

# Thiagarajar College

(An Autonomous Institution Affiliated to Madurai Kamaraj University)  
Re-Accredited with 'A' Grade by NAAC



## ***Thirty Eighth Academic Council Meeting***

### **Department of Zoology & Microbiology**

**Dr. Rm. Murugappan**  
**Dean – Curriculum Development**

**B.Sc.,  
Microbiology  
(Programme Code - UMB)**

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**Curriculum structure for**  
**B.Sc., CS, IT & BCA BBA & B.Com**  
**(For those who joined in 2019 and after)**

Category	Course	No.of Courses /paper	Credit Distribution	Hrs/ Week	Total Credits	
Part I	Tamil	2	3	-	06	
Part II	English	2	3	-	06	
		<b>Sub Total</b>				<b>12</b>
Part III	Core	-	-	-	84	
	Elective –Main	2	5	-	10	
	Elective – Generic	2+2	5	-	20	
		<b>Sub Total</b>				<b>114</b>
Part IV	<b>AECC</b> I &II Sem	I sem EVS II Sem .Prof.Skill Development	2	4	04	
	<b>NME III &amp; V Sem</b> Horizontal Migration	2	2	8	08	
	<b>SEC IV &amp; VI Sem</b> Vertical Migration	2				
	Value Education V Sem	1	1	2	<b>01</b>	
		<b>Sub Total</b>			<b>14</b>	<b>13</b>
	<b>Total</b>				<b>139</b>	
Part V	<b>NCC (Army &amp;Navy)/ PE/ NSS / Rotaract/ Quality Circle/ Library/ SSL/ Nature Club/Value Education/ YRC/WSC</b>				<b>01</b>	
	<b>Grand Total</b>				<b>140</b>	
	<b>Self-Study Paper (Optional)- -V Sem</b>			<b>05</b>	<b>145</b>	

AECC – Ability Enhancement Compulsory Course

SEC – Skill Enhancement Course

NME – Non Major Elective

For Choice based credit system (CBCS)

- For NME every department offers two papers (one in each at III & V semester)
- For SEC every department offer three papers for each course (Sem IV & VI)
- For Major elective there may be an option for choice.

**THIAGARAJAR COLLEGE, MADURAI – 9.**

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

**Curriculum structure for**

BA Tamil, English & Economics

B.Sc., Maths, Physics, Chemistry, Botany, Biotechnology Microbiology and Psychology

**(For those who joined in 2019 and after)**

Category	Course	No.of Courses /paper	Credit Distribution	Hrs/ Week	Total Credits
Part I	Tamil	4	3	12+12	12
Part II	English	4	3	12+12	12
		<b>Sub Total</b>		<b>48</b>	<b>24</b>
Part III	Core			72 +12	72
	Elect –Main	2	5	10	10
	Elect – Generic	2+2	5	24	20
		<b>Sub Total</b>		<b>118</b>	<b>102</b>
Part IV	AECC I & II Sem	I sem EVS II Sem .Prof.Skill Development	2	4	04
	NME III & V Sem Horizontal Migration	2	2	8	08
	SEC IV & VI Sem Vertical Migration	2			
	Value Education V Sem	1	1	2	1
		<b>Sub Total</b>		<b>14</b>	<b>13</b>
		<b>Total</b>			<b>139</b>
Part V	NCC (Army & Navy)/ PE/ NSS / Rotaract/ Quality/WSC Circle/ Library/ SSL/ Nature Club/Value Education/ YRC				1
		<b>Grand Total</b>			<b>140</b>
		<b>Self-Study Paper (Optional)- -V Sem</b>		<b>05</b>	<b>145</b>

AECC – Ability Enhancement Compulsory Course

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- For NME every department offers two papers (one in each at III & V semester)
- For SEC every department offer three papers for each course (Sem IV & VI)
- For Major elective there may be an option for choice.

## **Programme outcome-PO (Aligned with Graduate Attributes)- Bachelor of Science (B.Sc.,)**

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### **Scientific Knowledge and Critical Thinking**

Apply the knowledge of Life Science, Physical and Chemical Science, Mathematics, statistics, Computer science and humanities for the attainment of solutions to the problems that come across in our day-to-day life/activities.

### **Problem Solving**

Identify and analyze the problem and formulate solutions for problems using the principles of mathematics, natural sciences with appropriate consideration for the public health, safety and environmental considerations.,

### **Communication and Computer Literacy**

Communicate the fundamental and advanced concepts of their discipline in written and oral form. Able to make appropriate and effective use of information and information technology relevant to their discipline

### **Life-Long Learning**

Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **Ethical, Social and Professional Understanding**

Commitment to principles, codes of conduct and social responsibility in order to behave consistently with personal respect. Acquire the responsibility to contribute for the personal development and for the development of the community. Respect the ethical values, social responsibilities and diversity.

### **Innovative, Leadership and Entrepreneur Skill Development**

Function as an individual, and as a member or leader in diverse teams and in multidisciplinary settings. Become an entrepreneur by acquiring technical, communicative, problem solving, intellectual skills.

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**Department of –Zoology and Microbiology**

**Vision**

- To render exemplary quality education in Life Sciences and laboratory skills in order to produce generations of responsible, competent and employable graduates

**Mission**

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching positions in biological sciences.
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, and effective oral and written communication abilities for students.
- To create an holistic understanding of the allied subjects through interdisciplinary learning.

**Programme Educational Objectives (PEO)**

The objectives of this programme is to equip/prepare the students

<b>PEO1</b>	To prepare a new generation of microbiologists, capable of excelling in careers of their choosing.
<b>PEO2</b>	To equip the students to apply knowledge of prokaryotic and eukaryotic cellular processes, classification, interaction of microorganisms among themselves, with physical and chemical agents and higher order organisms
<b>PEO3</b>	To undertake research studies, collect relevant literature ,design experient, use experimental techniques, analysis the results statistically, rePSort and publish the findings
<b>PEO4</b>	Job opPSOrtunities in pharmaceutical, food and bioprocess industries
<b>PEO5</b>	Basics and current updates in the areas of microbiology, biochemistry, molecular biology Immunology and genetic engineering (andIndustrial Microbiology, Medical microbiology, Agriculture & Environmental Microbiology) are included to train the students and also sensitize them to scope for research.

**Programme specific outcomes- B.Sc., Microbiology**

On the successful completion of B.Sc., Microbiology the students will

<b>PSO1</b>	Comprehend the core concepts, methods and practices in life sciences especially microbiology, biotechnology etc.,
<b>PSO2</b>	Isolate, identify and characterize different types of microorganisms and their metabolites
<b>PSO3</b>	Interpret the etiology of infectious diseases, their transmission, treatment, control and prevention methods.
<b>PSO4</b>	Acquire theoretical basis and practical skills in the use of basic tools, technologies and methods common to different disciplines of life sciences.
<b>PSO5</b>	Be proficient in the fundamental knowledge and recent trends/updates of different disciplines in microbiology.

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**Department of –Zoology and Microbiology**  
**Bachelor of Science (B.Sc.,) Microbiology (w.e.f. 2019 batch onwards)**  
**Programme Code-UMB**

**Semester – I**

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U19 TM11	Tamil	6	3	90	25	75	100
Part II	U19 EN11	English	6	3	90	25	75	100
Core 1	UMB19 C11	General Microbiology	4	4	60	25	75	100
Core 2	UMB19 C12	Cell Structure and Dynamics	4	4	60	25	75	100
Core lab 1	UMB19 CL11	Lab in Microbiology	2	1	30	40	60	100
Generic Elective	UCH19 GE11Z	General Chemistry I	4	4	60	25	75	100
Generic Elective lab	UCH19 GL21Z	Anc.Chemistry lab	2	-	30	-	-	-
EVS	U19ES11	Environmental Science	2	2	30	15	35	50
<b>TOTAL</b>			<b>30</b>	<b>22</b>				

**Semester – II**

Course	Code No	Subject	Hrs/ Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U19 TM21	Tamil	6	3	90	25	75	100
Part II	U19 EN21	English	6	3	90	25	75	100
Core 3	UMB19 C21	Biochemistry	4	4	60	25	75	100
Core 4	UMB19 C22	Medical Microbiology	4	4	60	25	75	100
Core lab 2	UMB19 CL21	Lab in Biochemistry	2	1	30	40	60	100
Generic Elective	UCH19 GE21Z	General Chemistry II	4	4	60	25	75	100
Generic Elective lab	UCH19 GL21Z	Chemistry Lab	2	2	30	40	60	100
AECC	UMB19 AE21	Personality development	2	2	30			
<b>TOTAL</b>			<b>30</b>	<b>22</b>				

### Semester –III

Course	Code No	Subject	Hrs/Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U19 TM31	Tamil	6	3	90	25	75	100
Part II	U19 EN31	English	6	3	90	25	75	100
Core 5	UMB19 C31	Bioinstrumentation	4	4	60	25	75	100
Core 6	UMB19 C32	Microbial Physiology	4	4	60	25	75	100
Core lab 3	UMB19 CL31	Lab in Bioinstrumentation	2	1	30	40	60	100
Generic Elective	UBO19 GE31Z	Plant Life forms and Utilization	4	4	60	25	75	100
Generic Elective lab	UBO19 GL41Z	Plant Life forms and Utilization lab	2	-	30	40	60	100
NME1	UMB19 NE31	Health Education	2	2	30	15	35	50
<b>TOTAL</b>			<b>30</b>	<b>22</b>				

### Semester – IV

Course	Code No	Subject	Hrs/Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U19 TM41	Tamil	6	3	90	25	75	100
Part II	U19 EN41	English	6	3	90	25	75	100
Core 7	UMB19 C41	Molecular Biology	4	4	60	25	75	100
Core 8	UMB19 C42	Microbial Genetics	4	4	60	25	75	100
Core lab 4	UMB19 CL41	Lab in Molecular Biology and Microbial Genetics	2	1	30	40	60	100
Generic Elective	UBO19 GE41Z	Plant Pathology	4	4	60	25	75	100
Generic Elective lab	UBO19 GL41Z	Plant Life forms and Utilization and Plant Pathology Lab	2	2	30	40	60	100
SBE I	UMB19 SE41 A/B/C	IPR/ Bioethics and Biosafety/ Bioenergy	2	2	30	15	35	50
<b>TOTAL</b>			<b>30</b>	<b>22</b>				



**Semester --V**

Course	Code No	Subject	Hrs/Week	Cred	Total Hrs	Max Mark CA	Max Marks SE	Total
Core 9	UMB19 C51	Agricultural Microbiology	5	5	75	25	75	100
Core 10	UMB19 C52	Food Microbiology	5	5	75	25	75	100
Core 11	UB19 C53	Clinical Lab Technology	5	5	75	25	75	100
Core lab 5	UMB19 CL51	Lab in Agricultural Microbiology	2	1	30	40	60	100
Core lab 6	UMB19 CL52	Lab in Food Microbiology	2	1	30	40	60	100
Core lab 7	UMB19 CL53	Lab in Clinical Lab Technology	2	1	30	40	60	100
Core Elective	UMB19 CE51	Environmental Microbiology	5	5	75	25	75	100
NME II	UMB19 NE51	Sericulture	2	2	30	15	35	50
	U19VE 51	Value Education	2	1	30	15	35	50
<b>TOTAL</b>			<b>30</b>	<b>22</b>				

**Semester-VI**

Course	Code No	Subject	Hrs/W	Cred	Total Hrs	Max Mark CA	Max Marks SA	Total
Core 12	UMB19 C61	Immunology	5	5	75	25	75	100
Core 13	UMB19 C62	Industrial Microbiology	5	5	75	25	75	100
Core 14	UMB19 C63	Genetic Engineering and Biotechnology	5	5	75	25	75	100
Core lab 8	UMB19 CL61	Lab in Immunology	2+1*	1	45	40	60	100
Core lab 9	UMB19 CL62	Lab in Industrial Microbiology	2	1	45	40	60	100
Core Lab 10	UMB19 CL63	Lab in Genetic Engineering & Biotechnology	2+1*	1	45	40	60	100
Core Elective II	UMB19 CE61	Biostatistics and Bioinformatics	5	5	75	25	75	100
SBE II	UMB19 SE61 A/B/C	Stem Cell Biology/ Nano technology/Forensic Science	2	2	30	15	35	50
<b>Part V</b>			-	1		75	25	100
<b>TOTAL</b>			<b>30</b>	<b>22</b>				

\*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
<b>Part I</b>	<b>Tamil</b>	<b>4</b>	<b>3</b>	<b>12</b>
<b>Part II</b>	<b>English</b>	<b>4</b>	<b>3</b>	<b>12</b>
<b>Part III</b>	<b>Core Theory</b>	<b>8+6</b>	<b>4/5</b>	<b>72</b>
	<b>Core lab</b>	<b>10</b>	<b>1</b>	<b>10</b>
	<b>Core Elective</b>	<b>2</b>	<b>5</b>	<b>10</b>
	<b>Generic Elective Theory</b>	<b>4</b>	<b>4</b>	<b>16</b>
	<b>Generic Elective Theory</b>	<b>2</b>	<b>2</b>	<b>4</b>
<b>Part IV</b>	<b>AECC</b>	<b>2</b>	<b>2</b>	<b>4</b>
	<b>NME</b>	<b>2</b>	<b>2</b>	<b>4</b>
	<b>SEC</b>	<b>2</b>	<b>2</b>	<b>4</b>
	<b>VE</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>Part V (NSSNCC/Physical Education)</b>				<b>1</b>
<b>Grand total</b>				<b>140</b>

Course Code	Course Title	Category	L	T	P	Credit
UMB19C11	General Microbiology	Core-1	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

### Preamble

The course explains the basic concepts, history and development of microbiology. The course content focuses on the classification and biology of microbes - bacteria, viruses, fungi and algae. Elaborate the significance of beneficial microbes and methods for the control of pathogenic microbes.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Define the fundamental concepts, history and development of microbiology.	K1
CO2	Outline the taxonomical classification of microbes (bacteria fungi, viruses and algae).	K2
CO3	Analyse the structural organization and importance of bacteria, fungi, viruses and algae.	K2,K3
CO4	Perceive the theoretical basis and demonstrate the practical skills in the use of tools, technologies and methods common to microbiology.	K2 ,K3
CO5	Determine the methods to be adopted to control microbes.	K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	L	L	M
CO2	S	S	M	L	M
CO3	S	S	S	M	S
CO4	M	L	L	S	--
CO5	S	M	M	S	L

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

### 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, 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, 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, 5<sup>th</sup> edition. McGraw-Hill. Book Co. Singapore.
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9<sup>th</sup> edition, Pearson Education, Singapore.

## Reference Books

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

10. Schlegel, H.G. 2008. General Microbiology, 7<sup>th</sup> edition, Cambridge University Press, U.K.
11. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. 1991. General Microbiology, 5<sup>th</sup> edition, Prentice Hall of India Pvt. Ltd., New Delhi.

Course designer : **Dr.RM.Murugappan**

### Course contents and lecture schedule

Units	Topic	Lecture hrs.
<b>Unit I</b>		
1.1	Introduction of Microbiology. History of Microbiology - Discovery of microorganisms (Robert Hooke & Leeuwenhoek).	2
1.2	Contributions of Francesco Redi, John Needham, Spallanzani, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich, Alexander Fleming, Dubos and Winogradsky	5
1.3	Classification based on – Carolus Linnaeus, Carl Woese and Robert H. Whittaker (Five Kingdom system).	3
<b>Unit II</b>		
2.1	Outline classification for bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology	3
2.2	Structural organization of bacteria – Size, shape and arrangement of bacterial cells	1
2.3	Ultrastructure of a bacterial cell - cell wall, cell membrane, ribosomes, nucleoid, capsule, flagella, fimbriae, spores and cysts.	6
2.4	Growth of bacterial culture – Physical & Chemical requirements for growth; Phases of growth	4
<b>Unit- III</b>		
3.1	Types of growth media- natural, synthetic, complex, enriched, selective, anaerobic Growth media - definition with example	3
3.2	Pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture).	3
3.3	Control of microbes- Sterilisation, disinfection, antiseptic, tyndallisation, pasteurization	3
3.4	Physical- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter, Chemical methods	3
<b>Unit IV</b>		
4.1	Classification of viruses	2
4.2	General characteristics of viruses –General Morphology – Helical, Polyhedral, complex	1
4.3	Morphology and structure of TMV & Influenza virus	2
4.4	Classification of Fungi (Alexopoulos and Mims)	2
4.5	Distinguishing characteristics of Fungi – Filamentous, non-filamentous & dimorphic fungi	2
4.6	Morphology and structure of <i>Aspergillus niger</i> and <i>S. cerevisiae</i> .	2
4.7	Industrial uses of yeasts and molds	1
<b>Unit V</b>		
5.1	Classification and General Characteristics of Algae	3
5.2	Morphology and structure of <i>Chlorella</i> & <i>Anabaena</i>	3
5.3	Biological and economic importance of algae	3
5.4	General structure of Lichens.-Biological and economic importance of Lichens.	3

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19CL11	<b>Lab in General Microbiology</b>	Core Lab-1	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Know about the different instruments and glasswares used in microbiology.	K1
CO2	Define the safety measures and precautions to be taken.	K2
CO3	Sketch the structural organization of microbes (bacteria fungi, viruses and algae).	K2
CO4	Demonstrate the methods for the isolation of bacteria, fungi and algae.	K2 ,K3
CO5	Exhibit the practical skills in the use of tools, technologies and methods common to microbiology.	K2,K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	---	S	L
CO2	S	L	S	S	L
CO3	M	S	M	---	M
CO4	S	S	S	S	L
CO5	M	S	M	S	L

**S-Strong M-Medium L-Low**

#### 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-PSOitive and negative
10. Differential staining –Gram staining
11. SPSOre 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. 7<sup>th</sup> 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. 2<sup>nd</sup> Edition, Ane Books Pvt. Ltd., New Delhi.

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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C12	Cell Structure and Dynamics	Core-2	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

### Preamble

Students acquire knowledge on the structural organization and function of cells, tissues and organelles. Illustrate cell cycle and its regulation, including the mechanism of mitosis and meiosis.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Explain the diversity and similarity of living organisms at organization levels.	K1
CO2	Depict the structure of various cell organelles.	K1
CO3	Identify the structural and functional properties of cells, tissues , organelles etc.,	K2
CO4	PSOrtray the various mechanisms of inter and intra cellular communication.	K2,K3
CO5	Appraise the concepts of cells in terms of growth, division, specialisation, motility and interactions.	K2

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	M	M	S
CO2	M	---	---	M	M
CO3	M	M	---	M	S
CO4	L	---	---	M	M
CO5	M	---	---	M	---

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total arks</i>	52	52	140

### Unit I

Discovery of cell and Cell Theory. Ultrastructure of plant, bacterial and animal cells. Cell types



–epithelial cells, endothelial cells, 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. TransPSOrt 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, APSOptosis, Necrosis and Oncogenesis. Introduction to Stem cells

### Text Books:

1. PSOver, 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 (3<sup>rd</sup> edition). Garland Publishing, Inc., New York
2. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach (6<sup>th</sup> Edition). Sinauer Associates, Inc
3. De Roberties E.D.P and E.M.F.De Roberties. 2011. Cell and Molecular Biology. 8<sup>th</sup> 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, 2<sup>nd</sup> Edition, a John wiley & sons, Inc., publication – (e- book)

### Course Designers:

1. Dr. T S Ramyaa Lakshmi Dr. C. Ravi

### Course contents and lecture schedule

#	Topic	Lecture hrs.
1.1	Checking the entry behavior of students	01
1.2	Introducing the course	01
1.3	Discovery of cell and Cell Theory	02

1.4	Ultrastructure of plant cell	01
1.5	Ultrastructure of bacterial cell	01
1.6	Ultrastructure of animal cell	01
1.7	Cell types –epithelial cells, endothelial cells, Nerve cells	03
1.8	Specialization of cells into tissues and colonies	02
2.1	Microfilaments	01
2.2	Microtubules	01
2.3	Cilia and Flagella	02
2.4	Pili and Capsule	02
2.5	Plasma membrane models - Davson-Danielli and Fluid mosaic	03
2.6	Transport of molecules – active, passive	02
2.7	Diffusion	01
3.1	Mitochondria	01
3.2	Chloroplast	01
3.3	Ribosome	01
3.4	Peroxisomes	01
3.5	Endoplasmic reticulum (rough and smooth)	01
3.6	Golgi apparatus	01
3.7	Lysosome	01
3.8	Nucleus – Nucleolus	01
3.9	Chromosome – Eukaryotic and prokaryotic	02
3.10	Histones	01
3.11	Plasmids	01
4.1	Extra Cellular Matrix (ECM)	01
4.2	Cell Adhesion	01
4.3	Cell migration	01
4.4	Cell Junctions & Cell-cell Communication	02
4.5	Vesicle formation- fission and fusion	02
4.6	Quorum sensing	01
4.7	Intracellular signaling- calcium, receptors- G protein,	03
4.8	MAPK pathway	01
5.1	Stages of cell cycle	02
5.2	Regulation of cell cycle	02
5.3	Phases and significance of Mitosis	02
5.4	Phases and significance of Meiosis	02
5.5	Apoptosis	01
5.6	Necrosis	01
5.7	Oncogenesis	01
5.8	Introduction to Stem cells	01

Course Code	Course Title	Category	L	T	P	Credit
EVS	Environmental Studies	AECC1	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	15	35	50

## Preamble

Students acquire knowledge on the basic concepts, components and importance of environment.

## Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Define the structure and functions of ecosystem	K1
CO2	Explain the benefits of biodiversity conservation	K2
CO3	Summarise the sources, effects and control measures of various types of Pollutants	K1
CO4	Perceive the environment legislations in India for sustainable development.	K3

K1: Knowledge K2: Understand K3: Apply

## Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	M	L	M
CO2	---	M	M	---	M
CO3	---	L	M	L	L
CO4	---	---	L	L	L

S-Strong M-Medium L-Low

## Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%
Total marks	52	52	140

### 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.

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B. Sc., Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C21	Biochemistry	Core-3	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

### Preamble

The course elaborates on the chemical and physical properties of biomolecules. Emphasis the structure, classification and functions of proteins lipids, carbohydrates and nucleic acids. The course integrates important concepts from chemistry and biology.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Elaborate the chemical and physical properties of biomolecules and their importance in biological systems.	K1, K2
CO2	Explain the structure and classification of proteins, lipids, nucleic acids, and carbohydrates	K1, K2
CO3	Emphasis the role of metabolic pathways	K3
CO4	Demonstrate how chemical concepts are related to biological processes related to enzymology	K3
CO5	Sketch and analyse on the structure and functions of nucleic acids and vitamins	K2, K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	---	---	M	M
CO2	M	---	M	M	S
CO3	S	---	M	S	M
CO4	S	M	S	L	M
CO5	--	M	M	M	M

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

## **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: Homopolysaccharides- Starch and Glycogen

Heteropolysaccharides: Structural characteristics and functions of peptidoglycan and agar.

## **UNIT- III**

Structure and classification of amino acids based on polarity - properties and chemical reactions-Zwitter ion – Isoelectric PI,

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 Menden 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. Harpers Illustrated Biochemistry , Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil, 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, 11<sup>th</sup> 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

## Course contents and lecture schedule

	Topic	Lecture hrs.
<b>Unit I</b>		
1.1	Biomolecules - Interaction and bonding.	4
1.2	Water – Molecular structure and properties (Thermal, solvent, colligative) dissociation and ionization of water,	3
1.3	pH and buffers ( bicarbonate, phosphate and acetate ) ; Henderson –Hasselbach equation. pKa.	3
<b>Unit II</b>		
2.1	Carbohydrates: Classification	2
2.2	Monosaccharides – glucose, fructose and galactose – structure and isomerism – biological importance	4
2.3	Disaccharides	2
2.4	Polysaccharides- Homo and Heteropolysaccharides	2
<b>Unit III</b>		
3.1	Structure and classification of amino acids	3
3.2	Properties	2
3.3	Proteins – classification, Properties and biological importance	4
3.4	levels of organization: primary, secondary – Ramachandran Plot, tertiary and quaternary structure	5
<b>Unit IV</b>		
4.1	Lipids: Classification, properties, biological importance	4
4.2	Structure, Biosynthesis, oxidation of fatty acids	4
4.3	Enzyme classification	2
4.4	Mechanism, Enzyme kinetics	3
4.5	Factors influencing enzyme activity. Enzyme inhibition	2
<b>Unit V</b>		
5.1	Nucleic acids: Nucleoproteins, nucleosides, Nucleotides	3
5.2	chemical structure of DNA, synthesis of nucleic acids- Salvage and Denovo pathways.	4
5.3	Fat and water soluble vitamins: source, significance and deficiency.	4

Course Code	Course Title	Category	L	T	P	Credit
UMB19C22	Medical Microbiology	Core-4	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

### Preamble

Illustrate the role of microbes in human health. Emphasizes the etiology, mode of transmission, pathogenesis, diagnosis, prevention and treatment of diseases caused by microbes. The course also deals with the problem of emerging antimicrobial resistance with reference to known pathogens.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Illustrates the importance of the microorganisms in human health	K1
CO2	Emphasize the conceptual basis of pathogens and the mechanisms by which they cause disease in the humans	K1, K2
CO3	Appraise the importance of pathogenic bacterial infections in the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue	K2
CO4	Perceive diagnostic skills of pathogens and various symptoms in infectious diseases.	K2, K3
CO5	Justify the treatment of bacterial, viral, parasites and fungal disease and also the essentials of medical statistics and epidemiology	K2, K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	S	L	L
CO2	M	M	S	M	L
CO3	M	M	S	M	L
CO4	M	M	S	S	L
CO5	M	S	S	M	L

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

**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 Bacterial:

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

Gram Positive - *Streptococci*,

Acid Fast- *Mycobacterium tuberculosis*

Anaerobic – *Clostridium tetani*

**Unit III:**

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

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 Fungal:

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, 8<sup>th</sup> 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, 40<sup>th</sup> 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, 17<sup>th</sup> 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, 1<sup>st</sup> edition, MJP Publishers, Chennai.

