candidasp*. Filamentous fungi – *Aspergillus* and *Penicillium*. Dimorphic fungus – *Blastomyces dermatidis*.

Morphology and life cycle: Intracellular parasites – *Cryptosporidium* and *Plasmodium*. Intraluminal parasites – *Entamoeba histolytica* and *Ascaris lumbricoides*. Parasitic zoonoses – *Toxoplasma* and *Taenia*.

Unit IV

Morphology, pathogenesis, laboratory diagnosis and control measures of: DNA viruses – Herpes simplex virus and Hepatitis B virus. RNA viruses – Flavi virus (dengue), Retrovirus – HIV. Viral zoonoses - Japanese encephalitis and rabies. Prions and virions.

Unit V

Classification of antibiotics based on mode of action: antibacterial (Penicillin and Streptomycin), antiviral (Amantidine and Zidovudine), antifungal (Amphotericin and Nystatin) antiparasitic drugs (Quinine and Metranidazole) and anticancer drugs (Methotrexate and L asparaginase). Emerging and reemerging infections (MRSA – Methicillin resistant *Staphylococcus aureus*, NDMS – New Delhi methicillin strain). National programmes in prevention of infectious diseases.

Text Books

1. Ananthanarayanan and C.K.JeyaramPaniker, 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.

Reference Books:

1. Collee, J.G., A.G.Fraser, B.P.Marmion and A.Simmons, 2007. Mackie and McCartney, Practical Medical Microbiology, Fourteenth Edition, Churchill Livingstone.
2. 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.
3. Davis, B.D., R. Dulbecco, H.N.Eisen, and H.S. Ginsberg, 1990. Microbiology, Fourth Edition, Harper&Nowpublishers, Singapore.
4. Jawetz E.,J.C.Melnic and E.A.Adelberg, 2001. Review of Medical Microbiology, Prentice Hall International Inc., USA.
5. Leslie collier, A. Balowsand Sussman M. 2000. Topley& Wilson's Microbiology and Microbial infection Vol. 1 -5 Arnold Publishers, London.
6. Mandell, Douglas and Bennt's Principles and Practice of infectious diseases, 2000 vol. 1 & 2 Churchill livingstone.
7. Rajan, S. 2009. Medical Microbiology, MJP Publishers, Chennai.

Course Designers

- 1.Ms.S.Padmavathy
- 2.Mrs.V.Ananthi

THIAGARAJAR COLLEGE, MADURAI – 9.
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Course	: M.Sc Microbiology (Core Paper- 8)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: S3PY2	No. of Credits	: 4
		Hours/Week	: 5

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

Course Outcomes:

On the successful completion of the course, students will be able to

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

Unit I

Laboratory management – Biosafety in containment laboratory - Personal hygiene for Laboratory Technologists, National and International GLP and GMP, Accidents - types and safety measures. 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. Biomedical waste management

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Textbooks:

1. Sood, R, 2010. Medical Laboratory Technology – Methods and interpretations – Seventh edition, Jaypee, New Delhi.
2. Ochei, J and Kolkatkar, A. 2009. Medical Laboratory Science – Theory and Practice. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.

Reference Books:

1. Mukherjee, L.K. 2010. Medical Laboratory Technology – 3 volumes – second edition – Hill Publishing Ltd., New Delhi.
2. Alex, C., Sonnenwirth, 1998. Gradwohl's Clinical Laboratory Methods and Diagnosis, Vol. 1&2, eighth edition, B.I. Publications Ltd., New Delhi.
3. David, S. Jacobs, Wayne R. Demott, Paul R. Finley, 1994. Laboratory Test Hand Book, third edition, Key word index, Laxi-Compinc, Hudson.
4. Jacques Wallac, L., 1986. Interpretation of Diagnostic Tests: A Synopsis of Laboratory Medicine, Little Brown and Company, Boston/Toronto, USA.
5. Kathleenbecan, M.C., Bride, 1982. Text Books of Clinical Laboratory supervision, Century Crosts, New York.
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.