**Course Designers** Dr..Thiruvalluvan



## Course contents and lecture schedule

	Topic	Lecture hrs.
1.1	Resident Flora of Human Organs	1
1.2	Host-pathogen interactions; Opportunistic infections	3
1.3	Epidemiological terms and definitions	6
1.4	Mode of Transmission	2
2.1	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of Gram negative – <i>Vibrio cholerae</i> .	2
2.2	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of Gram negative- <i>Salmonella typhi</i>	2
2.3	Causative agent, mode of transmission, Pathogenesis, PSOsitive – <i>Streptococci</i> .	2
2.4	Causative agent, mode of transmission, Pathogenesis, of Acid Fast - <i>Mycobacterium tuberculosis</i>	4
2.5	Causative agent, mode of transmission, Pathogenesis, of Anaerobic – <i>Clostridium tetani</i>	2
3.1	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of DNA virus – Herpes simplex virus.	2
3.2	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of DNA virus - Hepatitis B virus	2
3.3	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of Retrovirus – HIV.	4
3.4	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of RNA virus – Retrovirus – Polio	2
3.5	Viral zoonoses - Rabies	2
4.1	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis and prophylaxis of Filamentous fungi – <i>Aspergillus niger</i>	2
4.2	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis and treatment of Ringworm infections - <i>Tinea sp</i>	3
4.3	Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of Non- filamentous fungi – <i>Candida albicans</i>	2
4.4	Morphology, life cycle, pathogenesis, lab diagnosis, and prevention of Intestinal Parasites - <i>Entamoeba histolytica</i>	2
4.5	Morphology, life cycle, pathogenesis, lab diagnosis, and prevention of Malarial Parasite - <i>Plasmodium vivax</i>	3
5.1	Morphology, life cycle, pathogenesis, lab diagnosis, and prevention of Intestinal Nematodes : a ) <i>Ascaris lumbricoides</i> , b) <i>Taenia solium</i>	4
5.2	Morphology, life cycle, pathogenesis, lab diagnosis, and prevention of Tissue Nematode : a) <i>Wuchereria bancrofti</i>	2
5.3	Classification and mechanism of action of antimicrobial agents: bacteria, viruses, fungi and parasites.	4
5.4	Methods of testing drug sensitivity.	2

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19CL21	Lab in Biochemistry	Core lab 2	2	-	-	

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	6	100

### Preamble

Provide hands on training to perform basic laboratory techniques in chemistry and biology. Provide fundamental principles, such as the structure/function of biomolecules, regulation of biological/biochemical processes.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Perform basic laboratory techniques in both chemistry and biology	K1
CO2	Prepare chemicals and buffers for biological reactions.	K1
CO3	Identify and characterize the bacteria based on biochemical reactions	K2
CO4	Identify and quantify the amount of biomolecules present in the samples.	K2, K3
CO5	Determine enzyme activities	K2, K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M
CO2	M	--	M	M	M
CO3	S	S	S	S	M
CO4	M	---	M	M	M
CO5	M	---	L	S	M

**S-Strong M-Medium L-Low**

1. Preparation of buffers
2. Biochemical characterization of a bacteria-IMViC, oxidase and catalase
3. Starch, casein and lipid hydrolysis
4. Extraction and Identification of aminoacids and lipids by TLC.
5. Qualitative analysis of carbohydrates and proteins
6. Preparation of standard graph for carbohydrates, proteins and lipids.
7. Quantitative estimation carbohydrates
8. Quantitative estimation 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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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19AE21	Personality Development	AECC2	2	-	-	

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	15	35	50

### Preamble

Impart quality education to the students for integrated **personality development** based on life skills and value systems.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Define and will possess different life skill strategies required for self development	K1,K2
CO2	Make use of the skills learnt effectively to meet the challenges and opportunities.	K3
CO3	Make use of skills learnt to meet or face harsh situation (conflict management)	K3
CO4	Develop life long learning, maintaining quality and relevance, according to changing requirement particularly of emerging knowledge economy	K3
CO5	Spell the importance and acquire various skills that make them employable and to secure a decent job.	K1,K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	---	---	---	S	L
CO2	---	---	----	S	M
CO3	---	---	----	S	L
CO4	---	---	----	S	L
CO5	---	---	----	S	L

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total Marks</i>	30	30	65

**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 Convey 1998. The 7 habits of highly effective teens. Fireside New York, USA.

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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C31	Bioinstrumentation	Core-5	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

### Preamble

The course is designed to understand the physical principles to apply on biological phenomenon. It is intended to give an overview of various techniques available to unravel the properties of biomolecules. A thorough knowledge of the theory and integration of the practice can be achieved.

### Course Outcomes

On the completion of the course the student will be able to

	Course Outcome	Knowledge Level
CO1	Comprehend the principles and applications of instruments used in biology	K1
CO2	Demonstrate the methodologies adopted for analyzing the biophysical and biochemical properties of comPSounds	K1,K2
CO3	Make use of an appropriate technique for particulate analysis	K3
CO4	Interpret the data obtained from various techniques like chromatography, Microscopy, Spectroscopy and Electrophoresis	K3
CO5	PSOrtray the diagrammatic representation of working mechanism of the instruments	K1,K2

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	---	M	S	L
CO2	S	S	---	S	L
CO3	M	---	S	M	L
CO4	M	---	M	S	M
CO5	M	---	M	M	S

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

## **Principle, working mechanism and applications of:**

### **Unit I**

ComPSound (Dark and Light field), Phase Contrast, Fluorescent, PSolarised, 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).

### **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, 2<sup>nd</sup> 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, 5<sup>th</sup> Edition Cambridge University Press, New York.

**Course Designers :Dr. C. Ravi & Dr. T.S. Ramya Lakshmi**

Sl. No	Topic	Lecture Hr.
1.1	Introducing the course	01
1.2	Dark field ComPSound Microscopy	01
1.3	Light field ComPSound Microscopy	01
1.4	Phase Contrast Microscopy	02
1.5	Fluorescent Microscopy	01
1.6	PSolarised Microscopy	01
1.7	TEM& SEM	02
1.8	Confocal Microscopy	01
1.9	Micrometry	01
2.1	pH meter	01
2.2	Centrifuge (Clinical, Density gradient and Ultra)	02
2.3	Sedimentation coefficient, RCF, RPM	01
2.4	Incubator, Autoclave	01
2.5	Quebec colony counter	01
2.6	GM counter	01
2.7	Liquid Scintillation counter	01
2.8	Sonicator	01
2.9	Lyophilizer	01
2.10	Filters (HEPA, membrane)	02
3.1	Colorimeter	02
3.2	Beer & Lamberts law	02
3.3	UV-visible Spectrophotometer	02
3.4	Infrared Spectrophotometer	02
3.5	Flame Photometer	02
3.6	Atomic Absorption Spectrophotometer	02
4.1	Introduction to Chromatography	01
4.2	Ascending Paper Chromatography	01
4.3	Descending Paper Chromatography	01
4.4	Circular Paper Chromatography	01
4.5	Thin layer Chromatography	01
4.6	Column Chromatography	02
4.7	Gel filtration Chromatography	01
4.8	Ion exchange Chromatography	01
4.9	Gas Chromatography	01
4.10	High Performance Liquid Chromatography	02
5.1	SDS-PAGE	02
5.2	Agarose Gel Electrophoresis	02
5.3	2D Gel Electrophoresis	02
5.4	Gel Documentation	01
5.5	Southern blotting	01
5.6	Western blotting	01
5.7	PCR & FACSS	03



**Thiagarajar College (Autonomous): Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C32	Microbial Physiology	Core-6	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

### Preamble

Provide a basic knowledge on various physiological phenomena involved in the functioning of microbes. Emphasise the response of microbes in terms of metabolic reactions to external stimuli (physiology).

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Elaborate the structural organization of microbes and membrane system	K1
CO2	Illustrate the diversity of microbial metabolisms and the strategies for their adaptive responses	K1,K2
CO3	Enlist the molecular basis, energetic of various metabolic reactions and their applications	K1, K2
CO4	Comprehend the principles underlying the dynamic nature of microbial physiology	K2,K3
CO5	Relate knowledge to practical application of microbes in industry , agriculture and medicine	K2, K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	---	S
CO2	S	L	M	---	M
CO3	M	M	M	L	M
CO4	M	S	L	L	M
CO5	M	L	---	M	M

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

## Unit I

Biochemical properties of membrane – Fluid mosaic model (Singer and Nicolson); 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)-CO<sub>2</sub> fixation – Calvin cycle.

## Unit IV

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

## Unit V

Fueling reaction in chemo – organotrophs: Acetogenesis and methanogenesis-Fueling reaction in chemolithotrophs: Hydrogen bacteria, sulphur bacteria, nitrifying bacteria. Methylotrophs and Methanotrophs. Gluconeogenesis and Glycogenesis – peptidoglycan biosynthesis. Stress response – Osmotic stress, oxygen, CO<sub>2</sub>, pH, Temperature.

### Text Books:

1. Moat, A.G., and J.W. Foster, 2009, Microbial Physiology-4<sup>th</sup> 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 12<sup>th</sup> Edition. Pearson Publication, New York.
12. SundaraRajan , S. 2003 Microbial Physiology, Anmol Publication, NewDelhi

**COURSE DESIGNERS     Dr.C. BALASUBRAMANIAN   & .Dr.T.S. RAMYALAKSHMI**

**Course contents and lecture schedule**

Sl.No.	Topic	Lecture hrs.
1.1	Biochemical properties of membrane	3
1.2	Membrane transport	6
1.3	Donnan concept	2
1.4	Nernst equation and its concept	2
1.5	Ion transport and its importance	2
2.1	Bioenergetics	5
2.2	TCA cycle	1
2.3	Respiratory chain	2
2.4	Phosphorelation	2
2.5	Chemiosmotic theory	3
2.6	Oxidation-Reduction	2
3.1	Oxygenic and anoxygenic photosynthesis	5
3.2	Photosynthetic pigments	2
3.3	Light reaction in oxygenic bacteria	2
3.4	Light reaction in An oxygenic bacteria	4
3.5	Calvin cycle	2
4.1	Glycolysis	2
4.2	PPP	2
4.3	EDP	2
4.4	Glyoxylate cycle	2
4.5	Fuelling reaction	3
4.6	Fuelling reaction in anaerobic respiration	4
5.1	Fuelling reaction in chemo-organotrophs	2
5.2	Acetogenesis and methanogenesis	2
5.3	Chemolithotrophs	2
5.4	Sulphur, Hydrogen and de-nitrifying bacteria	2
5.5	Methylo and methanotrophs	1
5.6	Glyco-neogenesis	1
5.7	Glyco-genesis	1
5.8	Peptidoglycan biosynthesis	1
5.9	Stress response	3

**Thiagarajar College (Autonomous): Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc., Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19CL31	<b>Lab in Bioinstrumentation</b>	Core lab 3	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	40	60	100

### Preamble

Familiarize with the instruments associated with biological studies. Provides the modus operandi of various instruments.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Familiarize with the instruments associated with biological studies	K1,K2
CO2	Learn the <i>modus operandi</i> of various instruments.	K2
CO3	Make use of various instruments, associated with microbiology	K2
CO4	Apply the knowledge gained for trouble shooting	K3
CO5	Portray the importance of analytical chemistry and protein separation	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	M	S	M
CO2	M	M	L	S	M
CO3	M	M	M	S	M
CO4	L	---	S	S	M
CO5	M	---	L	M	M

**S-Strong M-Medium L-Low**

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, 3<sup>rd</sup> 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. 6<sup>th</sup> edition. Pearson Education. New Delhi.

Course Code	Course Title	Category	L	T	P	Credit
UMB19 NE31	<b>Health Education</b>	NME1	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	15	35	50

### Preamble

The objective of the course is to provide knowledge and develop skills to empower the students to take care of their health and others through nutrition and hygiene.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Highlight the importance and role of nutrients in human health	K1
CO2	Create an awareness about the importance of health and hygiene	K2
CO3	Emphasis the various dimensions and determinants of health	K2
CO4	Describe various types of food with their functions and illustrate the harmful effects of Poor nutrition	K1,K2
CO5	Illustrate the ill effects, prevention and control measures of microbes/Pollutants	K3

**K1: Knowledge K2: Understand K3: Apply**

#### Course outcomes:

##### 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, 17<sup>th</sup> Edition, Banarasidas Publishers, Jabalpur.
2. Muruges, N. 2002. Health education and community pharmacy, 3<sup>rd</sup> Edition, Sathya Publishers, Madurai.

**Thiagarajar College (Autonomous): Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C41	Molecular Biology	Core-7	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	25	75	100

### Preamble

The course illustrates the ideology of genetic material in all life forms and the essence of central dogma of protein synthesis. Course emphasize on the early findings, chemical composition, structure and function of nucleic acids and proteins.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Illustrate the history behind the identification of genetic material	K1
CO2	Sketch the chemical composition, structure and function of nucleic acids	K1
CO3	Unravel the molecular mechanism behind the different stages of protein synthesis	K2, K3
CO4	Explain the genome organization in prokaryotic and eukaryotic organisms	K2, K3
CO5	Elaborate on post transcriptional and translational modifications	K2

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	---	M	M
CO2	M	S	M	S	S
CO3	S	---	L	S	M
CO4	S	S	M	S	S
CO5	M	M	---	M	M

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

**Unit I:**

DNA: Genetic material - Griffith and Chase experiment; chemical composition, Chargaff 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<sub>m</sub> 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.

**Text books:**

1. Malacinski, G.M. 2015. Freifelder's essentials of Molecular biology, 4<sup>th</sup> 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**



**Course contents and lecture schedule**

	TOPIC	Lecture hrs.
Unit I		
1.1	DNA: genetic material – Griffith and Chase experiment	3
1.2	Chemical composition, Chargaff rule, Watson and Crick model, DNA confirmations – A, B & Z	3
1.3	Physical organization of prokaryotic genome - Structure of nucleoid, positive and negative supercoiling;	3
1.4	Melting curves, T <sub>m</sub> value, cot ½ value, hypochromicity	3
Unit II		
2.1	RNA: Genetic material – Gierer and Schramm experiment; Genetic and non genetic RNA;	4
2.2	Chemical composition, structure of mRNA, tRNA and rRNA;	4
2.3	Genetic code: Deciphering genetic code, characteristics of genetic code	4
Unit III		
3.1	Prokaryotic replication: mode of replication - semiconservative	3
3.2	Meselsen and Stahl experiment;	1
3.3	Mechanism of replication - enzymology of DNA replication, origin of replication, initiation, elongation and termination;	4
3.4	types of replication- uni directional, bi directional and rolling circular	4
Unit IV		
4.1	Transcription: RNA Polymerase - types and subunits;	3
4.2	initiation – recognition of promoters, regulation by sigma factor, formation of open complex; elongation	4
4.3	termination rho dependent, rho independent, antitermination.	3
4.4	Post transcriptional modifications	2
Unit V		
5.1	Translation: Initiation – binding of ribosomes and formation of initiation complex,	3
5.2	Elongation – peptide formation-- translocation – EF	3
5.3	Termination – Peptide termination – Releasing factors -	3
5.4	PSOstranslational modifications.	3

**Thiagarajar College (Autonomous): Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C42	Microbial Genetics	Core-8	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	25	75	100

### Preamble

The course outlines prokaryotic gene expression with emphasis on gene transfer methods like transformation, transduction and conjugation. It explains undoubtedly how the mutation fuels the evolution of life forms on earth and how each organism protects their genome by repair mechanisms.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Explain the basic concepts and regulation of gene expression.	K1
CO2	Illustrate natural gene transfer methods and their importance in the survival of microbes.	K2
CO3	Explain the role of transposable elements, and how mutation fuel the evolution in all forms of life.	K1
CO4	Summarize the role of chemicals in modifying the nature of genetic material.	K2,K3
CO5	Interpret the role of various repair mechanisms to keep the organism's genome intact.	K2,K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	---	S	M
CO2	M	---	L	M	M
CO3	M	---	M	L	L
CO4	M	---	---	M	M
CO5	M	M	---	M	M

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<b>Total marks</b>	52	52	140

### **Unit I:**

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 II:**

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

### **Unit III:**

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 IV:**

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 V:**

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

### **Text books:**

1. Malacinski, G.M. 2015. Freifelder's essentials of Molecular biology, 4<sup>th</sup> 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., Robersts, K. and Walter, P. 1994. Molecular Biology of the Cell, III Edn. Garland Publishing, Inc.,
2. De Roberties E.D.P and E.M.F.De Roberties 2011. Cell and Molecular Biology.VIII Edn. Lippincott Williams & Wilkins, Pheladelphia.
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**

## Course contents and lecture schedule

	TOPIC	lecture hrs.
Unit I		
1.1	Mutation: Types of mutations – spontaneous and induced	3
1.2	Point mutation and chromosomal mutations;	3
1.3	Molecular basis of mutations – base substitution, frame shift and mismatch	3
1.4	DNA damage: lesions, dimerization, AP sites, oxidative damage, alkylation and genotoxic effects	3
Unit II		
2.1	DNA repair: Direct repair – photoreactivation and dealkylation,	2
2.2	excision repair –base excision and nucleotide excision, mismatch repair	4
2.3	recombination repair	2
2.4	SOS repair.	2
Unit III		
3.1	Regulation of prokaryotic gene expression:	4
3.2	Bacterial inducible and repressor system - lac operon, trp operon; attenuation and antitermination;	4
3.3	Repressors of phage lambda – maintenance of lysogenic state and switching from lysogenic lytic infection	4
Unit IV		
4.1	Genetic recombination in bacteria: Transformation, conjugation and transduction	4
4.2	generalized and specialized, homologous recombination-Holiday model	2
4.3	plasmid – types (F, R & Col),	4
4.4	stringent and relaxed plasmids; amplification and copy number	4
Unit V		
5.1	Transposable elements in prokaryotes: IS elements and transposons	3
5.2	composite and non-composite transposons	3
5.3	transposable elements in plasmids and phage mu	3
5.4	mechanism of transposition – replicative and conservative transpositions	3

**Thiagarajar College (Autonomous): Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19CL41	Lab in Molecular Biology and Microbial Genetics	Core lab 4	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	40	60	100

### Preamble

Competence in the broad scientific theory and application of techniques associated with molecular biology and microbial genetics.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Familiarize with the basic techniques associated with molecular biology	K2
CO2	Isolate and estimate the amount of nucleic acids in a sample	K1,K3
CO3	Isolate mutant colonies	K1,K3
CO4	Illustrate various methods in microbial control	K2
CO5	List and summarise the procedure of experiments carried out in the laboratory notebook	K2,K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	M	M	S
CO2	M	M	---	M	M
CO3	---	M	S	M	L
CO4	M	L	S	M	M
CO5	S	---	M	S	L

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

**Reference Books:**

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

**Thiagarajar College (Autonomous): Madurai – 625 009**  
**Department of Zoology**  
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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19CE51	<b>Environmental Microbiology</b>	Core Elective-1	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	25	75	100

### Preamble

Elaborates on plant microbe interaction, biofertilizers, biopesticides and its importance. Explain the microbial diversity on the soil and extreme habitats.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Explain the diversity of microorganism inhabiting a multitude of ecological habitats and their importance.	K2,K3
CO2	Competently explain various aspects of environmental microbiology and microbial ecology and be familiar with current research in environmental microbiology.	K3
CO3	Categorize various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc. and microbes involved	K1,K2
CO4	Summarize various plant microbes interactions , their applications especially the biofertilizers and their production techniques	K1,K3
CO5	Discuss the basic principles of environment microbiology and be able to apply these principles in solving environmental problems – waste water treatment and bioremediation	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	L	L	S
CO2	S	L	--	S	M
CO3	M	L	---	---	M
CO4	S	L	M	M	M
CO5	S	S	---	M	L

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	30%	30%	30%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	30%	30%	30%
<i>Total marks</i>	52	52	140

## 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 alkanooates), 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 : Dr.C. BALASUBRAMANIAN****Course contents and lecture schedule**

Sl.No.		Lecture hrs.
1.1	Microbial diversity in terrestrial	2
1.2	Microbial diversity in aquatic	2
1.3	Microbial diversity in atmosphere and in soil	5
1.4	Microbial diversity in extreme environment	6
UNIT II		
2.1	Microbial ecology	5
2.2	Microbial interactions	5
2.3	Microbial ecology	5
UNIT-III		
3.1	Degradation of bioPSOlymers	5
3.2	Degradation of hydrocarbons	5
3.3	Pesticide patterns	2
3.4	Pesticide degradation	3
UNIT-IV		
4.1	Solid waste treatment	5
4.2	Liquid waste treatment types	2
4.3	Aerobic reactors	6
4.4	Tannery effluent treatment	2
UNIT-V		
5.1	Bioluminescent marine microorganism	2
5.2	Quorum sensing	2
5.3	Microbial indicators (Marine)	2
5.4	Bio-fouling	2
5.5	Biofilm formation	1
5.6	Biodegradation of marine PSOllutants	3
5.7	Role of GMO`s in bioremediation	3

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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C51	Agricultural Microbiology	Core-9	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	25	75	100

### Preamble

The course briefs about plant-microbe interactions. Elaborate the role of microbes in plant growth. Emphasize the harmful and beneficial potential of microbes in plant growth and environment.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Interpret the role of microbes in plant growth and biogeochemical cycles	K1,K2
CO2	Emphasise the importance of microbial pesticides over chemical pesticides	K1,K2
CO3	Illustrate microbe mediated plant diseases and their control measures	K2
CO4	Emphasizes the harmful and beneficial potential of microbes to the environment and in plant growth.	K3
CO5	Rephrase the role of microbes in environmental problems and remedial measures	K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	---	---	M
CO2	M	---	---	M	M
CO3	---	L	S	M	M
CO4	M	M	M	M	M
CO5	S	M	M	M	M

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	30%	30%	30%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	30%	30%	30%
<i>Total marks</i>	52	52	140

### **Unit I**

Plant-microbe interaction: commensalism, mutualism and parasitism. Rhizobium: root nodule formation, physiology of N<sub>2</sub> 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 N<sub>2</sub> fixation, carrier based inoculum. Azotobacter: host plant specificity, physiology of a-symbiotic N<sub>2</sub> 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 VAM spores, production of VAM 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

Units	Topic	Lecture hrs.
<b>Unit I</b>		
1.1	Plant-microbe interaction: commensalism, mutualism and parasitism.	5
1.2	Rhizobium: root nodule formation, physiology of N <sub>2</sub> fixation (nod and nif genes),	4
1.3	host-rhizobium interaction, mass cultivation, carrier-based inoculants.	3
1.4	Biofertilizers: Types, advantages and limitation.	3
<b>Unit II</b>		
2.1	Rhizosphere and Phyllosphere, root exudates, influence of rhizosphere on crop productivity,	4
2.2	Plant growth promoting rhizobacteria.	3
2.3	Azospirillum: host plant specificity, physiology of asymbiotic N <sub>2</sub> fixation, carrier based inoculum.	4
2.4	Azotobacter: host plant specificity, physiology of a-symbiotic N <sub>2</sub> fixation, crop response and mass cultivation.	4
<b>Unit III</b>		
3.1	Cyanobacteria (Blue green algae): Anabaena-Azolla association - nitrogen fixation, factors affecting growth - mass cultivation,	3
3.2	Application of Anabaena-Azolla in rice field.	3
3.3	Mycorrhizal association: occurrence and distribution,	3
3.4	Phosphorus solubilisation, phosphate mobilisation,	3
3.5	Collection of VAM spores, production of VAM spores in stock plants.	3
<b>Unit IV</b>		
4.1	Symptoms, transmission and mechanism of plant diseases:	3
4.2	Viral – Tobacco-mosaic, Bunchy top-Banana, Tomato spotted wilt.	4
4.3	Bacterial – potato-Scab, Citrus-Canker, Blight.	3
4.4	Fungal -Smuts, Rusts, Leaf spots.	3
4.5	Factors affecting disease incidence.	2
<b>Unit V</b>		
5.1	Chemical and Biopesticides: types, advantages and limitation.	4
5.2	Bacterial pesticides - <i>Bacillus thuringiensis</i> .	2
5.3	Fungal pesticides - <i>Beauveria bassiana</i> ,	3
5.4	Viral pesticides - NPV, CPV, GV.	2
5.5	Phytochemicals - Neem extract	2

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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19CL51	Lab in Agricultural Microbiology	Core lab 5	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	40	60	100

### Preamble

Isolate and enumerate the microbial population in different environments. Illustrate the role of microbes in plant growth promotion. Brief about plant pathological methods.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Isolate and enumerate the microbial Population from rhizosphere	K1
CO2	Isolate and culture plant growth microbes	K1
CO3	Explain the importance and quantify plant growth hormones	K2
CO4	Distinguish plant growth promoting microbes from pathogens	K3
CO5	Quantify chemical compounds produced by microbes for plant growth promotion	K2

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	L	S	M
CO2	S	S	M	M	M
CO3	S	---	---	M	M
CO4	M	S	S	M	M
CO5	M	---	L	M	M

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 sPSOres 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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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C52	Food Microbiology	Core-10	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	25	75	100

### Preamble

Elaborate on microbes associated with food. Distinguish the beneficial and harmful effect on association. Brief about food spoilage, their types and prevention,

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Explain common food borne microbes, microbes as food and prebiotics and probiotics	K1,K2
CO2	Illustrate the role of microorganisms in fermented foods and in food processing. Microbiology of different types of fermented food products	K2,K3
CO3	Spell the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods	K1,K2
CO4	Summarize the different spoilage mechanisms in foods, illustrate methods to control deterioration and spoilage. Recognize and describe the characteristics of sPSOilage microorganisms in foods and their control.	K3
CO5	Learn various methods for the isolation, detection and identification of microorganisms in food and employ in industries. Spell the basis of food safety regulations and Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food	K,K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M
CO2	M	---	S	S	M
CO3	M	L	M	M	M
CO4	M	M	S	S	M
CO5	S	S	---	M	M

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	30%	30%	30%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	30%	30%	30%
<i>Total marks</i>	52	52	140

## **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.

Probiotics and prebiotics – 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.