Course Designers

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- 2.Mrs.V.Ananthi

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Microbiology (Core Paper- 9)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: III	Max. Marks	: 100
Sub. Code	: S3PY3	No. of Credits	: 4
		Hours/Week	: 5

Title of the Paper: **Genetic Engineering**

Course Outcomes:

On the successful completion of the course, students will be able to

- Expose to the principles behind the genetic engineering and to reveal various methods of gene manipulation
- 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 – pBR322 and pUC18, integrating shuttle vectors -YAC vectors.

Unit II

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

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.

Unit IV

Cloning of human insulin, interferon, somatostatin in *E.coli*. Human antibody production by r-DNA technology. Recombinant vaccine development - HBs Ag in yeast. Cloning for commercial production of antibiotics (Penicillin). Chymosin (Rennin) in *E.coli* and yeast.

Unit V

Transposable elements – Is elements. Mechanism of transposition – conservative and replicative. Gene silencing and antisense technology: Types and mechanism of gene silencing. Gene silencing in crop plants: tomato and rice. Si RNA and disease control. Plant

genetic engineering: Ti plasmid, DNA delivery to plant cells – microprojectile bombardment, microinjection, electroporation and pollen tubes. Gene therapy. Genome Editing – CRISPR.

Text Books

1. Brown, T.A. 2006. Gene Cloning, Fifth Edition, Chapman and Hall Publication, USA.
2. Glick, B.K. and J.J. Pasternak, 2002. Molecular Biotechnology Principles and Applications of Recombinant DNA, ASM Press, Washington.
3. SandhyaMitra, 1996. Genetic Engineering, Mac Millan India Ltd., New Delhi.
4. Kumaresan, V. 2009. Biotechnology, Saras publications, Nagercoil.

Reference Books

1. Baltz, R.H., G.D. Hegman and P.L. Skatrud, 1993. Industrial Microorganisms - Basic and applied Molecular Genetics, American Society for Microbiology, Washington.
2. Hammon, J., P. Mc Garvey and V.Y. Springer, 2000. Plant Biotechnology.
3. Krebs, J.E., E.S. Goldstein and S.T. Kilpatrick 2009. Lewin's Gene X Jones & Bartlett Publishers, Boston.
4. Old, R.W. and S.B. Primrose, 1996. Principles of Gene Manipulations, Blackwell Science Publications, London.
5. Primrose, S.B. and R.M. Twyman, 2009. Principles of Gene manipulation and Genomics, Seventh Edition, Blackwell publishing, UK.
6. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
7. Symonds, N., A. Toussaint., P. Van De Putte and M.M. Howe, 1987. Phage Mu. Cold Spring Harbor Laboratory.
8. Talwar, G.P., K.V.S. Rao and V.S. Chauhan, 1994. Recombinant and Synthetic Vaccines, Narosa Publishing House, New Delhi.
9. Thieman, W.J. and M.A. Palladino, 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
10. 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.
11. Young, M.M. 1992. Plant Biotechnology, Pergmen Press, Oxford London.

Course Designers

1. Mr. S. Kulandaivel
2. Dr. M. Karthikeyan

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Lab-5)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: III	Max. Marks	: 100
Sub. Code	: S3PYL1	No. of Credits	: 3
		Hours/Week	: 5

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

1. Collection and processing of clinical specimen for microbiological examination.
2. Staining techniques- Simple, Negative, Gram's, capsule, Spores(Organism – *Bacillus*, *Enterobacter*, *Escherichia coli*).
3. Staining of Acid fast Bacilli by Ziehl Neelson staining.
4. Stain for Amoeba / Intestinal protozoa / Malarial parasites – Leishman's stain, Giemsa stain.
5. Isolation and identification of pyogenic microorganisms.
6. Identification of *Streptococci sp.* by hemolysis (α , β and γ haemolysis)
7. Differentiation of *Streptococci sp.* by Bile solubility test.
8. Identification of *Staphylococci sp.* by hemolysis
9. Differentiation of *Staphylococci sp.* by coagulase test
10. Isolation and identification of microorganisms from urine sample(*E.coli*, *Proteus*, *Pseudomonas*)
11. Isolation of Dermatophytic fungus (*Candida albicans*, *Microsporum*, *Epidermophyton*, *Trichophyton*).
12. Biochemical tests for bacterial identification(MRVP test, TSI for enteric pathogen.)
13. Serodiagnosis of Bacterial Infection using Widal & RPR Test.
14. Preparation of dried filter paper discs for susceptibility assay.
15. Antimicrobial activity by Kirby – Bauer disc diffusion technique.
16. Determination of MIC & MBC.
17. Antimicrobial susceptibility test against filamentous and non- filamentous fungi.
18. Detection of β lactamase producing organisms.