SPSOilage of beer & wine,

SPSOilage of vegetables, fruits, meat & canned food.

## **Unit IV**

Parasitic infections transmitted by food: Amoebiasis & Taeniasis

Indicators of pathogens associated with Food: Faecal coliforms, faecal streptococcal forms, *Salmonella*, *Staphylococcus* & *Pseudomonas*.

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

## **Unit V**

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

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

### **Text Books:**

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

### **Reference Books:**

1. Banwart,G.J., 1987, Basic Food Microbiology, CBS Publishers & Distributors, New Delhi.
3. Deak, T, and L.R.Beuchat, 1996, Hand Book of Food SPSOilage Yeasts, CRC Press, New York
4. Garbutt,J., 1997, Essentials of Food Microbiology, Arnold-International Students" edition, London.
4. Jay,J.M, 1996, Modern Food Microbiology, CBS Publishers & Distributors, ND
5. Joshi, V.K. and Ashok Pandey (Eds), 1999, Biotechnology: Food fermentation Vol.II, Educational Publishers and Distributors, New Delhi.
6. Kulshreshtha, S.K. 1994, Food Preservation, Vikas Publishing House Pvt. Ltd.,New Delhi

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



## Course contents and lecture schedule

	Topic	lecture hrs.
Unit I		
1.1	Common Food borne Bacteria, Molds and yeasts.	3
1.2	Intrinsic and Extrinsic parameters of foods that influence microbial growth.	2
1.3	Microbes as food: Single cell protein (SCP) and edible mushrooms.	3
1.4	Probiotics and prebiotics – Benefits & applications	2
Unit II	Fermented food products	
2.1	Fermented dairy products: Buttermilk, Sour cream, Yoghurt & Cheese.	4
2.2	Fermented vegetables: Sauerkraut, Olives, Soy Sauce & Pickles	3
2.3	Microbial fermentation: Beer, Distilled liquors (Rum, Whisky & Brandy) & Wine.	4
2.4	Other food Products: Fermented meat, Idli batter & leavening of bread.	3
Unit III	Food spoilage	
3.1	Food spoilage: spoilage of Milk & Milk products.	3
3.2	Spoilage of beer & wine,	3
3.3	Spoilage of vegetables, fruits	3
3.4	Spoilage of , meat & canned food.	3
Unit IV	Food poisoning & food borne infections	
4.1	Parasitic infections transmitted by food: Amoebiasis & Taeniasis	3
4.2	Indicators of pathogens associated with Food: Faecal coliforms, faecal streptococcal forms,	3
4.3	Indicators of pathogens associated with Food: <i>Salmonella</i> , <i>Staphylococcus</i> & <i>Pseudomonas</i> .	3
4.4	Food poisoning: <i>Aspergillus flavus</i> & <i>Clostridium botulinum</i>	3
Unit V	Food preservation	
5.1	Physical preservation methods: Asepsis, filtration & centrifugation, high & low temperature & Pasteurization,	3
5.2	Physical preservation methods: desiccation, radiation, anaerobiosis, canning and controlled atmosphere.	3
5.3	Chemical preservation methods: Salt, Sugar, organic acid (Benzoic acid, Sorbic acid, propionates, acetic acid & lactic acid),	3
5.4	Chemical preservation methods: nitrates, nitrites, sulfur dioxide, ethylene dioxide, propylene oxide, wood smoke and antibiotics.	3

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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19CL52	Lab in Food Microbiology	Core lab 6	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	40	60	100

### Preamble

Familiarise the students with microbes associated with food, their isolation and prevention.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Demonstrate the methods for the isolation of microbes from various foods and their characterization	K3
CO2	Categorize the influence of different parameters on microbial occurrence and food spoilage.	K1,K2
CO3	Illustrate the food preservation methods and to employ it in industries	K2
CO4	Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food	K2,K3
CO5	Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems	K2,K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	S
CO2	S	S	M	M	M
CO3	S	---	M	S	M
CO4	M	S	S	S	M
CO5	M	---	---	S	S

S-Strong M-Medium L-Low

- Biochemical characterization of any bacterium--IMViC, oxidase and catalase
- Estimation of Alkaline phosphatase activity
- Derivation of Michaelis – Menten Constant and V-max of alkaline Phosphatase.
- Changes in protein conformation due to pH, temperature, ionic concentration by observing UV-spectra.
- Extraction and Identification of lipids by TLC.
- Estimation of Cellulase activity.

7. Specific tests for amino acids
8. Vitamin C assay
9. Starch, casein and lipid hydrolysis
10. Demonstration of Hill reaction
11. Methylene Blue Reductase Test
12. Effect of temperature, pH on bacterial growth.

**Reference Books:**

1. Aneja, K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.
2. Cappuccino, J.H. and Sherman, N.2002. Microbiology – A Lab Manual, Third Edition, The Benjamin Publishing Company, SingaPSOre.
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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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19C53	<b>Clinical Lab Technology</b>	Core-11	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	25	75	100

### Preamble

Familiarise the students with the collection, transport and analyses of clinical specimens for diagnosis. Provide a comprehensive understanding on the different techniques related to clinical laboratory science.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Demonstrate safe clinical laboratory practices to be followed for collection, transport and analyses of samples.	K1
CO2	Spell and interpret the different clinical laboratory techniques as entry level practitioners.	K1,K2
CO3	Elaborate the theoretical knowledge and exhibit technical skills in clinical sample analyses according to pre-established laboratory standards	K1
CO4	Apprehend the appropriate test sample acquisition, handling and test to be adopted for analyses. List and adhere to safety rules and regulations prescribed.	K2
CO5	Choose to work or establish a clinical laboratory	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	---	S	S	M
CO2	S	---	M	S	M
CO3	M	---	S	S	M
CO4	---	M	S	S	M
CO5	L	M	S	S	M

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

## **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, SingaPSOre.
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**

Sl. No	Topic	Lecture hrs.
1.1	Laboratory designing, Code of conduct for Clinical Laboratory	03
1.2	SOP&Personal hygiene for Laboratory Technologists	03
1.3	National and International GLP and GMP.	03
1.4	Accidents-types and safety measures.	03
1.5	First Aid in laboratory and Precautions	03
2.1	Collection and processing of blood sample.	02
2.2	Determination of TC, DC, ESR, Hb, Bleeding time&Clotting time.	05
2.3	ABO Blood group system and determination of blood group. Blood transfusion and Compatibility testing.	02
2.4	Determination of blood glucose, Urea, Cholesterol and Bilirubin.	04
2.5	VDRL and Widal test.	01
2.6	Blood culture and sensitivity.	01
3.1	Collection, transport and Storage of Urine sample.	02
3.2	Physical properties of Urine.	02
3.3	Chemical examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies.	05
3.4	Microscopic Examination of Urine – Cast Crystals and Cells.	04
3.5	Pregnancy Test. Urine culture and sensitivity.	02
4.1	Stool Collection and transport.	02
4.2	Macroscopic and Microscopic examination of stool	05
4.3	Chemical examination of stool	04
4.4	Stool Culture and sensitivity	02
4.5	Occult blood and its clinical significance	02
5.1	Sputum Collection and transport of specimen	02
5.2	Macroscopic and Microscopic examination of sputum	03
5.3	AFB staining	02
5.5	Sputum culture and sensitivity	02
5.6	Collection of semen	02
5.7	Semen analysis – motility, total count and abnormality	04

**Thiagarajar College (Autonomous): Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc., Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 CL53	<b>Lab in Clinical Lab Technology</b>	Core lab 7	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	40	60	100

### Preamble

Provides hands on training to the students on the collection, transport and analyses of clinical specimens. Make aware of dos and do not's while analysing the specimens.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Apply different clinical laboratory techniques for collection and analysis of body fluids	K1,K3
CO2	Exhibit technical skills in clinical sample analyses according to pre-established laboratory standards	K1,K2
CO3	List and adhere to safety rules and regulations prescribed for sample acquisition, handling and test to be adopted for analyses.	K2
CO4	Choose to work or establish a clinical laboratory	K3
CO5	Explain methods for microbial culture, evaluate microbial content testing and sterility testing	K2

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	---	S	S	M
CO2	M	---	S	S	M
CO3	---	M	S	S	M
CO4	L	M	S	S	M
CO5	M	M	M	M	L

**S-Strong M-Medium L-Low**

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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**Department of Zoology**

(For those joined B.Sc (other than Microbiology)/B.A/B.Com/BBA on or after June 2019)

**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 NE51	<b>Sericulture</b>	NME-2	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	15	35	50

**Preamble**

Elaborates on rearing of silkworms for the production of raw silk, comprises of food-plant cultivation to feed the silkworms and reeling the cocoons for unwinding the silk filament for value added benefits such as processing and weaving

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Explain the various techniques in rearing silkworm	K1,K2
<b>CO2</b>	Acquit with the infections and methods to overcome the disease occurrence on silkworm rearing	K3
<b>CO3</b>	Spell the life cycle of mulberry silkworm	K1
<b>CO4</b>	Venture into the sericulture industry as an entrepreneur	K3
<b>CO5</b>	Differentiate mulberry and non mulberry silkworm	K2

**K1: Knowledge K2: Understand K3: Apply**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	M	---	---	M	S
<b>CO2</b>	M	M	S	M	---
<b>CO3</b>	M	---	---	M	M
<b>CO4</b>	L	----	---	S	M
<b>CO5</b>	S	---	---	M	S

**Blooms taxonomy: Assessment Pattern**

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<b>Total marks</b>	30	30	65

## 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 4<sup>th</sup> 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.**

### Course contents and lecture schedule

	Topic	Lecturehrs.
Unit I	<b>Silk worm rearing</b>	
1.1	History of sericulture - silk route; Types of silkworm – mulberry & non-mulberry;	2
1.2	Univoltine, bivoltine and multivoltine races. <i>Bombyx mori</i> – Lifecycle;	3
1.3	Requirements for ideal rearing house & rearing equipments;	3
1.4	Rearing methods – shelf, shoot and floor rearing – advantages and disadvantages; feeding & bed clearing at different larval stages;	4
1.5	Preparation for moulting - Mountages - types and advantages. Harvesting, preservation & transportation of cocoons.	3
Unit II	<b>Silk reeling &amp; silkworm diseases</b>	
2.1	Silk reeling - Processing of cocoon, selection of cocoon for reeling, stifling methods	3
2.2	Cocoon cooking; Silk reeling methods. ; Composition and properties silk of silk fiber	4
2.3	Pests of silkworm – nature of damage & control measures - tachinid fly and dermestid beetle	3
2.4	Diseases of silkworm - causative agent, symptoms & control measures of pebrino, flacherie, NPV, green muscardine;	3
2.5	. Quality control of silk - cocoon grading , Silk grading, silk mark, Central Silk Board	2

**Thiagarajar College (Autonomous): Madurai – 625 009**  
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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 C61	<b>Immunology</b>	Core-12	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	25	75	100

### Preamble

Immunology, also known as immunobiology, is the study of the vertebrate immune system. The immune system is the organ system responsible for protecting the organism from infection by micro-organisms, viruses, and parasites. Covers a wide range of topics, from history of Immunology, Types of Immunity & Immunotechniques, Transplantation & Tumour Immunology, Immunological disorders & Vaccinology. This course will be an overview of a variety of topics that together describe the development and function of the immune system.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Define the basic biology of the cells of the immune system, including their development and specific functions	K1
CO2	Outline how the cells interact with each other in the formation of an immune response.	K2
CO3	Infer/interpret the molecular basis by which the immune system identifies pathogens.	K3
CO4	Perceive what occurs when there are failures of the immune system.	K2,K3
CO5	Become skilled at the experimental basis and reasoning that underlies the material in the course.	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	M	M	MM
CO2	M	---	M	M	M
CO3	M	M	---	M	M
CO4	L	---	M	M	M
CO5	M	M	S	S	M

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

## Unit I

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

## Unit II

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

Antibodies: Immunoglobulins – Domain structure – classes – IgG, IgA, IgM, IgD, IgE Characteristics-

Isotypes– Allotypes-Idiotypes– Humoral mediated immunity – Clonal selection theory (N.K. Jerne) - Antigen–Antibody interactions –Primary interaction, Secondary phenomena – Agglutination, Precipitation-kinetics of antibody response - primary and secondary — Hybridoma Technology – Monoclonal Antibodies – Applications.

## Unit III

Complement factors – Classical – Alternate Pathways-Lectin pathway-biological functions

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

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

Tolerance – definition – types - Autoimmunity–organspecific-Grave’s disease - Myasthenia gravis-Hashimoto’s thyroiditis- Systemic-Rheumatoid arthritis-Multiple sclerosis-Systemic lupus erythematosus (SLE).

## Unit IV

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

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

## Unit V

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

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

## Text Books:

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

## Reference Books:

1. Abbas, A.K., A.H. Lichtmann and Y.S. PSober. 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**

**Course contents and lecture schedule**

	<b>Topic</b>	<b>lecture hrs.</b>
1.1	History of Immunology: Contributions of Edward Jenner – Louis Pasteur – Elie Metchnikoff	3
1.2	Types of immunity: Innate-anatomic, physiologic, phagocytic, and inflammatory–	3
1.3	Acquired or Adaptive – antigenic specificity – diversity- Immunologic memory–self/nonself recognition Humoral– Cell-mediated immunity	4
1.4	Organs of immune system: Primary- Thymus & Bone marrow; Secondary – spleen –lymph nodes – GALT & MALT. Cells: Lymphocytes (T& B) – Macrophages, NK cells – APCs - Role.	5
2.1	Antigens – Haptens – Adjuvant – Epitopes – Requirements for immunogenicity –Antigens Vs Immunogens – Antigenic Peptides	2
2.2	Antibodies: Immunoglobulins – Domain structure – classes – IgG, IgA, IgM, IgD, IgE Characteristics	5
2.3	Isotypes– Allotypes-Idiotypes– Humoral mediated immunity – Clonal selection theory (N.K. Jerne)	3
2.4	Antigen–Antibody interactions –Primary interaction, Secondary phenomena – Agglutination, Precipitation-kinetics of antibody response - primary and secondary	3
2.5	Hybridoma Technology – Monoclonal Antibodies – Applications.	2
3.1	Complement factors – Classical – Alternate Pathways-Lectin pathway-biological functions	5
3.2	Cell mediated immunity – Cytokines – types – Network – Role in immune regulation.	3
3.3	Hypersensitivity reaction – Type I, II, III, IV. Tolerance – definition – types -	3
3.4	Autoimmunity–organspecific-Grave’s disease - Myasthenia gravis-Hashimoto’s thyroiditis-	2
3.5	Systemic-Rheumatoid arthritis-Multiple sclerosis-Systemic lupus erythematosus (SLE).	2
4.1	Transplantation antigens-Erythrocyte antigens-MHC	3
4.2	HLA – Class I & Class II Antigens	4
4.3	Immunological Basis of Graft Rejection -Allograft rejection –cells involved– GVHD –Prevention of graft rejection.	4
4.5	Tumor Antigens –Immunity to tumor-Tumor evasion mechanisms	2
4.6	Immunodiagnosis –Tumor therapy.	2
5.1	Immuno -deficiencies- Primary – B & T Cell deficiencies, combined – secondary- acquired	2
5.2	HIV – AIDS.	3
5.3	Vaccines: Types- Attenuated – Killed – Purified proteins (Toxoid) – Recombinant Vaccines.	7
5.4	Immunization schedule, Active & Passive immunization.	3

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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 CL61	Lab in Immunology	Core lab 8	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	40	60	100

### Preamble

Brief the basic principles and procedures involved in imparting immunity. Provides hands on training on basic immunological techniques.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Distinguish and display lymphoid organs	K1,K2
CO2	Demonstrate blood collection and serum separation	K2
CO3	Distinguish various blood cells and their importance	K2
CO4	Perform agglutination assays	K3
CO5	Demonstrate animal handling techniques	K2

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	---	M	M
CO2	M	M	S	S	M
CO3	M	M	S	S	M
CO4	M	---	M	S	M
CO5	S	S	---	M	M

**S-Strong M-Medium L-Low**

- 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, , 3<sup>rd</sup> ed., Blackwell Publishing, London.
2. Garvey J.S., Cremer N.E., Sussdorf D.H., 1983 Methods in Immunology, 3<sup>rd</sup> ed., Benjamin / Cummins Publishing, London.
3. Stites D.P., Terr A.L., Parslow T.G., 1994. Basic and Clinical Immunology, Prentice Hall Publishing, Canada.

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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 C62	Industrial Microbiology	Core-13	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	25	75	100

### Preamble

Elaborates the applications of microorganisms in fermentation process. Brief on upstream and downstream processes of fermentation, process optimization and strain development.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	List industrially important microbes from different sources.	K1
CO2	Explain the components and design of a bioreactor	K2
CO3	Identify and select the media based on the product requirement	K,K2
CO4	Illustrate the types and importance of downstream processing	K2
CO5	Solve the problems arise during fermentation process	K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	---	M	M
CO2	---	----	---	S	M
CO3	M	M	---	S	M
CO4	M	---	---	M	L
CO5	M	---	L	M	M

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140



### **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, 2<sup>nd</sup> edn. Panima Publishing corPSOration, 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

**Course contents and lecture schedule**

	<b>Topic</b>	<b>lecture hrs.</b>
<b>Unit I</b>		
1.1	Isolation of industrially important strains: Sources for sample collection,	3
1.2	screening techniques: primary screening – crowded plate technique,	3
1.3	Auxanography, enrichment technique, dye indicator and secondary screening.	3
1.4	Strain development- mutation, selection of auxotroph, protoplast fusion, parasexual reproduction.	4
1.5	Strain Maintenance.	2
<b>Unit II</b>		
2.1	Basic design and components of fermentor.	4
2.2	Types of fermentors- Tower, airlift, fluidized bed.	3
2.3	Types of fermentation – solid state fermentation and submerged fermentation,	3
2.4	Methods of fermentation- batch, fed-batch, continuous fermentation.	3
2.5	Growth kinetics (Batch).	2
<b>Unit III</b>		
3.1	Fermentation media: chemical composition,	2
3.2	raw materials- saccharides (starch and cellulose), industrial wastes.	3
3.3	Fermentation process control- media, pH, aeration, temperature, foam,	5
3.4	computer automation.	2
3.5	Media optimization- CCD –(Response surface methodology).	3
<b>Unit IV</b>		
4.1	production of Antibiotic – Penicillin	3
4.2	Production of vitamin (Riboflavin),	2
4.3	Production of Enzymes (Amylase)	3
4.5	Production of organic acid (Citric acid)	2
4.6	Production of beverage ( Wine)	2
<b>Unit V</b>		
5.1	Downstream processing: Introduction	1
5.2	Cell disruption-physical and chemical methods.	3
5.3	Separation- Precipitation, filtration, centrifugation,	3
5.4	solid liquid extraction, liquid-liquid extraction, chromatography	4
5.5	solvent extraction, drying and crystallization.	3

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**Department of Zoology**  
 (For those joined B.Sc., Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 CL62	<b>Lab in Industrial Microbiology</b>	Core lab 9	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	40	60	100

### Preamble

Isolate, Screen and mass produce industrially important microbes. Gain a basic knowledge on the working mechanism of a bioreactor.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Identify the instruments and elaborate on the techniques associated with Industrial microbiology	K1,K2
CO2	Screen, select and mass produce economically important microbes	K2
CO3	Differentiate and distinguish types and stages of fermentation process	K2,K3
CO4	Appraise antibiotic and alcohol production process.	K3
CO5	Able to trouble shoot the problem associated with fermentation process.	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	---	S	M
CO2	L	S	---	M	M
CO3	M	---	---	M	M
CO4	M	---	---	M	M
CO5	L	---	---	M	L

**S-Strong M-Medium L-Low**

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

### **Reference Books**

1. Anuj Kumar Rana, 2012. Downstream Processing Techniques in Biotechnology. Global Academic Publishers, New Delhi.
2. Murugan, 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.