Reference Books:

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

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Course	: M.Sc Microbiology (Lab-6)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: III	Max. Marks	: 100
Sub. Code	: S3PYL2	No. of Credits	: 3
		Hours/Week	: 4

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

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

Reference Books:

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

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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course : MSc Microbiology (core paper-10)	Int. Marks : 25
Class : IIYear	Ext. Marks : 75
Semester: IV	Max. Marks : 100
Sub.Code: S4PY1	No of Credits : 4
	Hours/Week : 5

Title of the Paper: **Bioprocess Technology**

Course Outcomes:

On the successful completion of the course, students will be able to

- Understand the basic principles involved in the industrial production of microbial products.
- Know the fundamental concepts of upstream and downstream processes of fermentation.

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

Downstream processing –cell disruption-physical and chemical methods. Separation-precipitation, filtration, centrifugation, liquid-liquid extraction, chromatography, drying and crystallization. Microbial assay of vitamin (B₁₂), Amino acid (valine), Antibiotics

(Streptomycin, erythromycin). Fermentation economics-Process cost, recovery cost, market potential and Cost benefit ratio.

Text books

1. Patel , A.H. 1996. Text Book of industrial Microbiology, MacMillan Indai Ltd., New Delhi
2. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. 2001. Industrial Microbiology: An Introduction, Blackwell Science, London.
3. Kalaichelvan, P.T. and Arul Pandi, I. 2007. Bioprocess Technology, MJP publishers, Chennai.

Reference Books:

1. Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
2. Casida, J.F. 2010. Industrial Microbiology, New Age International India Pvt. Ltd., New Delhi.
3. Crueger, W. and Crueger, A. 2000. Biotechnology: A 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 Vil.V., John Wiley and Sons Publications.
6. Patel, A.H., 1996, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.
7. Pepler, H., and Pearman, D. 2008. Microbial Technology,second edition,Vol.I, Academic Press, New York.
8. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New Delhi.
9. Stanbury, P.F, Whitaker, A. and Hall, S.J.1999. Principles of Fermentation Technology, Second Edition, Aditya Book (P) Ltd., New Delhi.
10. Wulf Cruger, Anneliese Cruger, and Thomas D. Brock, 1991. Biotechnology, A Text book of Industrial Microbiology.

Course designer

Mr.S.Kulandaivel

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with ‘A’ Grade by NAAC)
DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Microbiology (Core Paper-11)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: IV	Max. Marks	: 100
Sub. Code	: S4PY2	No. of Credits	: 4
Paper	: Core	Hours/Week	: 6

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

Course Outcomes:

On the successful completion of the course, students will be able to

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

Unit I

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

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

Unit II

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

Unit III

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

Unit IV

Biofertilizers: General account of taxonomy, physiology, mass cultivation, carrier based inoculants and application of Biofertilizers: Nitrogenous Bacteria - (*Rhizobium*, *Frankia*, *Azotobacter*), *Cyanobacteria* (*Nostoc* & *Anabaena*) and AM. Mechanism of phosphate

solubilization and phosphate mobilization. Storage, shelf life, quality control and marketing of Biofertilizers. Biomanures.

Unit V

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

Textbooks:

1. Frazier, W.C., and Westhoff, D.C. 2005. Food Microbiology, sixth edition, Tata McGraw Hill Publishing Ltd., New Delhi.
2. Garbutt, J. 1997. Essentials of Food Microbiology, Arnold – International Students edition, London.
3. Rengaswami, G. and Rajagopalan, S. 1973. Bacterial Plant Pathology – Tamil Nadu Agriculture University, Coimbatore.
4. Subba Rao, N.S. 2000. Soil Microorganisms and Plant Growth, Third Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Reference Books:

1. Adams, M.R. and Moss, M.O. 2006. Food Microbiology, New Age International (Rt) Ltd., New Delhi.
2. Alexander M. 1997. Introduction to soil microbiology, John Wiley & Sons, Inc, New York.
3. Benwart, G.J. 1987. Basic Food Microbiology, CBS Publishers & Distributors, New Delhi.
4. Deak, T. and Beuchat, L.R. 1996. Hand Book of Food Spoilage yeasts, CRC Press, New York.
5. Mehrotra, R.S. 1983. Plant Pathology, Tata McGraw Hill Publishing Company Ltd., New Delhi.
6. Pandey, B.P. 1997. Plant Pathology (Pathogen & Plant Disease), S.Chand & Company Ltd., New Delhi.
7. Ray Chadhuri, S.P. 1977. A Manual of Virus Diseases of Tropical Plants, MacMillan Company of India Ltd., Delhi.

Course Designers

1. Ms.S.Padmavathy.
2. Mrs.V.Ananthi.

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (core Paper- 12)	Int. Marks	: 25
Class	: II Year	Ext. Marks	: 75
Semester	: IV	Max. Marks	: 100
Sub. Code	: S4PY3	No. of Credits	: 4
Paper	: Core	Hours/Week	: 5

Title of the Paper: **Environmental Microbiology**

Course Outcomes:

On the successful completion of the course, students will be able to

- introduce the field of microbial ecology and environmental microbiology
- explore the functional ubiquity and diversity of microorganisms

Unit I:

Historical view and scope of microbial ecology. Atmo–Ecosphere – Characteristics and stratification of atmosphere, atmosphere as habitat and medium for microbial dispersal, microorganisms in atmo-ecosphere. Hydro-Ecosphere – Fresh water habitats, composition and activity of fresh water microbial communities, marine habitats, characteristics and stratification of the ocean, composition and activity of marine microbial communities – rocks, soil. Litho–Ecosphere – Deep subsurface microbiology, determining soil texture and humic acid characteristics.

Unit II:

Microbial interactions within the community – positive & negative interactions: symbiosis, amensalism, commensalisms, predation, parasitism and competition. Population within biofilms.

Unit III:

Biogeochemical cycling – nitrogen cycle (ammonification, nitrification, nitrate reduction and denitrification), carbon, hydrogen, oxygen, sulfur, phosphorus, iron. Winogradsky column.

Unit IV:

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.

Unit V:

Microbial remediation - phenolics, metals, sewage nutrients (phosphate and nitrate), xenobiotics. Microbial leaching of ores. Microbial deterioration - paper, leather, wood, paint and textiles.

Textbooks:

1. 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.
2. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New York.
3. Atlas,R.A.&Bartha,R.2000.Microbial Ecology, Fundamentals and Application, Benjamin Cummings, New York.

Reference books:

1. Ec Eldowney S., Hardman, D.J. and Waite, S. 1993. Pollution Ecology and Biotreatment-Longman Scientific Technical.
2. Grant, W.D. and Long, P.L. 1981. Environmental Microbiology. Blalckie Glasgow and London.
3. Vaun Mc Arthur J, 2009. Microbial Ecology-An Evolutionary approach, Elseviers Publications, Academic Press.
4. Madigan, M.T., Martinka,M.,Parker,J. & Brock, T.D.2000. Twelfth edition, Biology Microorganisms, Prentice Hall, New Jerry.
5. Saha, T.K.2010. Ecology and Environmental Biology, Books and Allied Pvt. Ltd. Kolkata.
6. Tortora G.J., Funke, B.R. & Case, C.L, 2009. Microbiology, Ninth Edition, Dorling Kindersely(India) Pvt. Ltd., Noida.