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 C63	Genetic Engineering and Biotechnology	Core-14	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	25	75	100

### Preamble

Acquaint the students to the tools and techniques employed in genetic engineering and biotechnology. This course provides theoretical bases to properties and applications of versatile DNA modifying enzymes, cloning strategies, vector types, host genotype specificities for selection and screening of recombinants and/or recombinant transformants. Illustrate the fundamental steps in gene cloning.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Elaborate the various tools and techniques of genetic engineering.	K1
CO2	Explain various molecular cloning methods, cloning vectors and their hosts, and how to find the right vector for molecular cloning.	K2,K3
CO3	Apply innovatively the techniques learnt in basic and applied fields of biological research.	K3
CO4	Explain the principles underlying DNA amplification and analysis.	K2,K3
CO5	Strategize research methodologies employing genetic engineering techniques.	K3

K1: Knowledge K2: Understand K3: Apply

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	---	M	M
CO2	M	M	---	S	M
CO3	M	M	---	S	M
CO4	M	L	---	M	M
CO5	M	L	M	S	M

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	30%	30%	30%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	30%	30%	30%
<i>Total marks</i>	52	52	140

**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, PUC18), 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****Dr. T.Rajagopal****Course contents and lecture schedule**

	<b>Topic</b>	<b>Lecture hrs.</b>
1.1	Tools in Genetic engineering	3
1.2	Host cell types for recombinants	1
1.3	Structure and Properties of cloning vectors	2
1.4	Properties of Different cloning vectors	6
2.1	Selection of desired DNA fragments and preparation recombinants	2
2.2	Linkers and adapters, Transformation (heatshock, electroPSOration, microinjection) and transfection.	2
2.3	Indirect transformation in plants (Ti plasmid based).	2
2.4	Screening of recombinants (colony hybridization, antibiotic based, blue white screening, Imuno based).	4
2.5	Construction of genomic and cDNA libraries.	2
3.1	Animal cell culture: Primary and Continuous Cell culture	2
3.2	Adherent and suspension cultures; functional characteristics of cultured cells.	2
3.3	ComPSOosition of animal cell culture media. Cryopreservation of animal cells.	2
3.4	Applications of animal cell culture.	3
3.5	Animal cloning (Dolly – nuclear transfer method).	3
4.1	Plant cell and tissue culture (PTC), culture media.	1
4.2	Types of plant tissue cultures (Callus, suspension, protoplast, anther & ovule cultures, somatic embryos and meristem cultures).	4
4.3	Micropropagation and somatic embryogenesis.	2
4.4	Applications of PTC: Massive plant production, virus free plants, Embryo rescue of endangered plants,	4
4.5	Germplasm collection and seed conservation.	1
5.1	PCR- Principle and its application, Reverse transcriptase-PCR	2
5.2	DNA finger printing (RAPD and RFLP), DNA sequencing methods- (Maxam Gilbert, Sanger's and Automated). Microarray.	4
5.3	Transgene, transgenesis, Transgenic animals (Sheep and fish) and Plants (Bt cotton, drought resistant plants and its applications.	4
5.4	Animal bioreactors and molecular farming.	2

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 CL63	<b>Lab in Gentic Engineering and biotechnology</b>	Core lab 5	-	-	2	1

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	40	60	100

### Preamble

Illustrate the creative use of modern tools and techniques for manipulation and analysis of genomic sequences. Expose the students to the application of recombinant DNA technology in biotechnological research.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Explain the concept of genetic engineering and biotechnology.	K1,K2
CO2	Adopt genetic engineering techniques in basic and applied experimental biology.	K2,K3
CO3	Demonstrate nucleic acid and protein isolation and separation technique.	K3
CO4	Demonstrate molecular cloning, DNA amplification techniques.	K2,K3
CO5	Employ the methodologies learnt for the development of society.	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	---	M	L
CO2	M	M	L	S	M
CO3	M	M	---	S	M
CO4	M	M	L	S	M
CO5	L	M	M	M	L

**S-Strong M-Medium L-Low**

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

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 CE61	Biostatistics and Bioinformatics	Core Elective-2	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	25	75	100

### Preamble

Provide students with the ability to integrate theory and practice across biological and computing disciplines. Define the principle concepts on biostatistics and bioinformatics

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Collect, organize and analyze the data.	K1
CO2	Interpret the results of biological experiments based on statistical analyses.	K2,K3
CO3	Discuss the benefits and implications of knowing the DNA sequences of organisms.	K3
CO4	Differentiate between databases, tools, repositories and be able to use each one to extract specific information.	K2,K3
CO5	Explore the evolutionary relatedness among genetically related organisms based on the gene and protein sequences.	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	----	M	M
CO2	S	---	---	M	L
CO3	M	S	L	S	M
CO4	L	M	M	S	M
CO5	S	S	L	S	S

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

### **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, quartile deviation

Standard deviation, variance, Coefficient of variation

### **Unit : II**

Probability Theorems; Distribution- types

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

Regression equations

### **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. 3<sup>rd</sup> Ed.PHI Learning Pvt.Ltd. New Delhi.

### **Reference books**

- 1.Gupta, S.P., 1987, Statistical Methods, thirty third edition, Sulston 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 Bioinformatics. Viva Books Pvt. Ltd., New Delhi
- 5.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.
- 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**

**Course contents and lecture schedule**

	<b>Topic</b>	<b>No of lecture hrs.</b>
<b>Unit I</b>		
1.1	Data –types, Collection,	1
1.2	Organization and Presentation of data-Table –types and components, graph, diagram.	3
1.3	Measures of central tendency; Mean, Median and Mode	2
1.4	Measures of Dispersion – Range, quartile deviation	2
1.5	Standard deviation, variance, Coefficient of variation	2
<b>Unit II</b>		
2.1	Probability Theorems;	3
2.2	Distribution- types	2
2.3	Correlation-types, Karl Pearson’s coefficient of correlation and Rank correlation	4
2.4	Regression equations	3
<b>Unit III</b>		
3.1	Hypothesis Testing- Level of Significance, types of errors, region of acceptance and rejection	2
3.2	Chi-square test ,	2
3.3	Student “t” test.	2
3.4	Anova-one way	2
3.5	Application of MS-Excel for statistical analysis	4
<b>Unit IV</b>		
4.1	Scope and applications of Bioinformatics.	2
4.2	Biological databases- DNA and protein- primary, secondary,	3
4.3	specialized and structural databases.	2
4.5	Similarity search, pairwise alignment- FASTA, BLAST:	3
4.6	Conserved region-Motif	1
4.7	Multiple sequence alignment- Local and global- Clustal W,	3
<b>Unit V</b>		
5.1	Phylogenetic analysis- Phylogenetic Trees, types	3
5.2	Neighbor Joining method, Maximum parsimony.	2
5.3	3D structure prediction -Homology modeling Principles and steps in evaluation,	3
5.4	Tool- SPDB viewer. Structure validation	2
5.5	Ramachandran plot-SAVES	2

# **Skill Based Elective**

**Offered**

**by**

**Department of Zoology**

**(Programme Code-UMB)**

## Thiagarajar College (Autonomous) :: Madurai – 625 009

### Department of Zoology

(For those joined B.Sc., Microbiology on or after June 2019)

#### Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB19 SE41A	<b>Intellectual Property Rights</b>	Skill based Elective-2	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Seond	Fourth	15	35	50

### Preamble

The course explains the basic concepts, patent, copyright and trademark on the Biological materials. The main focus of the course is on the Patenting and copyrights of Biological materials like microbes, genes, traits, techniques etc. It also explains the need for the protection of industrial design, techniques, genes etc.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Get awareness of acquiring the patent and copyright for their innovative works.	K1
<b>CO2</b>	Apply intellectual property rights principles (including copyright, patents and trademarks) to real problems and analyse the social impact of intellectual property law and policy.	K1, K3
<b>CO3</b>	Analyse professional issues which arise in the intellectual property right context.	K2, K3
<b>CO4</b>	Explain the Procedure for patent application and patent granting procedure.	K2
<b>CO5</b>	Describe the Indian Patent Act 1970, Copyright Act 1957 and Trademark Act 1999.	K2, K1

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	L	---	---	M	M
<b>CO2</b>	M	---	---	L	M
<b>CO3</b>	S	---	---	S	M
<b>CO4</b>	L	---	---	M	L
<b>CO5</b>	L	---	---	L	M

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<b>Total marks</b>	30	30	65

## 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. WIPSO, GATT, TRIP.

### Text Book:

1. A. Raphael Miller, Micheal H. Davis, Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
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, Textbook on intellectual property rights, Asia Law House (2001).
2. K. Singh, Intellectual Property rights on Biotechnology, BCIL, New Delhi (2010)
3. S. A. Stanley: Bioethics, Wisdom educational service (2008)
4. F.K. Beier, R.S. Crespi, T. Straus, Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi, 1985
5. U. Sathyanarayana: Biotechnology, Books and allied (p) Ltd, Kolkata (2009)
6. B.D. Singh, Biotechnology, Kalyani publishers, New Delhi (2009)

**Course designers Dr. T. RAJAGOPAL**

### Course contents and lecture schedule

	Topic	lecture hrs.
<b>Unit I</b>		
1.1	Intellectual Property Rights: concept, scope and economic importance	3
1.2	Types of intellectual property: origin and development	4
1.3	Patent: Patent Law, Patent Act 1970 with its amendment.	2
1.4	Procedure for patent application and patent granting procedure.	2
1.5	Copyright: Indian Copyright Act 1957 with its amendment; Ownership and duration of copyright. Need for protection of industrial design	4
<b>Unit II</b>		
2.1	Trademark: Need for protection of trademarks, Indian Trademark Act 1999	3
2.2	Patents of Biological materials in India: Protection of plant varieties and farmers rights.	3
2.3	Patenting - microbes, genes, traits, techniques.	4
2.4	Plant and animal genetic protection right and implication of protection.	2
2.5	WIPSO, GATT, TRIP	3

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**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19SE41B	<b>Bioethics and Biosafety</b>	Skill based Elective-2	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	15	35	50

### Preamble

The course explains the basic concepts, moral values on experimental animals and biosafety in laboratory. The main focus of the course is on the ethical implication of biotechnological product and techniques. It also explains the assessment of biological hazard and level of biosafety in environment.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
<b>CO1</b>	Recognize the fundamental concepts of Bioethics and Biosafety.	K1
<b>CO2</b>	Describe the pre-symptomatic genetic diseases and its importance in healthcare.	K2, K3
<b>CO3</b>	Have a detailed analyse the biological hazard and level of biosafety.	K2,K3
<b>CO4</b>	Perceive the theoretical basis of Institutional Animal Ethical Committee (IAEC) and Institutional Biosafety Committee (IBSC).	K2
<b>CO5</b>	Illustrate the genetically modified organisms and their implications in environment.	K2

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	L	---	---	L	L
<b>CO2</b>	L	---	M	---	L
<b>CO3</b>	L	---	---	---	M
<b>CO4</b>	M	---	---	L	L
<b>CO5</b>	M	M	S	M	M

S-Strong M-Medium L-Low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	30	30	65



### Unit-I

Introduction to Bioethics: Moral values on experimental animals, Human Genome Project and its ethical issues. 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 release in environment. Institutional Biosafety Committee (IBSC).

#### Text and Reference Books:

1. D.A. Fleming, D.L. Hunt, Biological safety Principles & practices (3rd Ed.) ASM Press, Washington (2001).
2. Rajmohan Joshi, Biosafety and Bioethics, Gyan Publishing House, New Delhi (2006)
3. U. Sathyanarayana, Biotechnology, Books and allied (p) Ltd, Kolkata (2009)
4. J.A. Thomas, R.L. Fush, Biotechnology and Safety Assessment (3<sup>rd</sup> Ed.), Academic Press (2002).
5. Sasson, A., Biotechnologies and Development, UNESCO publication (1988)

#### Course designers 1. Dr. T. RAJAGOPAL

##### Course contents and lecture schedule

	Topic	No of lecture hrs.
<b>Unit I</b>		
1.1	Introduction to Bioethics: Moral values on experimental animals, Human Genome Project and its ethical issues	4
1.2	Detection of pre-symptomatic genetic diseases and its importance in healthcare	4
1.3	Ethical implication of biotechnological product and techniques	4
1.4	Institutional Animal Ethical Committee (IAEC)	3
<b>Unit II</b>		
2.1	Introduction to biosafety: Guidelines and regulation	3
2.2	Biosafety in laboratory: Laboratory associated infection and other hazards, Assessment of biological hazard and level of biosafety	5
2.3	Use of genetically modified organisms and their release in environment	4
2.4	Institutional Biosafety Committee (IBSC)	3

**Thiagarajar College (Autonomous) :: Madurai – 625 009**

**Department of Zoology**

(For those joined B.Sc., Microbiology on or after June 2019)

**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 SE41C	<b>Bioenergy</b>	Skill based Elective-2	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	15	35	50

**Preamble**

The course elaborates on renewable and non renewable energy sources, focuses on Bio-Energy and in particular on the exploitation of biomass and biomass waste for energy recovery .

**Course Outcomes**

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	List the basic principle and application of bioenergy systems	K1
CO2	Explain the fundamental concepts in bioconversion of biomass to energy	K1,K2
CO3	Explain the fundamental concepts in biofuel production	K2
CO4	Develop designs for bioenergy conversion and scale up	K3
CO5	Apply the skills in the development of microbial fuel cells	K2,K3

K1: Knowledge K2: Understand K3: Apply

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	---	L	M
CO2	M	---	---	S	M
CO3	M	---	---	S	M
CO4	L	---	---	S	L
CO5	L	M	---	M	M

S-Strong M-Medium L-Low

**Blooms taxonomy: Assessment Pattern**

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	30	30	65

## UNIT I

Introduction to Renewable and non renewable energy ; 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 & hydrogen – 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**

### Course contents and lecture schedule

	Topic	No of lecture hrs.
1.1	Introduction to Energy concepts	1
1.2	Renewable and non renewable energy	1
1.3	Biomass – resources and classifications	2
1.4	Trans esterification and Combustion of Biomass	3
1.5	Biofuels and types	1
1.6	Ethanol and Methanol production using Bagasse	3
1.7	Biodiesel production from <i>Jatropha curcas</i>	2
2.1	Bio-oil production from oleaginous microorganisms	2
2.2	Application and scale up studies on bio-oil production	3
2.3	Microbial biogas production	2
2.4	Process design and Applications of biogas production	3
2.5	Introduction to microbial fuel cell	2
2.6	Microbial Fuel Cell - process design and applications	3
2.7	National Biofuel Policy	2

**Thiagarajar College (Autonomous) :: Madurai – 625 009**

**Department of Zoology**

(For those joined B.Sc Microbiology on or after June 2019)

**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 SE61B	Nanotechnology	Skill based Elective- 2	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	15	35	50

**Preamble**

Nanotechnology is an emerging field that combines principles from biology, physics, chemistry and mathematics to understand and control biological processes at the molecular level. Revolutionary advances are being made in the biomedical sciences using nanotechnology, varying from the visualization and manipulation of individual molecules, the use of nanoparticles to deliver drugs to specific sites.

**Course Outcomes**

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	List the fundamental concepts and scope of nanotechnology	K1
CO2	Explain the different types of nanoparticles	K2
CO3	Apply the techniques learnt in the field of bio and nanotechnology projects.	K3
CO4	Make use of different techniques for the characterization of nanoparticles	K2,K3
CO5	Demonstrate the applications of nanostructures in biomedical sciences	K2,K3

K1: Knowledge K2: Understand K3: Apply

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	---	M	M
CO2	---	---	---	S	M
CO3	S	---	---	S	M
CO4	M	---	---	M	L
CO5	L	---	M	M	L

**Blooms taxonomy: Assessment Pattern**

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	30	30	65

## Unit I:

Bionanotechnology: Fundamental concepts, scope and application. Different types of nanoparticles: Metallic nanoparticles: Gold, silver, titanium based, Non metallic nanoparticles: carbon and silicon based. Characterization of nanoparticles: Using 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

#### Course contents and lecture schedule

	Topic	No of lecture hrs.
Unit I		
1.1	Introduction to fundamental concepts of nanotechnology And its application	2
1.2	Different types of nanoparticles Metallic nanoparticles: Gold, silver, titanium based	2
1.3	Non metallic nanoparticles: carbon and silicon based.	2
1.4	Characterization of nanoparticles: Using UV-visible, FTIR,	2
1.5	AFM, SEM, TEM and XRD.	2
2.1	Biomedical applications of nanoparticles: listing and discussion	1
2.2	Targeted drug delivery	1
2.3	liposomes, nanoshells and hydrogels	2
2.4	Imaging technique-quantum dots and magnetic nanoparticles	2
2.5	Implants- orthopaedic and vascular,	2
2.6	Bionanosensors-nanocantilevers based on single stranded DNA	2
3	Lab Visit	4

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B. Sc., Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19SE61A	Stem Cell Biology	SBE	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Third	15	35	50

### Preamble

The course emphasizes the importance of stem cells and their application in therapeutic purpose. Elaborate the different types of stem cells and their properties. Controversies surrounding stem cell therapy is also highlighted.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Define the concepts of stem cells and its niches	K1
CO2	Differentiate theoretically the adult and embryonic stem cells	K1,K2
CO3	Illustrates the ethics and conflicts in stem cell application	K3
CO4	Outline the procedure for stem cell isolation, differentiation and maintenance	K1,K2
CO5	Analyse the case studies associated with stem cell therapy	K2,K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	---	M	L	L
CO2	L	---	L	---	M
CO3	M	---	---	L	M
CO4	M	---	---	S	M
CO5	M	L	---	M	L

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	30	30	65

## 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. Epigenetics

## Unit II

Clinical applications of hematopoietic stem cells, Stem cells and 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 Gottlieb, 2001. Cold spring Harbor Press. 0-87969-575-7/01 (e-book)

### Course Designers:

2. **Dr. T S Ramyaa Lakshmi**
3. **Dr. C. Ravi**

### Course contents and lecture schedule

	Topic	lecture hrs.
Unit I		
1.1	Definitions of stem cells, Pluripotency, Stem-cell plasticity Regulators of pluripotency,	4
1.2	Differences between adult and embryonic stem cells, Adult Stem Cell Niches,	3
1.3	primordial germ cells as stem cells	2
1.4	common markers to identify stem cells, protocol for embryonic stem cells isolation.	4
1.5	Epigenetics	2
2.1	Clinical applications of hematopoietic stem cells,	2
2.2	Stem cells and aging,	2
2.3	Correlation between stem cells and cancer,	2
2.4	Tissue regeneration, Stem cell banking, case study (spinal cord injury, cancer),	4
2.5	Controversies on human embryonic stem cell research.	4
2.6	Discussion	1

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc., Microbiology on or after June 2019)  
**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19SE61C	Forensic Science	Skill based Elective-2	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Sixth	15	35	50

### Preamble

The course explains the various concepts and importance of forensic science. Demonstrate knowledge and understanding of some of the links between forensic science and the legal system.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Spell the history and development of forensic science.	K1
CO2	Define the principles, types and significance of fingerprints in crime investigation.	K1
CO3	Explain the basic principles and application of forensic science	K2
CO4	Explain the fundamental concepts in physical, chemical and biological methods of crime investigation	K2
CO5	Make use of biological evidence for crime investigation	K2, K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	L	L	M
CO2	M	---	---	L	M
CO3	L	---	---	L	M
CO4	M	L	---	M	M
CO5	M	---	---	M	M

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	30	30	65



## 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 - Fundamental of DNA typing.

### Text Books:

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

### 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. PSOklis (1997) Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton.

**Course designers RM.Murgappan Dr.M.Karthikeyan**

### Course contents and lecture schedule

	Topic	lecture hrs.
1.1	Introduction to forensic Science	1
1.2	Organization and functions of Forensic laboratory	1
1.3	Physical evidences - their classification and significance -	3
1.4	Crime Scene examination and documentation	1
1.5	collection, preservation and transPSOrtation of physical evidence for laboratory examinations	3
1.6	Fundamentals of crime scene photography	2
1.7	Tool marks identification and restoration of field off/erased marks	2
2.1	Foot and tyre examinations and types	3
2.2	Finger print classification and classification	2
2.3	Toxicology-mode of action of drugs, Poisons and alcoholic beverages	3
2.4	Examination of biological fluids	2
2.5	Forensic characterization blood stains and patterns	3
2.6	Examination of fibres, hair, bones, teeth and skull	2
2.7	Fundamental of DNA typing	2

# **Generic Elective (Allied Papers)**

**Offered by Zoology Department**

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

**Generic Elective course Syllabus**  
**For Botany and Chemistry Major Students – w.e.f. 2019 June**

Major	Year	Sem	Code	Title of the Paper	Cont Hrs/W	Credit
Botany	III	V	UMB19 GE1	Economic Zoology	4	4
		VI	UMB19 GE2B	Insect Pests and Management	4	4
		VI	UMB19 GL1	Lab in Economic Zoology & Insect Pests and Management	2	2
Chemistry	II	III	UMB19 GE1	Economic Zoology	4	4
		IV	UMB19 GE3C	Clinical Chemistry	4	4
		IV	UMB19 GL2	Lab in 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 (Autonomous) :: Madurai – 625 009

### Department of Zoology

(For those joined B.Sc., Chemistry and Botany on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMB19 GE1	Economic Zoology	Generic Elective	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First Bot. / Second Chem	First for Botany/ Third for Chemistry	25	75	100

### Preamble

Elaborates the multidisciplinary nature of zoology. Explain the topics like sericulture, lac culture, apiculture, fisheries, poultry science, and so on.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Spell the importance of applied biological sciences or economic Zoology such as sericulture, apiculture, aquaculture	K1,K2
CO2	Explain rearing methods of beneficial organisms – an economic perspectives	K3
CO3	Spell the different strategies adopted in PSOultry and aquaculture	K2,K3
CO4	Spell the dos and donots in animal rearing	K2,K3
CO5	Start their own agro based small scale industry business such as PSOultry, apiculture, sericulture etc.,	K3

K1: Knowledge K2: Understand K3: Apply

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	---	--	M	S
CO2	S	L	M	S	M
CO3	M	---	---	S	M
CO4	S	M	M	S	S
CO5	---	---	M	S	S

S-Strong, M-Medium, L-low

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

### **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, PSOlyhedrosis, 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. Ananthkrishnan, 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**

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

### Course contents and lecture schedule

	Topic	lecture hrs.
<b>Unit I</b>		
1.1	Importance of sericulture, Sericulture industry in India	2
1.2	Moriculture: Morphology of mulberry plants, methods of propagation.	2
1.3	Classification of mulberry silkworm and non-mulberry silkworm	2
1.4	life cycle of mulberry silkworm ( <i>Bombyx mori</i> ), rearing of silkworms	4
1.5	diseases of silkworm (maggot, pebrine, Polyhedrosis, flacherie)	2
<b>Unit II</b>		
2.1	Economic importance, lac industry in India	3
2.2	Life history of lac insect	3
2.3	Host plants, rearing of lac insect	3
2.4	Processing of lac, composition of lac, Enemies of lac cultivation	3
<b>Unit III</b>		
3.1	Classification of bee's (rock bee, Indian bee, little bee, European bee, dammer bee)	4
3.2	social organization of honey bee, bee dance	2
3.3	life history of <i>Apis indica</i> , Composition of honey, bee keeping equipment's	2
3.4	Methods of bee keeping: Indigenous and modern (Newton's Bee hive) methods. Economic importance of honey	4
<b>Unit IV</b>		
4.1	Poultry industry in India, choosing a commercial layers and broilers	4
4.2	Poultry house (deep litter and cage systems), rearing of layers and broilers	4
4.3	Nutritional content: egg and flush. Diseases (Ranikhet, pullorum, Aspergillosis, Coccidiosis and their control)	4
<b>Unit V</b>		
5.1	Qualities of culturable fishes, Culture of Indian major carps (Catla, Rohu) and cat fishes (Parhin, Tengra)	4
5.2	fish farming (Pond, riverine, dam, lake cultures)	3
5.3	fish breeding (natural and induced), fish harvesting	2
5.4	preservation of fish, water quality management, ornamental fish culture and its economic importance	4

**Thiagarajar College (Autonomous) :: Madurai – 625 009**

**Department of Zoology**

(For those joined B.Sc Chemistry on or after June 2019)

**Programme Code-UMB**

Course Code	Course Title	Category	L	T	P	Credit
UMB19 GE3C	Clinical Chemistry	Generic Elective	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second Chemistry	Fourth	25	75	100

**Preamble**

Explain the principle, procedure and applications of analytical instruments. Clinical significance of body fluids and analyses.

**Course Outcomes**

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	List the principles and applications of analytical instruments	K1, K2
CO2	Summarize the basis & clinical significance of the urine, blood, serum analysis	K2
CO3	Elaborate the diseases associated with the abnormalities with urine and blood.	K2
CO4	Estimate the different components of body liquid samples.	K2, K3
CO5	Spell the influence and importance of hormones and enzymes	K2, K3

K1: Knowledge K2: Understand K3: Apply

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	---	S	L
CO2	M	L	M	S	L
CO3	L	M	S	M	M
CO4	---	---	L	S	M
CO5	M	---	M	M	L

S-Strong, M-Medium, L-low

**Blooms taxonomy: Assessment Pattern**

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

**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.

Course designers: Poornima kkani

	<b>Topic</b>	<b>lecture hrs.</b>
Unit I	<b>Analytical instruments</b>	
1.1	Principle and application – colorimeter	2
1.2	centrifuge types-clinical, gradient, differential	2
1.3	ELISA	3
1.4	PCR	3
1.5	Autoanalyzer	2
Unit II	<b>Urine analysis</b>	
2.1	Collection and preservation of urine sample-	2
2.2	Physical properties of urine (total volume, specific gravity, colour, turbidity and odour)	2
2.3	Components of urine - Bile salts and Bile pigment, urea –	3
2.4	Abnormal components of urine - proteins, sugar, ketone bodies	2
2.5	Diseases associated with abnormalities in urine	3
Unit III	<b>Blood analysis</b>	
3.1	Blood composition	2
3.2	Collection of blood samples, anticoagulants	3
3.3	Haemoglobin & Anaemia, ESR as an indicator of infection	3
3.4	blood urea & kidney function .	2
3.5	blood sugar & diabetes	2
Unit IV	<b>Serum analysis</b>	
4.1	Serum- separation of serum, composition of serum	2
4.2	estimation of lipid profile	4
4.3	liver function test (bilirubin)	4
4.4	serum protein separation.	2
Unit V	<b>Hormones and Enzymes</b>	
5.1	Clinical significance of Thyroid hormones T3, T4, TSH	3
5.2	Alkaline phosphatase	3
5.3	Creatine phosphokinase	3
5.4	Amylase – pancreatitis	3



## Thiagarajar College (Autonomous) :: Madurai – 625 009

### Department of Zoology

(For those joined B.Sc., Chemistry on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMB19 GL2	Lab in Economic Zoology and Clinical Chemistry	Generic Elective-2	5	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third and Fourth	25	75	100

### Preamble

Elaborate about beneficial insects. Appraise the steps involved in the development of apiary and sericulture unit. Brief different methods involved in water quality analyses. Acquainted with basic clinical lab techniques.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Explain the morphology, life history of lac insect, honey bees and silkworm	K1
CO2	Distinguish the different components of bee hives.	K2
CO3	Appraise the quality of water and honey .	K2,K3
CO4	Examine and analyse the body fluids	K2,K3
CO5	Analyse and estimate the blood components	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	L	L	L
CO2	M	---	---	S	L
CO3	L	---	M	S	L
CO4	L	M	S	S	M
CO5	M	M	S	S	M

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<i>Total marks</i>	52	52	140

**K1: Knowledge K2: Understand K3: Apply**

### **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 CO<sub>2</sub> 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 (Autonomous) :: Madurai – 625 009**

**Department of Zoology**

(For those joined B.Sc Botany on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMB19 GE2B	<b>Insect and Pest Management</b>	Generic Elective	4	-	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First Botany	Second	25	75	100

### Preamble

The course corroborates the knowledge on pests and their management. Understanding the bionomics of interests will bring innovative ideas to the learners. Provide an idea on the pest of agricultural, cattle, house hold and vectors. Elaborates on different pest control measures

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Classify the types of pests and important insect groups	K1
<b>CO2</b>	List the household pests and interpret disease transmission and control	K2,K3
<b>CO3</b>	Identify cattle pests and analyze their infection and control	K2
<b>CO4</b>	Categorize crop pests and apply management theory and practice	K
<b>CO5</b>	Emphasize biology, infestation, and damage caused by stored product insect pests	K2,K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	L	---	M	---	M
<b>CO2</b>	M	L	S	L	L
<b>CO3</b>	M	L	L	M	M
<b>CO4</b>	M	---	M	M	M
<b>CO5</b>	---	M	S	S	M

**S-Strong M-Medium L-Low**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%
<b>Total marks</b>	52	52	140

### **Unit I:**

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

### **Unit II:**

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

### **Unit III:**

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

7. David, B.V., and T. Kumaraswami, Elements of Economic Entomology, Popular Book DePSOt, Chennai (2000).
8. 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** (Name of the staff)

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

## Course contents and lecture schedule

	Topic	Lecture hrs.
<b>Unit I</b>		
1.1	Pest: Definition & types, feeding habits	4
1.2	types of mouth parts	2
1.3	General characters and outline of orders Coleoptera, Lepidoptera, Hemiptera & Hymenoptera	6
<b>Unit II</b>		
2.1	Biology, disease transmission and control of <i>Musca domestica</i> ( <a href="#">cholera</a> ),	3
2.2	<i>Anopheles stephensi</i> (malaria)	3
2.3	<i>Culex quinquefasciatus</i> (elephantiasis)	3
2.4	<i>Aedes aegypti</i> ( <a href="#">dengue</a> )	3
<b>Unit III</b>		
3.1	Biology, mode of transmission, infestation and control measures of <i>Hypoderma lineatus</i>	3
3.2	<i>Tabanus striatus</i> ,	3
3.3	<i>Hippobosca equine</i>	3
3.4	<i>Haematopinus quadripertusus</i>	3
<b>Unit IV</b>		
4.1	Life history, mode of infection, damage and control methods of major crop plants such as cotton boll worm ( <i>Helicoverpa armigera</i> )	3
4.2	sugarcane shoot borer ( <i>Chilo infuscatellu</i> )	2
4.3	rice stem borer ( <i>Scirpophaga incertulas</i> )	2
4.4	Brinjal borer ( <i>Leucinodes orbonalis</i> )	2
4.5	Basic concept & application of integrated pest management (IPM) and Insecticide Resistance Management (IRM)	3
<b>Unit V</b>		
5.1	Sorts of insect pests of house hold and stored products, their biology, mode of infestation, damage caused and control methods of cockroach ( <i>Periplaneta americana</i> )	3
5.2	silver fish ( <i>Lepisma saccharina</i> )	3
5.3	red flour beetle ( <i>Tribolium castaneum</i> )	3
5.4	rice weevil ( <i>Sitophilus oryzae</i> )	3

**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined B.Sc., Botany on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMB19 GL1	Lab in Economic Zoology and Insect Pests & Management	Generic elective lab	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First & Second	40	60	100

### Preamble

Elaborate about beneficial and harmful insects, their life cycle. Appraise the steps involved in the development of apiary and sericulture unit. Brief different pest control strategies.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Explain the morphology, life history of lac insect, honey bees and silkworm	K1
CO2	Distinguish the different components of bee hives.	K2
CO3	Appraise the quality of water and honey .	K2,K3
CO4	Categorize the different pests of agriculture crops	K3
CO5	Make a field study in an ecosystem	K3

**K1: Knowledge K2: Understand K3: Apply**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	L	L	L
CO2	M	---	---	S	L
CO3	L	---	M	S	L
CO4	L	---	---	M	M
CO5	S	---	M	M	M

**S-Strong, M-Medium, L-low**

### 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 CO<sub>2</sub> 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. LC<sub>50</sub> 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, PSOpular 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.

# THIAGARAJAR COLLEGE, MADURAI – 9.

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

## ENVIRONMENTAL STUDIES

(For those joined B.A., B.Sc., B.Com., B.B.A., B.C.A on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
U19EVS11	Environmental Studies	AECC1	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	15	35	50

### Preamble

Students acquire knowledge on the basic concepts, components and importance of environment.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Define the structure and functions of ecosystem	K1
CO2	Explain the benefits of biodiversity conservation	K2
CO3	Summarise the sources, effects and control measures of various types of Pollutants	K1
CO4	Perceive the environment legislations in India for sustainable development.	K3

K1: Knowledge K2: Understand K3: Apply

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

#### 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**

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

**Reference Books**

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

# THIAGARAJAR COLLEGE, MADURAI – 9.

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

## VALUE EDUCATION

(For those joined B.A., B.Sc., B.Com., B.B.A., B.C.A on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
U19VE51	Value Education	AECC1	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	15	35	50

### Preamble

Students acquire knowledge on the basic concepts, components and importance of environment.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Define the structure and functions of ecosystem	K1
CO2	Explain the benefits of biodiversity conservation	K2
CO3	Summarise the sources, effects and control measures of various types of Pollutants	K1
CO4	Perceive the environment legislations in India for sustainable development.	K3

K1: Knowledge K2: Understand K3: Apply

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

#### Unit I

**Self Development** – Introduction - Definition and Types of Values – Self Assessment – Values needed for self development - Values needed for family life –Principles of happy living

**Character development-** Good character – Good relationships - Legendary people of highest character – The quest for character –Developing character -The key to good character.

#### Unit II:

**Positive Thinking and Self Esteem** - Types of thoughts - Areas of thinking - Developing thought pattern - External influences on Thoughts - Methods to keep outlook positive – Meaning of Self Esteem – Self empowerment.

**Stress free living** – Illusions and causes - Symptoms and stages of stress – Self confidence– Role models and leadership qualities – Critical thinking - Communication skills – Happy and successful life.

### **Reference**

Study material / Course material

Values for Excellence in Life|| Compiled by then Curriculum Development Cell Thiagarajar College, Madurai, in collaboration with the Education wing, Brahma Kumaris, Madurai.

## **விழுமியக் கல்வி**

**கூறு - 1**

### **சுய முன்னேற்றம்**

அறிமுகம் - விழுமியங்களின் விளக்கம் மற்றும் வகைகள் - சுயமதிப்பீடு - சுய முன்னேற்றத்திற்கு விழுமியங்களின் தேவை - குடும்ப வாழ்க்கைக்கு விழுமியங்களின் தேவை - மகிழ்ச்சியான வாழ்க்கைக்கான கொள்கைகள்

### **பண்பு வளர்ச்சி**

நற்பண்பு - நல்லுறவு - உயரிய பண்புகளால் உயர்ந்த பெருமக்களாதல் - பண்புகளைத் தேடல் - பண்புகளை வளர்த்தல் - நற்பண்புகளுக்கான திறவுகோல்.

**கூறு - 2**

### **சுயமரியாதையும் நேர்மறைச் சிந்தனையும்**

சிந்தனையின் வகைகள் - சிந்தனைப் பகுதிகள் - சிந்தனையை வளர்க்கும் முறை - சிந்தனையில் புறத்தாக்கங்கள் - நேர்மறைப் பண்பை வெளித்தோற்றத்தில் காட்டும்முறை - சுயமரியாதையின் பொருள் - சுய அதிகாரமளித்தல்

### **அழுத்தமில்லா வாழ்க்கை**

பிரமைகளும் காரணங்களும் - அழுத்த நிலைகளுக்கான அறிகுறிகள் - தன்னம்பிக்கை - தலைமைப் பண்பில் முன்னுதாரணங்கள் - விமர்சனச் சிந்தனை - தொடர்புத் திறன்கள் - மகிழ்ச்சி மற்றும் வெற்றிகரமான வாழ்க்கை

### **Reference**

Study material / Course material

**“Values for Excellence in Life” Compiled by then Curriculum Development Cell  
Thiagarajar College, Madurai, in collaboration with the Education wing, Brahma  
Kumaris, Madurai**

# Self Study Paper

## Thiagarajar College (Autonomous) :: Madurai – 625 009

### SELF STUDY PAPER

(For those joined UG on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
U19SS51	Soft Skills	Self Study Paper	-	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	----	100	100

**\* Carries Extra 5 credits that do not form part mandatory credits (140) required for completion of the course. Optional paper not compulsory for all UG students.**

### Preamble

Prepare the students to develop skills, provide training to face interview .prepare themselves with the right skill-sets and attitude

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Possess a basic idea on the understanding of nature, cause, effect and ways to deal with critical challenges in everyday life	K1,K2
<b>CO2</b>	Overcome the aspects such as Communication barriers, Stress management, Emotions.	K3
<b>CO3</b>	Gain insights into high-in-demand soft skills and prepare themselves with the right skill-sets and attitude	K1,K2
<b>CO4</b>	Develop or take part inteam work, Thinking skills, Creativity and time management.	K3
<b>CO5</b>	Prepare themselves to face different levels of interviews. Develop skills to manage an organization	K3

**K1: Knowledge K2: Understand K3: Apply**

### Blooms taxonomy: Assessment Pattern

	CA		End of Semester
	First	Second	
<i>Knowledge</i>	40%	40%	40%
<i>Understand</i>	40%	40%	40%
<i>Apply</i>	20%	20%	20%

### Unit - 1

Self Awareness (Concept of Self-esteem, Positive and Negative self esteem)  
 Motivation (Nature and types, Factors enhancing and affecting Motivation, Needs and Drives)  
 (Creativity Introduction, Nature of Creativity, Stages of Creativity, Enhancing Creativity, Verbal and Non Verbal Creativity) Values and Ethics (Nature and Significance, Values, Ethics, Work Ethics, Character building, Manners and Ethics)

Self Management (Self management skills and Social Competency, Social Competency Behaviour, Value Orientation, Life goals)

## **Unit 2**

Communication and Thinking Communication (Definition, Types, Styles, Culture and Communication); Thinking (Nature, Types, Problem Solving, Proactive thinking, Positive Thinking, Assertiveness)

## **Unit 3**

Emotions (Nature of emotions, Emotional Intelligence and its strategies, Attachment, Love, Happiness, Introduction to Anger – Causes, Types, Functions and Consequences, Anger management)

Stress (Nature of stress, Relation between Demands and Coping, Types and Causes, Effects and Indicators, Management of Stress, Time management and Stress reduction) Empathy (Definition, Nature and Factors enhancing empathy)

## **Unit4**

Excelling through a placement process( Resume writing; Taking a written test; Group discussion – Need, Types, Tips and techniques; Interview handling – Tips and Techniques)

## **Unit 5**

Being effective in an organisation

50 rules of work, Professional Etiquettes and Mannerism, Building relationship within an organisation, Communication skills, Working in teams, Managing conflicts, Effective negotiation skills, Problem solving using creativity.

### ***Text book***

1. Life Skills for Success – AlkaWadkar – 2016 Edition SAGE | TEXTS  
Sagepublishing.com
2. Campus to Corporate – Roadmap to Employability – Gangadhar Joshi – 2015 Edition  
SAGE | TEXTS Sagepublishing.com

Reference textbook

- 1 ACE of Soft skills – Gopaldaswamy Ramesh and Mahadevan Ramesh, Pearson Publication
- 2 Bridging the soft skills gap – Bruce Tulgan – 2015 Edition – Wiley Publication

## B.Sc., Microbiology:

Assessment values of course learning outcomes and their mapping with program specific outcomes (PSOs)

Code	Course Name	PSO1	PSO2	PSO3	PSO4	PSO5
UMB19C11	General Microbiology	14	12	9	10	8
UMB19CL11	Lab in General Microbiology	12	12	10	12	6
UMB19C12	Cell structure and Dynamics	9	2	2	10	10
UMB19C21	Biochemistry	11	4	9	10	4
UMB19C22	Medical Microbiology	10	10	15	10	5
UMB19CL21	Lab in Biochemistry	11	5	11	13	10
U19AEC21	Personality development	-	-	-	-	-
UMB19C31	Bioinstrumentation	12	3	9	13	8
UMB19C32	Microbial physiology	12	10	7	4	11
UMB19CL31	Lab in bioinstrumentation	9	4	9	14	10
UMB19C41	Molecular Biology	12	10	5	13	12
UMB19C42	Microbial genetics	11	4	3	10	9
UMB19CL41	Lab in Molecular Biology and Microbial genetics	9	6	10	11	9
UMB19CE51	Environmental microbiology	14	9	3	8	10
UMB19C51	Agriculture microbiology	9	6	7	8	10
UMB19CL51	Lab in Agriculture microbiology	13	9	7	11	10
UMB19C52	Food microbiology	12	9	11	13	10
UMB19CL52	Lab in Food microbiology	13	8	9	14	12
UMB19C53	Clinical lab technology	9	4	14	15	10
UMB19CL53	Lab in Clinical lab technology	8	6	14	14	9
UMB19C61	Immunology	9	4	9	11	10
UMB19CL61	Lab in Immunology	11	7	8	13	10
UMB19C62	Industrial microbiology	8	5	1	12	9
UMB19CL62	Lab in Industrial microbiology	8	3	0	11	9
UMB19C63	Genetic engineering & biotechnology	10	6	2	13	10
UMB19CL63	Lab in Genetic engineering & biotechnology	9	10	4	13	8
UMB19CE61	Biostatistics and Bioinformatics	11	8	4	13	10
<b>Skill Based Elective</b>						
UMB19SE41A	Intellectual property rights	8	0	0	9	9
UMB19SE41B	Bioethics and Biosafety	7	2	5	4	7
UMB19SE41C	Bioenergy	8	2	0	12	9
UMB19SE61A	Nanotechnology	8	0	2	12	8
UMB19SE61B	Stem cell biology	8	1	3	7	8
UMB19SE61C	Forensic Science	9	1	1	7	10
<b>Generic Elective</b>						
UMB19GE1	Economic zoology	11	3	6	14	13
UMB19GE4C	Clinical chemistry	7	3	8	13	7
UMB19GEL1B	Economic Zoology and Clinical chemistry	8	4	9	13	7
UMB19GE2B	Insect and pest management	7	4	11	8	9
UMB19GEL2C	Lab in economic zoology and Insect and pest management	9	0	5	11	7

### Certificate course

	Course Name	PSO1	PSO2	PSO3	PSO4	PSO5
U19COP1	Apiculture	7	4	8	9	9

# **M.Sc., Microbiology**

**Programme Code: PMB**



## **Programme outcome-PO (Aligned with Graduate Attributes)- Master of Science (M.Sc.)**

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### **Knowledge**

Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

### **Complementary skills**

Students will be able to engage in critical investigation through principle approaches or methods and through effective information search and evaluation strategies. Employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies;

### **Applied learning**

Students will be able to apply disciplinary or interdisciplinary learning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate;

### **Communication**

Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Able to comprehend and write reports, documents, make effective presentation by oral and/or written form.

### **Problem solving**

Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

### **Environment and sustainability**

Understand the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

### **Teamwork, collaborative and management skills.**

Recognise the opportunities and contribute positively in collaborative scientific research. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

**THIAGARAJAR COLLEGE, MADURAI- 9**  
**An autonomous institution affiliated by Madurai kamaraj university**  
**(Re-Accredited with 'A' Grade by NAAC)**

**Vision**

- To render exemplary quality education in Life Sciences and laboratory skills in order to produce generations of responsible, competent and employable graduates

**Mission**

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching positions in biological sciences.
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, and effective oral and written communication abilities for students.
- To create an holistic understanding of the allied subjects through interdisciplinary learning.

**Programme Educational Objectives (PEO)**

**The Objectives of this programme is to equip/ prepare the students**

<b>PEO1</b>	Adopt for careers in the food/agriculture/ pharmaceutical industry, agriculture, and applied research
<b>PEO2</b>	To compete in competitive exams like NET, SET and civil services
<b>PEO3</b>	Analyze and interpret scientific data collected with microbiological laboratory techniques and safety procedures
<b>PEO4</b>	To utilize the scientific literature effectively for the successful completion of research projects related to microbiology
<b>PEO5</b>	A proficient microbiological quality analyst in an reputed company or will be an entrepreneur in the field concerned

**Programme Specific Outcome (PSO)**

**On the successful completion of M.Sc Microbiology the students will**

<b>PSO1</b>	Comprehend the core theories, concepts, practices and methods related to the different disciplines in microbiology
<b>PSO2</b>	Analyse the scientific information related to microbial processes and their role in ecosystem functioning and health issues
<b>PSO3</b>	Plan and execute safely a series of food, environment and medical microbiological experiments
<b>PSO4</b>	Be equipped with interdisciplinary skills, computational tools and techniques related to microbiology
<b>PSO5</b>	Exhibit their ideas/knowledge through their involvement in research/internship activities, association club and outreach activities specific to microbiology

**THIAGARAJAR COLLEGE, MADURAI- 9**  
**An autonomous institution affiliated by Madurai kamaraj university**  
**(Re-Accredited with 'A' Grade by NAAC)**  
**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**  
**COURSE STRUCTURE- M.Sc., Microbiology (w.e.f. 2019 - 2020 batch onwards)**  
**Programme Code : PMB**  
**Semester – I**

Course	Code	Title of the Paper	Contact Hrs/W	Credits	Total Hrs	MaxMarks CA	Max Marks SE	Total
Core1	PMB19 C11	General Microbiology	5	4	75	25	75	100
Core2	PMB19 C12	Microbial Biochemistry	5	4	75	25	75	100
Core3	PMB19 C13	Microbial Physiology	5	4	75	25	75	100
Core Elective1	PMB19 CE11	Elective 1 (Options Given)	5	4	75	25	75	100
Lab1	PMB19 CL11	Lab in General Microbiology	5	3	75	40	60	100
Lab2	PMB19 CL12	Lab in Microbial Biochemistry and Physiology	5	3	75	40	60	100
<b>Total</b>			<b>30</b>	<b>22</b>				

**Semester – II**

Course	Code	Title of the Paper	Contact Hrs/W	Credits	Total Hrs	MaxMarks CA	Max Marks SE	Total
Core4	PMB19 C21	Immunobiology	5	4	75	25	75	100
Core5	PMB19 C22	Molecular Biology	5	4	75	25	75	100
Core6	PMB19 C23	Microbial Genetics	5	4	75	25	75	100
Core Elective2	PMB19 CE21	Elective 2 (Options Given)	5	4	75	25	75	100
Lab3	PMB19 CL21	Lab in Immunobiology	5	3	75	40	60	100
Lab4	PMB19 CL22	Lab in Molecular Biology and Microbial Genetics	5	3	75	40	60	100
<b>Total</b>			<b>30</b>	<b>22</b>				

### Semester – III

Course	Code	Title of the Paper	Contact Hrs/W	Credits	Total Hrs	MaxMarks CA	Max Marks SE	Total
Core7	PMB19 C31	Medical Microbiology	5	4	75	25	75	100
Core8	PMB19 C32	Clinical Lab Technology	5	4	75	25	75	100
Core9	PMB19 C33	Genetic Engineering	5	4	75	25	75	100
Core Elective3	PMB19 CE31	Elective 3 (Options Given)	5	4	75	25	75	100
Lab5	PMB19 CL31	Lab in Medical Microbiology	5	3	75	40	60	100
Lab6	PMB19 CL32	Lab in Genetic Engineering	5	3	75	40	60	100
<b>Total</b>			<b>30</b>	<b>22</b>				

### Semester – IV

Course	Code	Title of the Paper	Contact Hrs/W	Credits	Total Hrs	MaxMarks CA	Max Marks SE	Total
Core10	PMB19 C41	Bioprocess Technology	5	4	75	25	75	100
Core11	PMB19 C42	Food and Agriculture Microbiology	5	4	75	25	75	100
Core612	PMB19 C43	Environmental Microbiology	5	4	75	25	75	100
Core Elective4	PMB19PJ41	Elective 4 – Project	5	4	75	25	75	100
Lab7	PMB19 CL41	Lab in Bioprocess Technology	5	3	75	40	60	100
Lab8	PMB19 CL42	Lab in Food, Agriculture and Environmental Microbiology	5	3	75	40	60	100
<b>Total</b>			<b>30</b>	<b>22</b>				

**A) Consolidation of Contact Hours and Credits: PG Microbiology**

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

**B) Curriculum Credits**

Core	- 74 Credits
Elective	- 16 Credits
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Total	90 Credits
	-----

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C11	General Microbiology	Core-1	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

**Preamble**

Enable graduate students to attain basic laboratory skills and sound theoretical knowledge in the field of microbiology.

**Prerequisite**

Basic knowledge on the elemental concepts in Microbiology.

**Course Outcomes**

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level
CO1	Spell the history, scope of microbiology and basic safety practices of a laboratory	K1, K3
CO2	Interpret the structural organization, morphology and reproduction of microbes	K1, K4
CO3	Construct and practice the control of microbes by various physical and chemical methods	K4, K5
CO4	Summarize and define the structure and life cycle of viruses	K1, K2
CO5	Illustrate the distribution, nutrition, reproduction of various algae and fungi	K1, K2

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

**Mapping of COS with PSOs**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	S	M	L
CO2	S	S	M	L	L
CO3	S	-	M	M	L
CO4	S	-	L	-	-
CO5	S	M	-	-	M

S:Strong M:Medium L: Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : General Microbiology

### Unit I

History and scope of microbiology. Preparation of solutions, media. Principles, functioning and types of Biosafety cabinets. Safety in the laboratory: Common hazards in the laboratory – Electrical equipment, chemicals – corrosive, irritant, toxic, flammable, explosive, ionising radiations, infectious materials, gas and fire. Safety measures – use of equipments and gas facility, personal protection, waste disposal, 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, sheaths, prostheca and cell wall (Gram positive and Gram negative). Internal structure- cell membrane, cell inclusions-carbon storage polymers, polyphosphate, sulfur, minerals, magnetosomes, gas vesicles and carbonate.