Course Designers

1. Ms.S.Padmavathy
2. Mrs.V.Ananthi

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Elective Paper- 4)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: IV	Max. Marks	: 100
Sub. Code	: S4PYEP	No. of Credits	: 3
		Hours/Week	: 5

Title of the Paper: **Project Work**

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Course	: M.Sc Microbiology (Lab-7)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: IV	Max. Marks	: 100
Sub. Code	: S4PYL1	No. of Credits	: 3
		Hours/Week	: 5

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

Reference Books:

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

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Lab- 8)	Int. Marks	: 40
Class	: II Year	Ext. Marks	: 60
Semester	: IV	Max. Marks	: 100
Sub. Code	: S4PYL2	No. of Credits	: 3
		Hours/Week	: 5

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

1. Viable count of bacteria in milk.
2. Methylene Blue Dye reduction test.
3. Resazurin dye reduction test.
4. Phosphatase test.
5. Turbidity test
6. Litmus milk reactions.
7. Microbial Contamination in plant food products.
8. Microbial Contamination in animal food products.
9. Potability analysis of drinking water.
10. Structure of root & stem nodules.
11. Isolation of *Rhizobium* from root nodules.
12. Isolation of *Xanthomonas malvacearum* from angular leaf spot of cotton
13. Isolation of pathogenic fungi from plant
14. Isolation of cyanobacteria from soil
15. Isolation of Arbuscular Mycorrhizal spores from soil.
16. Staining of VAM.
17. Isolation & enumeration of *Azospirillum* – an associative symbiotic nitrogen fixing bacteria.
18. Isolation & enumeration of *Azotobacter* & *Beijerinckia* – non symbiotic nitrogen fixing bacteria.
19. Isolation of Phosphate solubilizing Microorganisms from soil.
20. Vermicomposting.
21. Development of Winogradsky column.
22. Oligodynamic action of heavy metals on microbes
23. Biodegradation of oil/dye
24. Physical, Chemical, Microbial assessment of water – Acidity, Alkalinity, BOD, COD.
25. 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.

Elective Papers

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
(For those who join in 2017 and after))

Course	: M.Sc Microbiology (Elective Paper -1)	Int. Marks	: 25
Class	: I/ II year	Ext. Marks	: 75
Semester	: I /II/III Sem	Max. Marks	: 100
Sub. Code	:SIPYE1	No. of Credits	:54
		Hours/Week	: 5

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

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the evolution and taxonomy of microbial communities
- become familiar with diversity and classification of microorganisms

Unit I

Microbial evolution – evolution of early life forms, RNA world, energy and carbon metabolism, origin of eukaryotes, evolutionary chronometers, diversity indices-dominant indices, similarity indices – Jaccard coefficient, cluster analysis, community stability, theories of succession, molecular adaptation of extremophiles. Characteristics of microorganisms - Morphological, chemical, cultural, metabolic, antigenic, genetic, pathogenic and ecological. Microbial classification, nomenclature and identification.

Unit II

Salient features of archaea and bacteria. Diversity, characteristic features and significance of *Thermoproteus*, *Desulfococcus*, *Methanobacterium*, *Methanococcus*, *Methanosarcina*, *Halobacterium*, *Thermoplasma*, *Pyrococcus*.

Unit III

Diversity, characteristic features and significance of *Aquifex*, *Thermotoga*, *Deinococcus*, *Chloroflexus*, *Heliothrix*, *Synechococcus*, *Myxosarcina*, *Pseudoanabena*, *Chlorobium*.

Unit IV

Diversity, characteristic features and significance of *Acetobacter*, *Achromobacter*, *Bdellovibrio*, *Bifidobacterium*, *Brevibacterium*, *Arthrobacter*, *Caulobacter*, *Cytophaga*

Unit V

Diversity, characteristic features and significance of *Actinomadura*, *Jathinobacterium*, *Nitrosomonas*, *Propionibacterium*, *Photobacterium*, *Phyllobacterium*, *Saccharococcus*, *Vitreoscilla*, *Verrucomicrobium*

Text Books

1. Prescott, L.M., J.P. Harley and D.A.Helin, 2008. Microbiology, Fifth Edition, McGraw Hill, New York.
2. 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.
3. Madigan, M.T., M. Martinka, J. Parker and T.D.Brock, 2000. Twelfth Edition, Biology Microorganisms, Prentice Hall, New Jerry.
4. Schlegel, H.G. 2008. General Microbiology, Seventh edition, Cambridge Univeristy Press.
5. Stanier, R., Y. Lingraham, M.L.Wheelis and R.P.Painter, 1986. General Microbiology, Fifth Edition, Macmillan, London.

Reference Books

1. Atlas, R.M. 2000. Microbiology Fundamentals and Application, Macmillan Publish Company, New York.
2. Dubey, R.C. and D.K.Maheswari, 2010. A text book of Microbiology, S. Chand and Company Ltd, NewDelhi.
3. Mark Wheelis, 2010. Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi.
4. Pelczar, M.J., E.C.Schan, and N.R.Kreig, N.R.2010. Microbiology – An application based approach, Fifth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi.
5. Postgate, J. 1998. Nitrogen Fixation, Third Edition, Cambridge University Press.
6. Tortora G.J., B.R. Funke, and C.L.Case, 2009. Microbiology, Ninth Edition, Dorling Kindersely (India) Pvt. Ltd., Noida.

Course Designers

1. Mr.S.Kulandaivel
2. Ms.S.Padmavathy

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Elective Paper- 2)	Int. Marks	: 25
Class	: I/II Year	Ext. Marks	: 75
Semester	: I /II/III Sem	Max. Marks	: 100
Sub. Code	: SIYPE2	No. of Credits	: 4
		Hours/Week	: 5

Title of the Paper: **Biological Techniques**

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the principles and applications of classical and modern techniques in Biology.
- experience hands-on and a critical appreciation of commonly employed analytical techniques in biochemistry.

Unit I

Microscopy: light microscope - basic principles, types-phase contrast, dark field polarizing and fluorescent microscope. Electron microscopy - principles, working function and application of TEM, SEM. Principles and uses- Camera Lucida.

Unit II

Spectrophotometry: principles and working function and application of UV spectrophotometers -single beam, double beam, Atomic absorption spectrophotometer, IR and NMR. Flame photometer. pH meter

Unit III

Radioactivity: nature of radioactivity, types of radioisotopes, half-life, Unit of radioactivity, detection and measurements. principles and working function of Geiger Muller counter, liquid scintillation counter. X-ray diffraction.

Unit IV

Chromatography - Principle, types and working function and application -Paper chromatography, ion exchange, TLC, GC, GC-MS and HPLC. Centrifugation: Basic principles, sedimentation coefficient, centrifugal forces. Types of centrifuges - clinical, high speed, refrigerated, ultra. Types and applications of centrifugation - rotar types, density gradient, differential centrifugation.

Unit V

Electrophoresis - Principle, types and application of Agarose electrophoresis (Horizontal), SDS-PAGE (vertical), Pulse Field gel electrophoresis (PFGE). Gel documentation. Sonicator, Lyophilizer (freeze dryer)

References Books

1. Wrigglesworth, J.M. 1984. Biochemical research technique - a practical introduction. John Wiley, New York.
2. Patki, L.R., Bhalchandra, L. and Jeevaji, I.H., 1989. An introduction to microtechniques, S. Chand and Company Ltd., New Delhi.
3. Keith Wilson and John Walker, 1994. Practical Biochemistry - principles and techniques, Cambridge Press, New York.
4. Keith Wilson and Goulding, K.H. 1986.a biologists guide to principles and techniques of practical biochemistry, ELBS, London.
5. Kothari, C.R., 1988. Research methodology, Wiley Eastern Ltd., New Delhi.
6. Irfan A. Khan and Atiya Khanum, 1994. Fundamental of Biostatistics, Ukaaz publishers, India.
7. Anderson, J., Durosn, B.H. and Poole, M. 1986. Thesis and assignment writing, Wiley Eastern Ltd., New Delhi.