### Unit III

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

### Unit IV

Outline classification of viruses. Structure and life cycle of viruses- bacterial virus (T<sub>4</sub>, 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

## Text Books:

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., Duclco, R., Fisen, H.N. and Ginsberg, H.S. 1990. Microbiology, Fourth Edition, Harper & Row Publishers, Singapore.
6. Dubey, R.C. and Maheswari, D.K. 2010. A text book of Microbiology, S. Chand and Company Ltd, 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

### Lecture Schedule

#	Topic	lecture hrs.
1.1	History and scope of microbiology	2
1.2	Preparation of solutions, media.	2
1.3	Principles, functioning and types of Biosafety cabinets.	2
1.4	Safety in the laboratory: Common hazards in the laboratory – Electrical equipment, chemicals – corrosive, irritant, toxic, flammable, explosive, ionising radiations, infectious materials, gas and fire.	5
1.5	Safety measures – use of equipments and gas facility, personal protection, waste disposal, first aid.	4
2.1	Morphology and structure of bacteria - size, shape and arrangement of bacterial cell.	3
2.2	External structure and chemical composition of - flagella, pili, capsules, sheaths, prostheca	4
2.3	cell wall (Gram positive and Gram negative	3
2.4	Internal structure- cell membrane, cell inclusions - carbon storage polymers, polyphosphate, sulfur, minerals, magnetosomes, gas vesicles and carbonate.	5
3.1	Control of microorganisms	3



3.2	Physical agents - conditions influencing antimicrobial action, temperature, desiccation, osmotic pressure, radiation, filtration	4
3.3	Chemical agents -characteristics of an ideal antimicrobial agents, phenolic compound, alcohol, halogens, heavy metals, dyes, synthetic detergents, quaternary ammonium compounds, aldehydes, gaseous agents	5
3.4	Evaluation of antimicrobial chemical agents.	2
4.1	Outline classification of viruses	1
4.2	Structure and life cycle of viruses	1
4.3	bacterial virus -T <sub>4</sub>	2
4.4	bacterial virus –Lambda	1
4.5	Animal virus –Pox	2
4.6	Animal virus –Adeno	2
4.7	Plant virus -TMV	2
4.8	Plant virus –CMV	2
4.9	Insect virus –Baculovirus	1
4.10	Mycophages	1
4.11	Cyanophages	1
5.1	Outline classification of fungi	1
5.2	Outline classification of algae	1
5.3	Distribution, importance, structure, nutrition and reproduction of fungi- <i>Rhizopus</i> ,	1
5.4	Distribution, importance, structure, nutrition and reproduction of fungi- <i>Saccharomyces</i> ,	1
5.5	Distribution, importance, structure, nutrition and reproduction of fungi- <i>Agaricus</i>	2
5.6	Distribution, importance, structure, nutrition and reproduction of fungi- <i>Fusarium</i>	2
5.7	Distribution, importance, structure, nutrition and reproduction of Algae – <i>Chlamydomonas</i>	1
5.8	Distribution, importance, structure, nutrition and reproduction of Algae – <i>Chrysamoeba</i>	1
5.9	Distribution, importance, structure, nutrition and reproduction of Algae – <i>Sargassum</i>	2
5.10	Distribution, importance, structure, nutrition and reproduction of Algae – <i>Gellidium</i>	2
5.11	Lichens- Structures and types	1

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19CL11	Lab General Microbiology, Microbial Diversity and Taxonomy	Core lab-1	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

**Preamble**

To provide hands on training of techniques involved in the isolation, cultivation and characterization of microbes.

**Prerequisite**

Basic knowledge on the fundamental concepts in practical biology techniques.

**Course Outcomes**

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Explain and demonstrate the correct usage of the scientific methods	K1, K2,K3
CO2	Demonstrate and practice the safety measures while working in the Microbiology laboratory	K1, K2,K3
CO3	Construct an experiment to isolate, culture, identify microorganisms in culture	K1, K2,K3
CO4	Illustrate the use of chemical and physical control of microbes	K1, K4
CO5	Explain the macroscopic and microscopic characteristics of fungi, protozoa and algae	K1, K2,K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

**Mapping of COS with PSOs**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	-	S	M	S
CO3	S	S	S	M	S
CO4	S	-	M	L	S
CO5	S	M	L	-	S

S- Strong -Medium L-Low

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

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. Kannan, N. 1996. Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
11. Reddy, S.W. and Reddy, R.S. 2000. Microbiology: A Laboratory Manual, BSC Publishers & Distributors.

## **Course Designers:**

**1.Mr.S.Kulandaivel**

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**  
 (For those joined M. Sc., Microbiology on or after June 2019)  
 Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C12	Microbial Biochemistry	Core-1	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

### Preamble

The objective of the course is to provide knowledge on understanding the core principles of microbial biochemistry. To acquire knowledge on structure, function and metabolism of biomolecules.

### Prerequisites

Basic knowledge on chemistry and biology

### Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Demonstrate an understanding of the chemistry, structure and function of biological molecules	K1,K2
CO2	Acquire knowledge about protein structure and function.	K1, K2
CO3	Impart Knowledge on Lipid structure function and biosynthesis	K1, K2
CO4	Demonstrate and Elaborate the principles of Enzyme kinetics, structure and function.	K1,K4,K5
CO5	Classify the structure, types and properties of Nucleic acids and vitamins	K2,K3,K4

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

## Mapping of COs with POs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	-	M	S
CO2	S	M	-	S	S
CO3	S	-	-	S	L
CO4	S	M	L	M	S
CO5	S	-	L	L	M

S- Strong -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper – Microbial Biochemistry

### 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 -  $\alpha$ ,  $\beta$  and  $\omega$  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: Types and properties of Vitamins – 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, NewDelhi.
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

**Dr.M.Karthikeyan**

### Course contents and lecture schedule

	Topic	No of lecture hrs.
1.1	Carbohydrates: Structure and classification	2
1.2	Properties of monosaccharides (glucose, fructose)	2
1.3	Properties of disaccharides (lactose, maltose, sucrose)	2
1.4	Polysaccharides Structure and classification	1
1.5	Properties of Polysaccharides (starch, cellulose, and agar- agar).	2
1.6	Gluconeogenesis & glycolysis,	2
1.7	Kreb's cycle & Hexose monophosphate shunt,	2
1.8	Glyoxylate cycle & Entner Doudroff pathway.	2
2.1	Amino Acid: Classification based on structure, polarity	1

2.2	Biological importance and reactivity,	2
2.3	physical properties and chemical reactions	3
2.4	Aminoacid biosynthesis	2
2.5	Protein: Classification,	2
2.6	Physical and chemical properties	2
2.7	Protein structure – Primary, Secondary & Tertiary	2
2.8	Ramachandran Plot	1
3.1	Lipids Classification	2
3.2	Properties of Lipid	2
3.3	Phospholipid synthesis in bacteria	3
3.4	Cholesterol synthesis in bacteria	3
3.5	Lipid Metabolism- $\alpha$ , $\beta$ oxidation of fatty acids	3
3.6	$\omega$ oxidation of fatty acids	1
3.7	Lipid peroxidation	1
4.1	Enzyme Classification	2
4.2	Mechanism of enzyme action	2
4.3	Enzyme kinetics - Michaelis Menten equation	2
4.4	Enzyme kinetics - Lineweaver Burk plot	2
4.5	Factors influencing enzyme activity	3
4.6	Enzyme inhibition- active site, allosteric site	2
4.7	Isozyme, ribozyme and abzyme.	2
5.1	Nucleic acids Structure	2
5.2	Synthesis and degradation of purines	2
5.3	Synthesis and degradation of pyrimidines	2
5.4	Types and properties of Vitamins	3
5.5	Water soluble vitamins (B & C)	3
5.6	Fat soluble vitamins (A,D,E & K)	3
<b>Total</b>		<b>75</b>

**THIAGARAJAR COLLEGE, MADURAI- 9****(Re-Accredited with 'A' Grade by NAAC)****DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CL12	<b>Lab in Microbial Biochemistry and Physiology</b>	Core Lab-2	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

**Preamble**

Provide a basic knowledge on the core principles of microbial biochemistry.

**Prerequisites**

Awareness on chemistry and biology

**Course Outcomes**

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level
CO1	Recall the laws of thermodynamics, concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions	K1, K2
CO2	Explain the conceptual knowledge of aerobic and anaerobic respiration and various intermediary mechanisms involved	K1, K2
CO3	Illustrate the structural similarities and differences among various physiological groups of bacteria/archaea	K1, K4
CO4	Explain the ways microorganisms grow, proliferate and die in a given environment and mechanisms beneath those life events	K4, K5
CO5	Distinguish the diversity of metabolic processes	K3, K4

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

**Mapping of COs with POs**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	-	L	M
CO2	S	-	-	M	S
CO3	S	M	L	L	S
CO4	S	M	L	M	S
CO5	S	S	L	L	S

S- Strong -Medium L-Low



1. Estimation of  $pK_A$  value.
2. Determination of  $\lambda_{max}$  (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:

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

### Course Designers

1. Dr.M.Karthikeyan

**THIAGARAJAR COLLEGE, MADURAI- 9**  
**An autonomous institution affiliated by Madurai kamaraj university**  
**(Re-Accredited with 'A' Grade by NAAC)**  
**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMBC13	Microbial Physiology	Core-1	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

### Preamble

Microbial physiology covers the basic principles of physiological mechanisms and response in microbes.

### Prerequisite

Basic knowledge on the principles behind microbial physiology.

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Define the different growth phases, growth kinetics and physiological adaptations of bacteria	K1,K2
CO2	Explain the microbial photosynthetic mechanism, phosphorylation process, respiration cycles and the respective pigments involved	K1,K2
CO3	Experiment with different laws of thermodynamics, chemical coupling reactions and uses of biomembranes in transportation	K2,K3
CO4	Develop a wide knowledge of extremophiles and its responses against various stress conditions	K2, K4
CO5	Predict the different physiological adaptations during sporulation and its respective genetic aspects	K4,K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	L	M
CO2	S	S	-	L	S
CO3	S	M	L	L	M
CO4	S	S	M	L	S
CO5	S	M	-	M	S

S- Strong -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	15% (20)
Understand -K2	15% (9)	15% (9)	15% (20)
Apply-K3	30% (18)	30% (18)	30% (40)
Analyze-K4	20% (12)	20% (12)	20% (25)
Evaluate-K5	20% (12)	20% (12)	20% (25)
Total Marks	<b>60</b>	<b>60</b>	<b>130</b>

## Title of the paper : Microbial Physiology

### 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: Historical background. General types of microbial photosynthesis - oxygenic and anoxygenic. Structure of photosynthetic pigments – chlorophylls, bacteriochlorophyll, carotenoids and phycobilins. Photosynthetic bacteria - green sulphur and purple. Mechanism of photosynthesis - non-cyclic and cyclic electron transport and photophosphorylation. Carbon assimilation - calvin, reverse citric acid cycle and hydroxy propionate cycle.

### 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- 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 Designers:

1. Mrs. V. Ananthi

### Lecture Schedule

	Topic	No of lecture hrs.
1.1	Growth of Bacteria: Phases of growth	2
1.2	Growth kinetics	2
1.3	Batch culture, continuous culture, diauxic growth and synchronous culture - induction of synchrony.	2
1.4	Factors affecting growth	2
1.5	Physiological adaptation to extreme environmental conditions.	3
1.6	Nutritional types and metabolic diversity based on carbon source	2
1.3	Nutritional types and metabolic diversity based on energy and electron sources source	2
2.1	Bacterial Photosynthesis: Historical background	1
2.2	Types of microbial photosynthesis - oxygenic and anoxygenic.	2
2.3	Structure of photosynthetic pigments	2
2.4	Photosynthetic bacteria - green sulphur and purple.	2
2.5	Mechanism of photosynthesis - non-cyclic and cyclic electron transport and photophosphorylation.	3
2.6	Carbon assimilation pathways	1
2.7	Calvin & Reverse citric acid cycle	2
2.8	Hydroxypropionate cycle	2
3.1	Bioenergetics: Principles and laws of thermodynamics	2
3.2	TCA cycle	2
3.3	Electron transport chain	2

3.4	Chemiosmotic theory of Mitchell - efficiency of coupling.	2
3.5	Fluid mosaic model,	2
3.6	Transport across membrane	3
3.7	Sodium – Potassium pump	2
4.1	Introduction to Microbial stress responses	1
4.2	Osmotic stress and osmoregulation	2
4.3	Aerobic to anaerobic transitions	2
4.4	Oxidative stress, pH stress and acid tolerance,	2
4.5	Thermal stress and heat shock response,	2
4.6	Nutrient stress and starvation stress	2
4.7	Stringent response	2
4.8	Microbial stress responses in extremophiles	2
5.1	Endospore formation	1
5.2	Characteristics of endospore forming bacteria	2
5.3	life cycle of Bacillus- stages of sporulation.	2
5.4	Physiological and genetic aspects of sporulation, metabolic changes during germination	3
5.5	Life cycle of myxobacteria	2
5.6	Physiological and genetic aspects of sporulation - genes involved in signaling, aggregation	3
5.7	Chemotaxis and signal transduction system	2

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C21	<b>Immunobiology</b>	Core-1	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

### Preamble

Immunology is helpful for the students to understand the cells and organs of immune system so as they can acquire a wide knowledge on immunity and immune system.

### Prerequisite

Essential knowledge on immunity and importance of overall reactions shown by the immune system

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level ( Bloom's Taxonomy)
<b>CO1</b>	Explain the importance of immunology, types of immune system, lymphoid organs and development of the immune cells	<b>K2,K5</b>
<b>CO2</b>	Spell about the various types of antigens and immunoglobulins and its production	<b>K1,K2</b>
<b>CO3</b>	Develop the basic knowledge on immune effector mechanisms and its regulations	<b>K3</b>
<b>CO4</b>	Distinguish the vaccines and immunity against various infectious diseases	<b>K3,K5</b>
<b>CO5</b>	Outline a clear view on various immunodiagnostic methods and transplantation immunology	<b>K2,K4</b>

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	<b>S</b>	<b>L</b>	<b>S</b>	<b>L</b>	<b>S</b>
<b>CO2</b>	<b>S</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>M</b>
<b>CO3</b>	<b>S</b>	<b>L</b>	<b>M</b>	<b>-</b>	<b>L</b>
<b>CO4</b>	<b>S</b>	<b>M</b>	<b>L</b>	<b>L</b>	<b>L</b>
<b>CO5</b>	<b>S</b>	<b>L</b>	<b>M</b>	<b>-</b>	<b>M</b>

S- Strong -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Immunobiology

### Unit I

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

### Unit II

Antigens – characteristics, types, cross reactivity, hapten, adjuvant, immunogenicity and antigenicity. Immunoglobulins – types, structure and functions. Molecular biology of immunoglobulin synthesis, antibody diversity and isotype switching.Mechanism of antigen recognition by T and B cells.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 - idio type network and autoimmune diseases.Mechanism of immune regulation – tolerance.

### Unit IV

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

### Unit V

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

### Lecture Schedule

S.No.	Topic	No. of Lecture Hours
1.2	History and Scope of Immunology	2
1.2	Types of Immunity – Innate, acquired, passive and active	2
1.3	Physiology of Immune Response ( Humoral and cell mediated immunity)	2
1.4	Lymphoid Organs – Primary	3
1.5	Lymphoid Organs – Secondary	2
1.6	Cells of Immune system – Ontogeny and development of cells innate and adaptive immune system	2
1.7	Hematopoiesis and stem cells	2
2.1	Antigens – Characteristics, Types, cross reactivity, hapten, adjuvant, immunogenicity and antigenicity	2
2.2	Immunoglobulins – Types, Structure and functions	3
2.3	Molecular biology of Immunoglobulin synthesis, Antibody diversity & Isotype Switching	3
2.3	Mechanism of antigen recognition by T and B cells	3
2.4	Immunotechnology – Hybridoma and monoclonal antibodies	2
2.5	Antibody Engineering – Production of chimeric and hybrid monoclonal antibodies	2
3.1	Immune Effector Mechanisms – Cytokines – Properties and functions	2



3.2	Complement Components – Classical pathway & their regulation	2
3.3	Alternate Pathway & their regulation	1
3.4	Complement activation & complement deficiencies	1
3.5	Hypersensitivity – Anaphylaxis & Cytotoxic	2
3.6	Hypersensitivity – Immune complex deposition and cell mediated	2
3.7	Autoimmunity , Idiotype network	1
3.8	Autoimmune diseases	2
3.9	Mechanism of Immune regulation – Tolerance	2
4.1	Immunity to infectious diseases – Bacterial (Tuberculosis) and Viral (AIDS)	3
4.2	Protozoan (Malaria) and Parasitic diseases (Leishmaniasis)	2
4.3	Immune deficiency disorders - T & B cells, Phagocytic & Natural killer cell associated diseases	3
4.4	AIDS and other immunodeficiencies	3
4.5	Vaccines – Identification and analysis of vaccines	2
4.6	Inactivated , Subunit & synthetic vaccines	1
4.7	DNA, RNA and Live attenuated vaccines	1
5.1	Transplantation immunology – Graft versus host reaction	2
5.2	Structure and functions of class I and class II molecules, HLA Typing	2
5.3	Principles of Tumor Immunology - Tumor antigens, immune response to tumor and immunotherapy of malignancy	2
5.4	Immunodiagnosis based on antigen and antibody interaction – Precipitation, agglutination,	3
5.5	EIA, RIA, ELISPOT assay	3
5.6	Immunofluorescence techniques, flow cytometry and immunohistochemistry	3

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**DEPARTMENT OF ZOOLOGY**  
 (For those joined M.Sc., Microbiology on or after June 2019)  
 Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CL21	Lab in Immunobiology	Core-1	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	60	100

### Preamble

Immunological techniques helps to understand and acquire a wide knowledge on immunity and immune system.

### Prerequisite

Knowledge on the key concepts in immunology

### Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Demonstrate an understanding of the key concepts in immunology	K1,K2
CO2	List and experiment with immunization and their preparation and its importance	K1,K3
CO3	Appreciate the significance of maintaining a state of immune tolerance sufficient to prevent the emergence of autoimmunity	K4,K5
CO4	Illustrate the salient features of antigen antibody reaction and its uses in diagnostics and various other studies	K1,K2,K3
CO5	Apply scientific principles in the interpretation of immunological responses and data	K1,K4,K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	L	-	M
CO2	S	-	L	-	S
CO3	S	L	L	L	S
CO4	S	M	L	L	M
CO5	S	L	M	L	M

S- Strong M-Medium L-Low

## 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. Invivo 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. Immuno-electrophoretic 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.

## Course Designers:

**1.Dr.S.Padmavathy**

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19C22	<b>Molecular Biology</b>	Core-1	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

### Preamble

The objective of this course is to provide in-depth knowledge of biological systems at molecular level. This course work is designed to understand mechanism genome organization, transcription and translation process in Prokaryotes & Eukaryotes.

### Prerequisite

Basic knowledge on biology and chemistry.

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Outline the importance of nucleic acids, structure, types and properties	K1, K2
CO2	Analyse the molecular basis of DNA replication and modes	K3, K4
CO3	Interpret the transcription process of prokaryotes and eukaryotic genomes	K2, K4
CO4	Analyse the difference between translation process of prokaryotes and eukaryotic genomes	K2, K4
CO5	Elaborate the role oncogenes and tumour viruses in cancer progression	K4 K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

### Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5
CO1	S	-	-	-	L
CO2	S	L	-	M	M
CO3	S	L	-	M	M
CO4	S	-	L	L	M
CO5	S	L	L	M	S

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper - Molecular Biology

### Unit I

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

### Unit II

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

### Unit III

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

### Unit IV

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

### Unit V

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

## Text Books

1. David Freifelder. D. 2008. Microbial Genetics, Eighteenth Edition, Narosa Publishing House, NewDelhi.
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, NewDelhi.
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 Dr.M.Karthikeyan**

### Course contents and lecture schedule

S.No.	Topics	No. of Lecture Hours
1.1	Discovery of DNA	2
1.2	Molecular basis of DNA as genetic material	2
1.3	Structure of DNA – A, B and Z form	2
1.4	Forms of DNA – DNA heteroduplex, circular, superhelical DNA, twisted circle	2
1.5	Properties of DNA – denaturation, renaturation, melting curve & Hyperchromicity	2
1.6	Structure of RNA	2
1.7	Types of RNA – t – RNA, mRNA & rRNA	2
1.8	Epigenetics – Histone proteins	1
2.1	Replication of DNA – Semiconservative mode	3
2.2	Meselson and Stahl Experiment	2
2.3	Enzymology of DNA Replication – DNA polymerase I, II and III, topoisomerase I and II, helicase, primase and gyrase	4
2.4	Molecular basis of DNA Replication (Replication fork, Origin, Okazaki fragments)	3
2.5	Types of Replication (Circular and Theta)	3
3.1	Transcription in Prokaryotes & Eukaryotes : Initiation – promoters, upstream & downstream sequences, sigma and transcription factors	3

3.2	Transcription –Elongation – RNA polymerase subunits	3
3.3	Termination – Rho dependent and Rho independent	2
3.4	Nus A and Anti termination	1
3.5	RNA Processing (Post Transcriptional modifications)	3
3.6	Inhibitors of Transcription	1
3.7	Reverse Transcription	2
4.1	Genetic code – Elucidation of Triplet code , Code characteristics , codon dictionary , Reading frames , sense and nonsense code.	2
4.2	Degeneracy – Wobble hypothesis – Universality of genetic code	2
4.3	Process of Translation in Prokaryotes & Eukaryotes : Initiation Process – initiation factors, initiator t-RNA, aminoacid activation, shine dalgarno sequences, initiation site	3
4.4	Elongation – elongation factors and translocation	3
4.5	Termination – termination factors	2
4.6	Post translational modifications – post translational transport, signal hypothesis	3
5.1	Tumor viruses and Oncogenes: Transformed cells, detection of integral viral DNA, structure of integral viral DNA	3
5.2	Protein Kinase and transformation by retroviruses	3
5.3	The cellular counterpart of src	2
5.4	Carcinogens and activation of oncogenes	2
5.5	Oncogenic proteins – protein kinases, growth factors, Ras protein	3
5.6	Transformation protein in DNA viruses	2

**THIAGARAJAR COLLEGE, MADURAI- 9**  
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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C23	<b>Microbial Genetics</b>	Core-1	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

### Preamble

Microbial genetics deals with the basic principles of mutation and different concepts and functions of DNA.

### Prerequisite

Basic knowledge on nucleic acids structure, synthesis and function.

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
<b>CO1</b>	Elaborate the basic principles of mutation and their effects on living system	<b>K1, K2,K5</b>
<b>CO2</b>	Explain the fundamental concepts of DNA damage and repair mechanism	<b>K2, K4</b>
<b>CO3</b>	Spell a wide knowledge on regulations of gene	<b>K1, K4</b>
<b>CO4</b>	List the plasmid types, properties and transfer mechanisms	<b>K1, K2, K3</b>
<b>CO5</b>	Familiar with several gene transfer and recombination mechanisms	<b>K1, K2, K3</b>

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	<b>S</b>	<b>L</b>	<b>-</b>	<b>L</b>	<b>M</b>
<b>CO2</b>	<b>S</b>	<b>L</b>	<b>L</b>	<b>M</b>	<b>M</b>
<b>CO3</b>	<b>S</b>	<b>L</b>	<b>-</b>	<b>M</b>	<b>L</b>
<b>CO4</b>	<b>S</b>	<b>-</b>	<b>-</b>	<b>M</b>	<b>S</b>
<b>CO5</b>	<b>S</b>	<b>M</b>	<b>L</b>	<b>M</b>	<b>M</b>

S- Strong M -Medium L-Low



## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : 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, IUOII. Gariand Publishing Inc., New York.
2. Hayes.W. 1968. Geneticsof 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 Bartlelt publishers, Boston.
6. Stanley R. Maloy, John E.C. and Freifelder, D.2008. Microbial Genetics, Narosa Publishing House, New Delhi.