Course Designers

- 1.Mr.S.Kulandaivel
- 2.Dr.M.Karthikeyan

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course : MSc Microbiology (Elective paper-3)	Int. Marks : 25
Class : I/II Year	Ext. Marks : 75
Semester: I//II/III Sem	Max. Marks : 100
Sub.Code: SYPE3	No of Credits : 4
	Hours/Week : 5

Title of the Paper: **Forensic Science**

Course Outcomes:

On the successful completion of the course, students will be able to

1. Understand the basic principles and application of forensic science
2. Know the fundamental concepts in physical, chemical and biological methods of crime investigation

UNIT I

Introduction to forensic Science –Development of Forensic science in India - Organization and functions of Forensic laboratory; Physical evidences - their classification and significance, Crime Scene examinations - documentation of crime scene- recognition, collection, preservation and transportation. Fundamentals of crime scene photography. Tool marks - identification - restoration of field off/erased marks.

Unit II

Foot and tyre impressions - examination of foot and tyre prints. Finger prints - Finger print patterns and classification – Toxicology - classification and mode of action of poisons - narcotic drugs - alcoholic beverages - Examination of biological fluids - blood, seminal and saliva Examination of hair, bones, teeth and skull - Fundamentals of DNA typing.

Unit III

Types and identification of microorganisms-bacteria and fungi of forensic significance, Techniques in forensic microbiology. Bioterrorism- Types of biological agents – Category A, B, C. Planning and response to bioterrorism – Preparedness, Biosurveillance, Biodefence. Epidemiology of Bioterrorism- Study of spore, powdered minerals and pollens of forensic importance, Use of pollen grains & spores in criminal or civil investigation

Unit IV

Introduction – Bioinformatics and databases – sequence, structure & domain, application and scope. Biological databases: Nucleotide sequence databases – protein databases – specialized sequence data bases. Data retrieval and analysis. Sequence alignment: Types - local and global alignment. Alignment methods – pair wise sequence alignment: FASTA and BLAST.

Introduction to ORF and primer designing. Secondary structure prediction: GOR, Chou – Fasman.

Unit V

Multiple sequence alignment – methods and softwares – Clustal W, Multalign – phylogenetic analysis. Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure. Drug designing and docking analysis. Structure visualization tool- RASMOL. Genomics-scope and applications of structural, comparative and functional genomics, microarray technology.

Text books:

1. Nanda, B.B., Tiwari, R.K. 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi.
2. Duncan, G.T., and M.I. Tracey, M.I. 1997. Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton .

Reference books :

1. Tilstone, W.J., M.L. Hastrup, M.L., and C. Hald, Fisher's, C. 2013. Techniques of Crime Scene Investigation, CRC Press, Boca Raton .
2. James, S.H., and Nordby, J.J. 2005. Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton.
3. Bevel, T., and Gardner, R.M. 2008. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton.
4. Poklis. 1997. Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton.
5. Attwood, T.K. and Parry Smith., D.J. 2002. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd.
6. Mount, W. 2001. Bioinformatics Sequence and Genome Analysis. Cold Spring harbour Laboratory Press, New York

Course designer

Dr.M.Karthikeyan

THIAGARAJAR COLLEGE, MADURAI – 9.
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DEPARTMENT OF ZOOLOGY AND MICROBIOLOGY
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Course	: M.Sc Microbiology (Elective Paper-4)	Int. Marks	: 25
Year & Sem	: I /II Year- I/II/ III Sem	Ext. Marks	: 75
Sub. Code	: SYPE4	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4
Title of the Paper: Cell Biology			

Course Outcomes:

On the successful completion of the course, students will be able to

- understand the fundamental concepts of cell organelles and its function
- explain the role of membranes in cell communication

Unit I

Discovery of cell and Cell theory. Ultrastructure of plant, bacterial and animal cells. Cell types epithelial cells, endothelial cells and Nerve cells. Specialization of cells into tissues and colonies. Structure, types and functions of: Mitochondria, Chloroplast, Ribosome, Peroxisomes, Endoplasmic reticulum (rough and smooth), Golgi apparatus, Lysosome, Nucleus – Nucleolus, Chromosome – Eukaryotic and prokaryotic, Histones and Plasmids

Unit II

Microfilaments, Microtubules, Cilia, Flagella, Pili, Capsule, Plasma membrane models - Davson-Danielli and Fluid mosaic. Transport of molecules – active, passive and diffusion. Cell junctions- gap junctions, tight junctions & anchoring junctions

Unit III

Cell signalling- G-protein coupled and TGF β receptor system
JAK/STAT, Ras and MAP kinase pathway
Cell cycle & its regulation- mitosis and meiosis
Molecular and biochemical characteristics of cancer cells
Cell ageing, Cell death and its regulation

Unit IV

Extra Cellular Matrix (ECM), Cell Adhesion, Cell migration, Cell Junctions & Cell-cell Communication, Vesicle formation- fission and fusion, Quorum sensing, Intracellular signaling- calcium, receptors- G protein, MAPK

Unit V

Stages of cell cycle, regulation of cell cycle, Phases and significance of Mitosis, Meiosis, Apoptosis, Necrosis and Oncogenesis. Introduction to Stem cells

Text Books:

1. Powar, C.B. 2009. Cell Biology. Himalayan Publishing House, New Delhi.
2. Paul, A. 2009. Cell and Molecular Biology. Books and Allied (P) ltd, India.

Reference Books

1. Alberts, B. et al. 1994. Molecular Biology of the Cell (3rd edition). Garland Publishing, Inc., New York.
2. De Roberties E.D.P and E.M.F.De Roberties 2011. Cell and Molecular Biology. 8th edition. B.I. Publicatons Pvt. Ltd., India
3. Paul, A. 2009. Cell and Molecular Biology, Books and Allied (P) ltd, India.
4. Allison LA. 2007. Fundamental Molecular Biology. Blackwell Publishing Ltd., USA.
5. Lodish, Berk, Zipursky, Matsudara, Baltimore and Darnell.1999. Molecular Cell Biology, Fourth Edition, W.H.Freeman and Company, Newyork.
6. Watson, J.D., N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 1998. Molecular Biology of the Gene, Fourth edition, The Benjamin / Cummings Publishing Company Inc., Tokyo.
7. Wolfe, L.S., 1993. Molecular and Cellular Biology, Wadsworth publishing company.

Course designer

1. Ms.S.Padmavathy
2. Mrs.V.Ananthi

THIAGARAJAR COLLEGE, MADURAI – 9.
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Course	: M.Sc Microbiology (Elective Paper-4)	Int. Marks	: 25
Year & Sem	: I /II Year- I/II/ III Sem	Ext. Marks	: 75
Sub. Code	:SYPE5	Max. Marks	: 100
Hours/Week	: 5	No of Credits	: 4
Title of the Paper: Biostatistics			

Course Outcomes:

On the successful completion of the course, students will be able to

- Recognise the type of variables, summarise the data and construct suitable graphical representation of data and understand the basics of experimental design including randomization, and control
- Set and interpret significance levels (P value) for datasets and explain the probability background of the hypothesis tested
- Understand the conditions which determines the choice of statistical tests and conclude the experimental results with statistical conclusions
- Use Microsoft excel to perform summary statistics and inferential statistics

Unit I- Descriptive statistics

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

Unit II-Summary statistics

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

Unit III-Hypothesis testing-I

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

Unit IV-Hypothesis testing-II

Single factor ANOVA; basic assumptions under ANOVA, loss of replications, ANOVA with two treatments. Tests for Multiple comparisons- Tukey test. Practical training using MS-Office excel.

Unit V- Bivariate analysis

Correlation – types, methods of correlation – graphical method, mathematical method; Karl Pearson's Rank; Regression analysis – equation, estimation of unknown value from known value; Chi-square test, test of independence;

Text Books

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

Reference Books

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

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