### Course Designers:

1.Mrs.V.Ananthi

### Lecture Schedule

	Topic	No of lecture hrs.
1.1	Origin of mutation	1
1.2	Biochemical basis of mutation	2
1.3	Spontaneous mutation – random and non – adaptive mutation,	2
1.4	mutation rates	1
1.5	Origin of spontaneous mutation – isolation of mutants.	2
1.6	Selection of bacterial variation: Direct - fluctuation test, indirect - replica plating	2
1.7	Mutagenesis &mutagenic agents	2
1.8	Detection of mutagen - Ames test	1
1.9	Molecular basis of mutation	2
2.1	Introduction to DNA damage &repair	1
2.2	DNA damages - hit theory & UV radiation	3
2.3	DNA repair: post irradiation effects on survival levels	2
2.4	Introduction to Biochemical repair mechanism	1
2.5	Photo reactivation & liquid holding theory	2
2.6	Excision repair	2
2.7	Recombination repair	2

2.8	SOS repair	2
3.1	Regulation of bacterial gene expression	2
3.2	Lactose system - coordinate regulation	2
3.3	Lac components, positive and negative regulation	3
3.4	Catabolite repression,	2
3.5	Lac mutant isolation	2
3.6	Tryptophan operon - repression vs attenuation	2
3.7	Arabinose operon and its regulation	2
4.1	Plasmids and its types	2
4.2	Properties of plasmids - F, R & Col plasmids	3
4.3	Agrobacterium Ti and broad host range plasmid.	2
4.4	Detection and purification of plasmid DNA	2
4.5	Transfer of plasmid DNA.	1
4.6	Replication of plasmid	1
4.7	Control of copy number and plasmid amplification	2
4.8	Plasmid curing and incompatibility	2
5.1	Introduction to Gene transfer mechanisms and recombination	1
5.2	Transformation: Discovery - Griffith experiment, Avery <i>et al</i> experiment.	1
5.3	Detection: standard plating test,	1
5.4	Competence - DNA uptake mechanism, molecular mechanism of transformation & mapping based on transformation.	3
5.5	Conjugation: F plasmid, insertion of plasmid, chromosome transfer mechanism,	3
5.6	Interrupted and uninterrupted mating.	1
5.7	Topic	No of lecture hrs.
5.8	Transduction of Lambda phage DNA, generalized & specialized transduction	1
5.9	Molecular mechanism of lytic and lysogenic cycle in Lambda phage	2
5.10	Mechanism of specialized transduction,	1
5.11	Co-transduction, mapping based on transduction	1

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CL22	Lab in Microbial Genetics and Molecular Biology	Core-1	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	60	100

### Preamble

Microbial genetics deals with the basic principles of mutation and different concepts and functions of DNA

### Prerequisite

Critical knowledge on the gene regulation and mechanism

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level (according to Bloom’s Taxonomy)
CO1	Elaborate the general safety routines for laboratory work in molecular biology	K4,K5
CO2	Develop and apply the protocols for basic experimental work in the field of molecular biology	K3,K5
CO3	Outline the most significant molecular and cell based methods used today to extend their knowledge of biology	K1,K2,K4
CO4	Simplify and explain the various methods used for genetic recombination	K4,K5
CO5	Appraise the importance and analysis of genetic material	K4

**K1 – Knowledge**

**K2 – Understand**

**K3 – Apply**

**K4 – Analyse**

**K5 -**

**Evaluate**

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	-	M	-	M
CO2	S	L	L	M	S
CO3	S	-	L	L	S
CO4	S	L	L	M	S
CO5	S	L	-	M	S

S- Strong M -Medium L-Low

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<sup>+</sup> and Rec A<sup>-</sup>.
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:**

9. 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.
10. Berger, S.L. and Kimmel, R. 1987. Guide to Molecular Cloning Techniques, Academic Press, Inc., New York.
11. Brown, T.A. 1998. Molecular Biology Lab Fax 11 Gene Analysis, Academic Press, London.
12. Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.
13. 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
14. Rajamanickam, C. 2001, Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
15. Sambrook, I., Fritsch, E.F. and Maniatis, T. 2001. Third Edition, Molecular Cloning 1, 2, 3 - A Laboratory Manual, Cold Spring Laboratory Press, USA.

**Course Designers**

1. Dr. M. Karthikeyan

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C31	Medical Microbiology	Core-1	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

### Preamble

Medical microbiology covers the route cause of various diseases and the mode of action of antibiotics used in its treatment.

### Prerequisite

Basic knowledge on the mechanisms by which bacteria, fungi, parasites and viruses attack the body to cause disease and familiar with the diagnosis, prevention, treatment and epidemiology of infectious diseases

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level ( Bloom's Taxonomy)
CO1	Outline the general characteristics, laboratory diagnosis and control measures of bacteria	K1, K2
CO2	Appraise the diagnosis, prevention, treatment and epidemiology of infectious diseases including the impact of bacterial infectious agents on the human body	K2, K5
CO3	Explain the general characteristics, pathogenesis and laboratory diagnosis of fungi, parasites	K2, K5
CO4	Make use of different microbiological methods for diagnosis and analyse the cause of viral attack that cause disease	K3, K4
CO5	Classify various antibiotics based on mode of action and its performance	K3, K4, K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	M
CO2	S	M	M	L	M
CO3	S	M	M	L	M
CO4	S	M	M	L	M
CO5	S	S	L	L	S

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Medical Microbiology

### 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*. Intralumen 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, 17<sup>th</sup> 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. Balows and Sussman M. 2000. Topley & Wilson's Microbiology and Microbial infection Vol. 1 -5 Arnold Publishers, London.
6. Mandell, Douglas and Bennett'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.Mrs.V.Ananthi

### Lecture Schedule

S.No.	Topics	No. of Lecture Hours
1.1	General Characters, pathogenesis, laboratory diagnosis, principles of management and control measures of Gram positive cocci – <i>Staphylococci</i>	2
1.2	<i>Streptococci</i>	2
1.3	Gram negative cocci – <i>Gonococci</i>	2
1.4	Gram positive non spore forming bacilli – Aerobic – <i>Corynebacteria</i>	2
1.5	Anaerobic – <i>Actinomyces</i>	2
1.6	Gram positive spore forming bacilli – aerobic ( <i>Bacillus anthracis</i> )	3
1.7	Anaerobic ( <i>Clostridia</i> )	2
2.1	General Characters, pathogenesis, laboratory diagnosis, principles of management and control measures of Gram negative nonspore forming bacilli – Aerobic – <i>Bordetella</i>	2
2.2	Small gram negative facultatively anaerobic bacteria – <i>Yersinia</i>	2
2.3	Enteric gram negative bacilli – <i>Vibrio, E.coli, Salmonella</i>	3
2.4	Acid fast bacteria – <i>M.tuberculosis, M.leprae</i>	2
2.5	Cell wall less bacteria – <i>Mycoplasma</i>	2
2.6	Spirochaetes – zoonotic Leptospirosis	2
2.7	Sexually transmitted diseases – Syphilis	2



3.1	Mycology – General characteristics, life cycle, pathogenesis and laboratory diagnosis of Yeast – <i>Cryptococcus neoformans</i>	2
3.2	Yeast like fungi – <i>Candidasp.</i>	2
3.3	Filamentous fungi – <i>Aspergillus, Penicillium</i>	2
3.4	Dimorphic fungi – <i>Blastomycesdermatidis</i>	2
3.5	Parasitology – Morphology and life cycle of intracellular parasites – <i>Cryptosporidium, Plasmodium</i>	3
3.6	Intralumen parasites – <i>Entameoba histolytica, Ascaris lumbricoides</i>	2
3.7	Parasitic zoonoses – <i>Toxoplasma &amp; Taenia</i>	2
4.1	Morphology, pathogenesis and laboratory diagnosis of DNA viruses – Herpes virus – HSV	2
4.2	Hepatitis B virus	2
4.3	RNA viruses – Flavi virus – Dengue	2
4.4	Retrovirus – HIV	3
4.5	Viral zoonoses - Japaneseencephalitis, rabies	4
4.6	Prions and virions	2
5.1	Classification of antibiotics based on mode of action	2
5.2	Antibacterial (Penicillin & Streptomycin)	1
5.3	Antiviral (Amantidine, Zidovudine)	1
5.4	Antifungal (Amphotericin and Nystatin)	1
5.5	Antiparasitic (Quinine and Metrodinazole)	1
5.6	Anticancer drugs (Methotrexate and L- Asparaginase)	2
5.7	Emerging and remerging infections (MRSA – Methicillin Resistant <i>Staphylococcus aureus</i> )	2
5.8	NDMS – New Delhi Methicillin strain	2
5.9	National Programmes in prevention of infectious diseases	3

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CL31	Lab in Medical Microbiology	Core-1	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	40	60	100

### Preamble

Medical microbiology elaborate the role of microbes in causing diseases and preventive measures to be followed

### Prerequisite

Knowledge on the mechanism, diagnosis, prevention and treatment of infectious diseases

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Identify microorganisms of relevance to health care and the pharmaceutical industry and their sources	K1,K2
CO2	Perform microbiological laboratory procedures according to appropriate safety standards	K4,K5
CO3	Evaluate microbial content testing and sterility testing	K3,K4
CO4	Compare and contrast different microbial diseases, including the properties of different types of pathogens, and the mechanisms of pathogenesis	K1,K2,K3
CO5	Illustrate the therapeutic treatments for microbial infections, and distinguish when a vaccine, antibiotic, or other therapy is likely to be the most appropriate response	K1,K2,K3

**K1 – Knowledge  
Evaluate**

**K2 – Understand**

**K3 – Apply**

**K4 – Analyse**

**K5 -**

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	M
CO2	S	M	M	L	M
CO3	S	M	M	L	M
CO4	S	L	M	L	S
CO5	S	M	M	L	S

S- Strong M -Medium L-Low

### 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 ( $\alpha$ ,  $\beta$  and  $\gamma$  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 (*Candidaalbicans*, *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  $\beta$  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.

#### Course Designers:

1.Mrs.V.Ananthi

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C32	Clinical lab Technology	Core-8	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

### Preamble

Expose the students to perform and operate clinical laboratory procedures and equipments. The course work demonstrates technical skills, quality control parameters and other health related settings required for clinical lab technician.

### Prerequisite

Basic knowledge on handling the microbes for clinical evaluation. Experiment with non pathogenic microbes

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level ( Bloom’s Taxonomy)
CO1	Spell the basic lab safety methods and different clinical lab techniques	K1,K2
CO2	Apply and Acquire theoretical knowledge on blood sample analysis and grouping	K2,K3
CO3	Emphasize the scientific knowledge on urine sample processing and analysis	K3,K4,
CO4	Interpret the importance of microscopic, macroscopic and culture sensitivity analyses of stool samples	K4,K5
CO5	Make use of scientific knowledge on specimen collection and examination of sputum and semen sample analyses	K2,K3,K4

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

## Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	L	S
CO2	S	L	S	-	S
CO3	S	L	S	L	S
CO4	S	L	S	L	S
CO5	S	L	S	L	S

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper – Clinical Lab Technology

### 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:

3. Sood, R, 2010. Medical Laboratory Technology – Methods and interpretations – Seventh edition, Jaypee, New Delhi.
4. 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

1.Dr.M.Karthikeyan

### Course contents and lecture schedule

Unit	Topic	No of lecture hrs.
1.1	Laboratory management – Biosafety in containment laboratory	2
1.2	Personal hygiene for Laboratory Technologists	2
1.3	National and International GLP and GMP	2
1.4	Accidents - types and safety measures	1
1.5	Normal flora of human systems – skin	1
1.6	Normal flora of human systems – respiratory tract	1
1.7	Normal flora of human systems – gastrointestinal tract	1
1.8	Normal flora of human systems – genitourinary tract	1
1.9	Nosocomial infections	1
1.10	Nucleic acid based microbial diagnostic techniques – LCR, NASBA and QBRDA.	2

1.10	Biomedical waste management	1
2.1	Collection and processing of blood sample	1
2.2	Determination of TC, DC, ESR, Hb, BT & CT.	3
2.3	ABO Blood group system and determination of blood group.	2
2.4	Blood transfusion and Compatibility testing	1
2.5	Determination of blood glucose,	1
2.6	Determination of blood Urea	1
2.7	Determination of blood Cholesterol	1
2.8	Determination of Bilirubin.	1
2.9	VDRL	1
2.10	Widal test	1
2.11	Blood culture and sensitivity	2
3.1	Collection, transport and Storage of Urine sample	2
3.2	Physical properties of Urine.	2
3.3	examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies	5
3.4	Microscopic Examination of Urine – Cast Crystals and Cells.	2
3.5	Pregnancy Test	2
3.6	Urine culture and sensitivity.	2
4.1	Collection and transport of stool sample.	3
4.2	Macroscopic and Microscopic examination of stool.	3
4.3	Chemical examination of stool.	3
4.4	Stool Culture and sensitivity	3
4.5	Occult blood and its clinical significance	3
5.1	Collection and transport of sputum specimen.	2
5.2	Macroscopic and Microscopic examination of sputum-AFB staining.	5
5.3	Sputum culture and sensitivity.	2
5.4	Collection of semen	2
5.5	Semen analysis – motility, total count and abnormality	4
<b>Total</b>		<b>75</b>

**THIAGARAJAR COLLEGE, MADURAI- 9**  
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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C33	<b>Genetic Engineering</b>	Core-9	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

**Preamble**

Genetic engineering reveals various gene manipulation methods and its application

**Prerequisite**

Be aware of the principles behind the genetic engineering and to reveal various methods of gene manipulation

**Course Outcomes**

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
<b>CO1</b>	Explain to the principles behind the restriction and modification methods	<b>K1,K2,K5</b>
<b>CO2</b>	Recall and make use of various cloning methodologies, genomic library construction and blotting techniques	<b>K1, K2, K3</b>
<b>CO3</b>	Present/ List an in-depth knowledge of PCR and sequencing methods	<b>K3,K4</b>
<b>CO4</b>	Interpret and defend the cloning techniques of various bacteria and yeast	<b>K2,K5</b>
<b>CO5</b>	Explain the importance of transposition, plant genetic engineering and gene silencing	<b>K3,K4,K5</b>

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

**Mapping of COS with PSOs**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	-	L	M	S
<b>CO2</b>	S	L	L	M	S
<b>CO3</b>	S	L	M	M	S
<b>CO4</b>	S	L	M	M	S
<b>CO5</b>	S	L	M	M	S

S- Strong M -Medium L-Low



## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the Paper : Genetic Engineering

### 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 –  $\alpha$  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. David, N., C.Sabine and Y.J. Delnatte, 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
3. Hammon, J., P. Mc Garvey and V.Y. Springer, 2000. Plant Biotechnology.
4. Krebs, J.E., E.S. Goldstein and S.T. Kilpatrick 2009. Lewin's Gene X Jones & Bartlett Publishers, Boston.
5. Old, R.W. and S.B. Primrose, 1996. Principles of Gene Manipulations, Blackwell Science Publications, London.
6. Primrose, S.B. and R.M. Twyman, 2009. Principles of Gene manipulation and Genomics, Seventh Edition, Blackwell publishing, UK.
7. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
8. Symonds, N., A. Toussaint., P. Van De Putte and M.M. Howe, 1987. Phage Mu. Cold Spring Harbor Laboratory.
9. Talwar, G.P., K.V.S. Rao and V.S. Chauhan, 1994. Recombinant and Synthetic Vaccines, Narosa Publishing House, New Delhi.
10. Thieman, W.J. and M.A. Palladino, 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
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. Winnaker, E.L. 1987. From Gene to Clone: Introduction to Gene Technology, VCH Publications, Weinheim Federal Republic German.
13. Young, M.M. 1992. Plant Biotechnology, Pergmen Press, Oxford London.

### Course Designers:

1. Dr. S. Padmavathy

### Lecture Schedule

S.No.	Topics	No. of Lecture Hours
1.1	Restriction and modification in bacteria - <i>E. coli</i> K & B system.	2
1.2	Restriction enzymes – nomenclature, classification, Type I, II and III and applications.	2
1.3	DNA modifying enzymes – nucleases – polymerases, ligases	2
1.4	Cloning vectors – plasmids, cosmids, phasmids, phagemids,	4
1.5	Expression vectors, plasmid vectors – pBR322 and pUC18	3
1.6	Integrating shuttle vectors - YAC vectors	2
2.1	Cloning methodologies – $\alpha$ complementation, sticky and blunt end	2

	cloning	
2.2	Cloning from mRNA – synthesis of cDNA, cloning cDNA in plasmid and phage vectors – cDNA libraries.	2
2.3	Cloning from genomic DNA – genomic library.	2
2.4	Shot gun cloning.	1
2.5	Screening of recombinant – phenotypic expression of characters	2
2.6	Blotting techniques - Western,Northern and Southern.	2
2.7	Physical mapping of cloned genes – restriction mapping	2
2.8	Human Genome Project	2
3.1	PCR – gene amplification, primer designing, optimization	2
3.2	Variation in the PCR (RAPD, RFLP, RACE, RT-PCR)	3
3.3	DNA sequencing – Sanger – Coulsen’s method, Maxam Gilbert’s method. Using computers for DNA sequence analysis.	3
3.4	Microbial genomics – whole genome shotgun sequencing	3
3.5	General characteristics of microbial genome	2
3.6	Structural genomics – proteomics.	2
4.1	Cloning of human insulin, interferon	3
4.2	Somatostatin in <i>E.coli</i> .	3
4.3	Human Antibody Production by r-DNA Technology	3
4.4	Recombinant vaccine development - HBs Ag in yeast.	2
4.5	Cloning for commercial production of antibiotics (Penicillin).	2
4.6	Chymosin (Rennin) in <i>E.coli</i> and yeast	2
5.1	Transposable elements – Is elements, Mechanism of Transposition – Conservative and Replicative	2
5.2	Gene silencing and antisense technology: Types and mechanism of gene silencing.	2
5.3	Gene silencing in crop plants: tomato and rice.	1
5.4	Si RNA and disease control.	2
5.5	Plant genetic engineering: Ti plasmid	2
5.6	DNA delivery to plant cells – microprojectile bombardment, microinjection, electroporation and pollen tubes	2
5.7	Gene therapy	2
5.8	Genome Editing – CRISPR	2

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CL32	Lab in Genetic Engineering	Core lab 6	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	40	60	100

**Preamble**

Genetic engineering reveals various gene manipulation methods and its application

**Prerequisite**

Aware of the principles behind the genetic engineering and to reveal various methods of gene manipulation

**Course Outcomes**

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Explain and demonstrate nucleic acid separation techniques	K2, K5
CO2	Analyze the restriction endonuclease activity	K3,K4
CO3	Spell the principles for gene regulation in prokaryotic and eukaryotic cells	K1, K5
CO4	Make use of modern gene technologies are used to elucidate genetic issues	K3
CO5	Appraise Mendelian genetics, family tree, gene cloning, restriction endonucleases, DNA-sequencing, PCR	K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

**Mapping of COS with PSOs**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	M	S
CO2	M	S	L	L	-
CO3	M	-	M	S	L
CO4	S	S	S	S	M
CO5	-	L	-	M	M

S- Strong M -Medium L-Low

## **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.

## **Course Designers:**

**1.Dr.S.Padmavathy**

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB 19C41	<b>Bioprocess Technology</b>	Core-1o	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	25	75	100

**Preamble**

Bioprocess technology reveals the fundamental principles of upstream and downstream process of microbial fermentation.

**Prerequisite**

Basic knowledge and understanding on the principles involved in the industrial production of microbial products

**Course Outcomes**

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level ( Bloom’s Taxonomy)
<b>CO1</b>	Infer the basic principles of bioprocess technology like strain development and preservation techniques	<b>K1,K2</b>
<b>CO2</b>	Summarize and apply the different methods of fermentation and various designs of fermentors	<b>K2,K3</b>
<b>CO3</b>	Explain the several media based on optimization technique and secure a wide view on fermentation kinetics	<b>K2,K5</b>
<b>CO4</b>	Simplify a diverse knowledge on the production of different fermentation products	<b>K4</b>
<b>CO5</b>	Elaborate the fundamental concepts of downstream processes involved in fermentation	<b>K4,K5</b>

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

**Mapping of COS with PSOs**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	-	M	L	S
<b>CO2</b>	S	L	L	-	S
<b>CO3</b>	S	M	M	L	S
<b>CO4</b>	S	M	M	L	S
<b>CO5</b>	S	S	M	-	S

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Bioprocess technology

### 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, N<sub>2</sub> 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 (B<sub>12</sub>, 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 (B<sub>12</sub>), 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 Bioseperation Vol.V., John Wiley and Sons Publications.
6. Patel, A.H., 1996, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.
7. Peppler, 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 Designers:

1. Mr.S.Kulandaivel

### Lecture Schedule

	Topic	No of lecture hrs.
1.1	General concepts of industrial microbiology	3
1.2	Isolation of productive strains-screening technique - primary and secondary.	3
1.3	Strain development – mutation, protoplast fusion and recombinant DNA techniques.	3
1.4	Preservation techniques - serial sub-culture, mineral oil, freeze drying, N <sub>2</sub> storage.	3
1.5	Preservation techniques - Storage of fungi- soil culture, silcagel culture and water storage	3
2.1	Types of fermentation	1
2.2	solid state fermentation-types of substrates	3



2.3	Submerged fermentation. Methods of fermentation-batch continuous and fed batch system.	3
2.4	Types and design of fermentors-batch, CSTF, air lift, tower, bubble column, fluidized bed fermentor	3
2.5	Fermentor auxiliary equipment.	2
2.6	Sterilization of equipment and air	3
3.1	Introduction to Media-chemical composition	1
3.2	Raw materials - saccharide, starchy, cellulose and industrial wastes.	2
3.3	Media optimization and sterilization (batch and continuous).	2
3.4	Fermentation kinetics-Batch and continuous.	3
3.5	Inoculum development- Bacterial, fungal spores, fungal mycelium	3
3.6	Immobilization of cells and enzymes	2
3.7	Immobilization methods and application.	2
4.1	Introduction to Fermentation of microbial products	1
4.2	Anaerobic fermentation (Beer, wine, alcohol)	3
4.3	Aerobic fermentation (Vinegar, citric acid), Amino acid (lysine, glutamic acid),	3
4.4	Aerobic fermentation Antibiotics (Penicillin, Streptomycin), Enzymes (Amylase, Protease),	3
4.5	Aerobic fermentation Vitamins (B <sub>12</sub> , Riboflavin),	3
4.6	Aerobic fermentation hormones (Gibberlic acid and Indole acetic acid)	2
5.1	Downstream processing - cell disruption-physical and chemical methods.	2
5.2	Separation- precipitation, filtration, centrifugation	2
5.3	Liquid-liquid extraction, chromatography, drying and crystallization.	3
5.4	Microbial assay of vitamin (B <sub>12</sub> ), Amino acid (valine),	2
5.5	Microbial assay Antibiotics (Streptomycin, erythromycin).	2
5.6	Fermentation economics-Process cost, recovery cost,	2
5.7	Fermentation economics – Market potential and cost benefit ratio	2

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CL41	Lab in Bioprocess Technology	Core Lab-7	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	40	60	100

### Preamble

Bioprocess technology reveals the principles of upstream and downstream process of microbial fermentation.

### Prerequisite

Basic knowledge on the principles involved in the industrial production of microbial products

### Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Discuss/demonstrate the important aspects in bioprocess technology for commercialization purpose of biotechnology products	K1,K2
CO2	Analyze the mass transfer and material balance calculation in different types of application in bioprocess	K3,K4
CO3	Infer the kinetics parameter values in different types of fermentation process	K4,K5
CO4	Apply fundamental calculation in bioprocessing	K2,K3
CO5	Illustrate the schematic diagram of upstream and downstream processing for product recovery and purification	K3,K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	L	S
CO2	S	S	S	L	S
CO3	S	S	S	L	S
CO4	S	M	M	L	S
CO5	S	S	S	L	S

S- Strong M -Medium L-Low

## **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. Janarthanam 2012. Practical Manual on Fermentation Technology. I.K. International Publishing house. New Delhi.
5. Pepler,H,J and Periman,D. 2008.Microbial Technology Fermentation Technology, (Two Volumes )Second Edition, Elsevier, Academic Press.U.K.

## **Course Designers:**

1. Mr.S.Kulandaivel

**THIAGARAJAR COLLEGE, MADURAI- 9**  
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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C42	<b>Food &amp; Agriculture Microbiology</b>	Core - 11	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	25	75	100

### Preamble

Food and agricultural microbiology constitutes important part in the field of applied biological science, food industry and agriculture.

### Prerequisite

Understanding on the interrelationships of microorganisms with foods, their role in food spoilage and the role of microbes in plant growth

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level ( Bloom's Taxonomy)
<b>CO1</b>	Familiarize with the methods for the production of fermented dairy products, food spoilage and pathogenic microorganisms responsible	<b>K1,K2</b>
<b>CO2</b>	Make use of the knowledge about the food preservatory methods to overcome the food intoxication and poisoning	<b>K3,K4</b>
<b>CO3</b>	Explain plant and microbial interactions and their respective outcoming diseases	<b>K2,K5</b>
<b>CO4</b>	List the importance of biofertilizers towards field application and their respective production methods	<b>K1,K3,K4</b>
<b>CO5</b>	Importance of biopesticides over chemical pesticides and their production methods using several microbes	<b>K5</b>

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>-</b>	<b>S</b>
<b>CO2</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>L</b>	<b>S</b>
<b>CO3</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>L</b>	<b>S</b>
<b>CO4</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>-</b>	<b>S</b>
<b>CO5</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>-</b>	<b>S</b>

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Food & Agriculture Microbiology

### 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.

**Text Books:**

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.Mrs.V.Ananthi**

**Lecture Schedule**

	<b>Topic</b>	<b>No of lecture hrs.</b>
1.1	Production of fermented dairy products: Cheese,	1
1.2	Production of fermented dairy products: yoghurt	1
1.3	Production of fermented dairy products: butter milk.	1
1.4	Fermented vegetables; Sauerkraut	1
1.5	Fermented vegetables; pickles	1
1.6	Fermented vegetables; soy sauce.	1
1.7	Fermented meat	1
1.8	Fermented Indian foods - leavening of bread	1
1.9	Food spoilage: Spoilage of fruit and vegetables,	2
1.10	cereal and cereal products,.	1
1.11	Meat and meat products	1
1.12	milk and milk products	1
1.13	Food borne diseases – food intoxications & food poisoning	1
1.14	Microbes as food (Probiotics) – Potential and therapeutic applications.	1
2.1	Food preservation – principle, Methods - physical – asepsis,	7

	high temperature, low temperature, drying, radiation, canning, controlled atmosphere;	
2.2	chemical preservatives- organic acids and their salt, nitrites, sulfur dioxide, sulfites, sugar, salt and oxidizing agents.	5
2.3	Food Inspection – Hazard Analysis Critical Control point.	3
3.1	Transmission of plant pathogens, mechanism of microbial pathogenicity, factors affecting disease incidence. Bacteria – <i>Xanthomonas malvacearum</i> (Cotton blight),	2
3.2	Transmission of plant pathogens, mechanism of microbial pathogenicity, factors affecting disease incidence. Bacteria – <i>Xanthomonas citri</i> (Citrus canker).	2
3.3	Fungi – <i>Ustilago maydis</i> (Smut rust of Corn)	2
3.4	Fungi - <i>Cercospora arachidicola</i> (Tikka disease of groundnut).	2
3.5	Virus – DNA virus (Bhendi yellow vein clearing virus),	2
3.6	RNA virus – (Cucumber mosaic virus).	2
3.7	Phytoplasma – Brinjal little leaf	2
3.8	Phytoplasma –seasamum phyllody.	1
4.1	<b>Biofertilizers:</b> General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: Nitrogenous Bacteria - ( <i>Rhizobium</i> )	2
4.2	<b>Biofertilizers:</b> General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: Nitrogenous Bacteria-( <i>Frankia</i> )	2
4.3	<b>Biofertilizers:</b> General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: Nitrogenous Bacteria –( <i>Azotobacter</i> ),	2
4.4	<b>Biofertilizers:</b> General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: <i>Cyanobacteria</i> ( <i>Nostoc</i> & <i>Anabaena</i> ).	2
4.5	<b>Biofertilizers:</b> General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: -AM.	3
4.6	Mechanism of phosphate solubilization and phosphate mobilization.	2
4.7	Storage, shelf life, quality control and marketing of Biofertilizers. Biomanures	2
5.1	<b>Biopesticides:</b> Bacterial pesticides: <i>Bacillus thuringiensis</i> .	3
5.2	<b>Biopesticides:</b> Bacterial pesticides: <i>Pseudomonas</i> .	3
5.3	<b>Biopesticides:</b> Viral Pesticides: Nuclear Polyhedrosis virus..	3
5.4	<b>Biopesticides:</b> Fungal pesticides: Entomopathogenic fungi - <i>Beaveria bassiana</i> .	3
5.5	<b>Bioherbicides</b> - Integrated weed management.	3

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc., Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CL42	<b>Lab in Food, Agriculture and Environmental Microbiology</b>	Core lab7	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	40	60	100

### Preamble

Food and agricultural microbiology implies in the field of applied biological science, food industry and agriculture.

### Prerequisite

Understanding the interrelationships of microorganisms in foods environment and agriculture products, their role in food spoilage , soil fertility and in plant growth

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level ( Bloom’s Taxonomy)
<b>CO1</b>	Define the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in food	<b>K1,K2</b>
<b>CO2</b>	Explain the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage	<b>K2,K5</b>
<b>CO3</b>	Analyse the methods used in agriculture to control disease in plant	<b>K4,K5</b>
<b>CO4</b>	Experiment with microbial ecology and its interaction	<b>K3,K4,K5</b>
<b>CO5</b>	Appraise the metabolic processes of microorganisms, role of bacteria in environment and industrial processes	<b>K4,K5</b>

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	<b>S</b>	<b>M</b>	<b>M</b>	<b>-</b>	<b>S</b>
<b>CO2</b>	<b>S</b>	<b>M</b>	<b>M</b>	<b>-</b>	<b>S</b>
<b>CO3</b>	<b>S</b>	<b>M</b>	<b>M</b>	<b>-</b>	<b>S</b>
<b>CO4</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>L</b>	<b>S</b>
<b>CO5</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>L</b>	<b>S</b>

S- Strong M -Medium L-Low



## Title of the paper : Lab in Food & Agriculture 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.

## Course Designers:

1. Mrs.V.Ananthi

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 C43	<b>Environmental Microbiology</b>	Core-1	4	1	-	4

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	25	75	100

### Preamble

To impart knowledge on impact of microorganisms in different environmental regimes. This course would also able to study the relationship between microbes and nature its role in the maintenance of sustainable environment.

### Prerequisite

Basic knowledge on environmental science, microbiology and pollutants

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level (Bloom's taxonomy)
CO1	List the role and impact of microbes in different environments	K1, K2
CO2	Develop theoretical knowledge about the microbial ecology and their interactions	K2 K3
CO3	Examine and explain the role of microbes in biogeochemical process in different ecosystems.	K4, K5
CO4	Interpret theoretical and practical knowledge on waste treatment techniques.	K4, K5
CO5	Determine the role and application of microorganisms in pollution control	K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 – Evaluate

### Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	M
CO2	S	S	M	M	-
CO3	L	M	S	M	M
CO4	M	S	M	L	-
CO5	S	S	M	L	-

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper - Environmental Microbiology

### 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. Blackie Glasgow and London.
3. Vaun Mc Arthur J, 2009. Microbial Ecology-An Evolutionary approach, Elsevier 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.Mr.S.Kulandaivel 2.Dr.S.Padmavathy 3.Mrs.V.Ananthi 4.Dr.M.Karthikeyan**

**Lecture Schedule**

	<b>Topic</b>	<b>Lecture hrs.</b>
1.1	Historical view and scope of microbial ecology.	2
1.2	Atmo–Ecosphere – Characteristics and stratification of atmosphere, atmosphere as habitat and medium for microbial dispersal, microorganisms in atmo-ecosphere.	4
1.3	Hydro-Ecosphere – Fresh water habitats, composition and activity of fresh water microbial communities	4
1.4	marine habitats, characteristics and stratification of the ocean, composition and activity of marine microbial communities – rocks, soil.	4
1.5	Litho–Ecosphere – Deep subsurface microbiology, determining soil texture and humic acid characteristics.	3
2.1	Microbial interactions within the community – positive & negative interactions:	2
2.2	Symbiosis	2
2.3	Amensalism	1
2.4	Commensalisms	2
2.5	Predation	2
2.6	parasitism	2

2.7	Competition	2
2.8	Population within biofilms	2
3.1	Biogeochemical cycling – nitrogen cycle (ammonification, nitrification, nitrate reduction and denitrification),	3
3.2	Biogeochemical cycling –carbon	2
3.3	Biogeochemical cycling –hydrogen	1
3.4	Biogeochemical cycling –oxygen	2
3.5	Biogeochemical cycling -sulfur,	1
3.6	Biogeochemical cycling- phosphorus.	2
3.7	Biogeochemical cycling –iron	1
3.8	Winogradsky column.	2
4.1	Waste treatment- types of wastes	1
4.2	characteristics of solid and liquid wastes	2
4.3	Treatment of solid wastes - composting and vermiform composting	4
4.4	Treatment of liquid wastes - primary, secondary (trickling filter, activated sludge, oxidation pond, oxidation ditch) and tertiary treatment	5
4.5	Eutrophication.	2
5.1	Microbial remediation – phenolics	2
5.2	Microbial remediation –metals	2
5.3	Microbial remediation -sewage nutrients (phosphate and nitrate)	2
5.4	Microbial remediation - xenobiotics.	2
5.5	Microbial leaching of ores.	2
5.6	Microbial deterioration – paper	1
5.7	Microbial deterioration - leather	1
5.8	Microbial deterioration – wood	1
5.9	Microbial deterioration - paint	1
5.10	Microbial deterioration – textile	1
<b>Total</b>		<b>75</b>

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 PJ41	<b>Project</b>	Elective4	-	-	5	3

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	40	60	100

### Preamble

Expose to collect and read literature pertaining to their project work. Train the students to do lab exercise individually under the guidance of their project guide

### Prerequisite

Basic knowledge on the Laboratory techniques related to Life Sciences .Interpretation of data using statistical tools

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Level
<b>CO1</b>	Collect and analyse the scientific literature from web resources	K1,K2
<b>CO2</b>	Explain the theoretical basis of the tools, technologies and methods common to microbiology;	K2,K5
<b>CO3</b>	Demonstrate practical skills in the use of tools, technologies and methods common to microbiology,	K3,K4
<b>CO4</b>	Apply the scientific method and hypothesis testing in the design and execution of experiments.	K3
<b>CO5</b>	Construct a summative project or paper that draws on current research, and/or techniques in life sciences.	K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	-	S	S
<b>CO2</b>	S	-	S	S	M
<b>CO3</b>	S	L	-	S	S
<b>CO4</b>	S	S	-	S	M
<b>CO5</b>	S	S	-	S	S

S- Strong M -Medium L-Low

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**  
 (For those joined M.Sc Microbiology on or after June 2019)  
 Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CE1	Microbial Diversity & Taxonomy	Elective	5	-	-	5

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First/Second	First/Second/Third	25	75	100

### Preamble

Microbial Diversity and Taxonomy deals with the origin of microbial world and their classification under different taxa

### Prerequisite

Awareness on the evolution, diversity, taxanomy of microbial communities

### Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Demonstrate broad view on the evolution of different biomolecules and microbes	K1,K2
CO2	Explain the features and diversity of archaebacteria	K2,K5
CO3	Compare the diversity, characteristics and significance of Photosynthetic microbes	K3,K4
CO4	Distinguish the microbes based on their morphological characters	K3,K4
CO5	Evaluate /Be acquainted with significance of nitrogen fixing microbes	K4,K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	S
CO2	S	S	S	L	S
CO3	S	S	S	-	S
CO4	S	S	S	-	S
CO5	S	S	S	-	S

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Microbial Diversity & Taxonomy

### Unit I

Microbial evolution – evolution of early life forms, RNA world, energy and carbon metabolism, origin of eukaryotes, evolutionary chronometers, diversity indices, dominant indices. Community similarity analysis – Jaccard coefficient, cluster analysis, community stability, theories of succession, molecular adaptation of extremophiles. Characteristics of microorganisms - Morphological, chemical, cultural, metabolic, antigenic, genetic, pathogenicity and ecological. Microbial classification, nomenclature and identification.

### UnitII

Salient features of archaea and bacteria. Diversity, characteristic features and significance of *Thermoproteus*, *Desulfococcus*, *Methanobacterium*, *Methanococcus*, *Methanosarcina*, *Halobacterium*, *Thermoplasma*, *Pyrococcus*.

### UnitIII

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

### Lecture Schedule

S.No.	Topics	No. of Lecture hours
1.1	Microbial evolution – evolution of early life forms, RNA world, energy and carbon metabolism	3
1.2	Origin of eukaryotes, evolutionary chronometers, diversity indices, dominant indices.	3
1.3	Community similarity analysis – Jaccard coefficient, cluster analysis, community stability, theories of succession, molecular adaptation of extremophiles.	3
1.4	Characteristics of microorganisms - Morphological, chemical, cultural, metabolic, antigenic, genetic, pathogenicity and ecological.	3
1.5	Microbial classification, nomenclature and identification	3
2.1	Salient features of archaea and bacteria. Diversity, characteristic features and significance of <i>Thermoproteus</i>	2
2.2	<i>Desulfococcus</i>	2
2.3	<i>Methanobacterium</i>	2
2.4	<i>Methanococcus</i>	2
2.5	<i>Methanosarcina</i>	2
2.6	<i>Halobacterium</i>	2

2.7	<i>Thermoplasma</i>	2
2.8	<i>Pyrococcus</i>	1
3.1	Diversity, characteristic features and significance of <i>Aquifex</i>	2
3.2	<i>Thermotoga</i>	2
3.3	<i>Deinococcus</i>	2
3.4	<i>Chloroflexus</i>	2
3.5	<i>Heliothrix</i>	2
3.6	<i>Synechococcus</i>	2
3.7	<i>Myxosarcina</i>	1
3.8	<i>Pseudoanabena</i>	1
3.9	<i>Chlorobium</i>	1
4.1	Diversity, characteristic features and significance of <i>Acetobacter</i>	2
4.2	<i>Achromobacter</i>	2
4.3	<i>Bdellovibrio</i>	2
4.4	<i>Bifidobacterium</i>	2
4.5	<i>Brevibacterium</i>	2
4.6	<i>Arthrobacter</i>	2
4.7	<i>Caulobacter</i>	2
4.8	<i>Cytophaga</i>	1
5.1	Diversity, characteristic features and significance of <i>Actinomadura</i>	2
5.2	<i>Jathinobacterium</i>	2
5.3	<i>Nitrosomonas</i>	2
5.4	<i>Propionibacterium</i>	2
5.5	<i>Photobacterium</i>	2
5.6	<i>Phyllobacterium</i>	2
5.7	<i>Saccharococcus</i>	1
5.8	<i>Vitreoscilla</i>	1
5.9	<i>Verrucomicrobium</i>	1

**THIAGARAJAR COLLEGE, MADURAI- 9**  
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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CE2	<b>Biological Techniques</b>	Elective	5	-	-	5

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First/Second	First/Second/Third	25	75	100

### Preamble

Biological techniques deals with the principles and applications of classical and modern techniques used in biology

### Prerequisite

Basic knowledge on the principles and applications of classical and modern techniques in Biology.

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Explain the principles and types of microscopes	K1,K2,K5
CO2	Analyse and Appraise the applicatory views on various spectrophotometers	K4, K5
CO3	Spell the importance on radioisotopes and radioactivity	K1,K2,K3
CO4	Summarize and Utilize the different separation techniques on biomolecules	K2, K3
CO5	Interpret the importance commonly employed electrophoretic techniques	K4,K5

K1 – Knowledge      K2 – Understand      K3 – Apply      K4 – Analyse      K5 – Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	S
CO2	S	M	M	L	S
CO3	S	M	M	L	S
CO4	S	M	M	L	S
CO5	S	M	M	L	S

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Biological Techniques

### 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)

## Text Books:

1. Kothari, C.R., 1988. Research methodology, Wiley Eastern Ltd., New Delhi.
2. Irfan A. Khan and Atiya Khanum, 1994. Fundamental of Biostatistics, Ukaaz publishers, India.

## Reference 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. Anderson, J., Durosn, B.H. and Poole, M. 1986. Thesis and assignment writing, Wiley Eastern Ltd., New Delhi.

## Course Designers:

1.Mr.S.Kulandaivel

## Lecture Schedule

	Topic	No of lecture hrs.
1.1	Microscopy: light microscope - basic principles, types.	3
1.2	phase contrast,	2
1.3	dark field polarizing	2
1.4	fluorescent microscope	2
1.5	Electron microscopy - principles, working function and application of TEM	2
1.6	Electron microscopy - principles, working function and application of SEM,	2
1.7	Principles and uses- Camera Lucida	2
2.1	Spectrophotometry: principles and working function and application of UV spectrophotometers -single beam, double beam,	3
2.2	Atomic absorption spectrophotometer	3
2.3	IR	2
2.4	NMR	2
2.5	Flame photometer	3
2.6	pH meter	2
3.1	Radioactivity: nature of radioactivity	2
3.2	types of radioisotopes	2
3.3	half-life	2
3.4	Unit of radioactivity,	2
3.5	detection and measurements	1
3.6	principles and working function of Geiger Muller	2
3.7	liquid scintillation counter	2
3.8	X-ray diffraction	2
4.1	Chromatography - Principle, types and working function and	1

	application -Paper chromatography,	
4.2	Chromatography - Principle, types and working function and application - ion exchange chromatography,	1
4.3	Chromatography - Principle, types and working function and application –Thin layer chromatography	1
4.4	Chromatography - Principle, types and working function and application –GC	1
4.5	Chromatography - Principle, types and working function and application –GC-MS.	1
4.6	Centrifugation: Basic principles, sedimentation coefficient, centrifugal forces.	2
4.7	Types of centrifuges – clinical	1
4.8	Types of centrifuges – high speed	1
4.9	Types of centrifuges – refrigerated	1
4.10	Types of centrifuges – ultra	1
4.11	Types and applications of centrifugation - rotar types, density gradient, differential centrifugation.	4
5.1	Electrophoresis - Principle, types and application of Agarose electrophoresis (Horizontal)	3
5.2	Electrophoresis - Principle, types and application of Agarose electrophoresis (vertical)	3
5.3	Pulse Field gel electrophoresis (PFGE).	3
5.4	Gel documentation	2
5.5	Sonicator	1
5.6	Lyophilizer (freeze dryer)	3

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**DEPARTMENT OF ZOOLOGY**  
 (For those joined M.Sc Microbiology on or after June 2019)  
 Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CE3	Forensic Science	Elective	5	-	-	5

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First/Second	First/Second/Third	25	75	100

### Preamble

To impart knowledge on the biological aspects of forensic science and its applications. This course would also able to provide the comprehend the computational analyses of the biological components in crime scene investigation.

### Prerequisite

Basic knowledge on chemistry, biology and informatics.

### Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level Bloom's Taxonomy)
CO1	Demonstrate the competency in the collection, processing, analyses, evaluation and documentation evidences.	K1, K2, K3
CO2	Prove the competency in the principles of crime scene investigation and documentation.	K3, K4,K5
CO3	Appraise the significance of techniques involved in forensic microbiology.	K4, K5
CO4	Evaluate the importance of biological databases and protein structure prediction.	K4,K5
CO5	Analyse on drug designing and genomic techniques	K4,K5

K1 – Knowledge    K2 – Understand    K3 – Apply    K4 – Analyse    K5 - Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	S	S	S	M
CO2	-	-	S	S	S
CO3	S	M	S	M	M
CO4	M	-	S	S	S
CO5	-	L	L	M	M

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Forensic Science

### 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, 2<sup>nd</sup> 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 Designers:

1. Mr. S. Kulandaivel

### Lecture Schedule

	Topic	No of lecture hrs.
1.1	Introduction to forensic Science	1
1.2	Organization and functions of Forensic laboratory	1
1.3	Physical evidences - their classification and significance -	3
1.4	Crime Scene examination and documentation	1
1.5	collection, preservation and transportation of physical evidence for laboratory examinations	3
1.6	Fundamentals of crime scene photography	2
1.7	Tool marks identification and restoration of field off/erased marks	2
2.1	Foot and tyre examinations and types	3
2.2	Finger print classification and classification	2
2.3	Toxicology-mode of action of drugs, poisons and alcoholic beverages	3
2.4	Examination of biological fluids	2
2.5	Forensic characterization blood stains and patterns	3
2.6	Examination of fibres, hair, bones, teeth and skull	2
2.7	Fundamental of DNA typing	2
3.1	Types and identification of microorganisms-bacteria and fungi of forensic significance,	
3.2	Types and identification of microorganisms-bacteria and	2

	fungi of forensic significance,	
3.3	Bioterrorism- Types of biological agents – Category A, B, C.	3
3.4	Planning and response to bioterrorism	3
3.5	Epidemiology of Bioterrorism	1
3.6	Study of spore, powdered minerals and pollens of forensic importance	3
3.7	Use of pollen grains & spores in criminal or civil investigation	3
4.1	Introduction – Bioinformatics and databases – sequence, structure & domain, application and scope.	2
4.2	Biological databases: Nucleotide sequence databases	2
	protein databases – specialized sequence data bases.	2
	Topic	No of lecture hrs.
4.3	Data retrieval and analysis	1
4.4	Sequence alignment: Types - local and global alignment	2
4.5	Alignment methods – pair wise sequence alignment: FASTA and BLAST.	3
4.6	Introduction to ORF and primer designing.	1
4.7	Secondary structure prediction- GOR and Chou-fasman method	2
5.1	Multiple sequence alignment – methods and softwares	2
5.2	Clustal W, Multalign – phylogenetic analysis.	3
5.3	Homology modeling - SPDB viewer	1
5.4	Ramachandran plot for evaluation of predicted structure	1
5.5	Drug designing and docking analysis	1
5.6	Sturcture visualization tool-RASMOL	1
5.7	Genomics-scope and applications	2
5.8	Structural,comparative and functional genomics	2
5.9	Microarray technology	2

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**DEPARTMENT OF ZOOLOGY & MICROBIOLOGY**  
 (For those joined M.Sc Microbiology on or after June 2019)  
 Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CE4	Cell Biology	Elective	5	-	-	5

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First/Second	First/Second/Third	25	75	100

### Preamble

Cell biology explains the fundamental concepts of cell organelles and its function.

### Prerequisite

Key knowledge on the importance of cell organelles and their role in different cell communication and signaling mechanisms

### Course outcomes

On the completion of the course the student will be able to

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Understand the fundamentals of cell structures and organelles	K1,K2
CO2	Explore the role of cell organelles and transport of biomolecules	K1,K2
CO3	Become familiar with cell signaling and its regulations	K1,K2
CO4	Secure a wide knowledge on cell communication and quorum sensing	K1,K3,K4
CO5	Gather an extempore knowledge on different phases of cell cycle	K1,K2,K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

### Mapping of COs with POs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	L	-
CO2	S	M	L	-	-
CO3	S	M	-	L	-
CO4	M	S	L	L	L
CO5	S	M	-	L	L

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Cell Biology

### 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 $\beta$  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**

**Dr.S.Padmavathy**

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**DEPARTMENT OF ZOOLOGY**

(For those joined M.Sc Microbiology on or after June 2019)

Programme Code :PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB19 CE5	<b>Biostatistics</b>	Elective	5	-	-	5

L - Lecture

T – Tutorial

P – Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
First/Second	First/Second/Third	25	75	100

### Preamble

Biostatistics deals with the statistical analysis of different biological data and its interpretation. The goal of the elective course in Biostatistics is to prepare students to comprehend, develop and apply, quantitative and qualitative techniques in mathematics, statistics, and computing to handle biological data collection and analysis.

### Prerequisites

A basic knowledge on biology and mathematics.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Define variability and uncertainty in sampling and data collection	K1
CO2	Categorize the type of variables, summarize the data and construct graphical and diagrammatic representation of data.	K3,K4
CO3	Apply probability principles for setting significance levels and testing hypothesis using statistical tests	K5
CO4	Analyse results of statistical test and interpret experimental conclusion	K4
CO5	Perform basic statistical test using MS-Office Excel at ease and independently	K2,K5

K1 – Knowledge

K2 – Understand

K3 – Apply

K4 – Analyse

K5 - Evaluate

### Mapping of COS with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	L	S	L
CO2	L	S	S	S	L
CO3	L	S	S	M	M
CO4	-	S	M	M	M
CO5	-	M	M	S	M

S- Strong M -Medium L-Low

## Blooms taxonomy

Blooms Taxonomy			
	CA		End of Semester (Marks)
	First (Marks)	Second(Marks)	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Total Marks	<b>60</b>	<b>60</b>	<b>150</b>

## Title of the paper : Biostatistics

### 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 Delh.
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 Designers:**

1. Dr.C.Binu Ramesh
2. Dr.Rm.Murugappan



## M.Sc., Microbiology:

Assessment values of course learning outcomes and their mapping with program specific outcomes (PSOs)

Code	Title of the paper	PSO1	PSO2	PSO3	PSO4	PSO5
PMB19C11	General Microbiology	15	6	8	5	5
PMB19C12	Microbial Biochemistry	15	5	2	11	9
PMB19C13	Microbial Physiology	15	12	4	6	13
PMB19CL11	Lab in General Microbiology, Microbial Diversity and Taxonomy	15	7	12	7	15
PMB19CL12	Lab in Microbial Biochemistry and Physiology	15	8	3	7	14
PMB19C21	Immunobiology	15	7	9	3	9
PMB19C22	Molecular Biology	15	3	2	7	10
PMB19C23	Microbial Genetics	15	5	2	9	10
PMB19CL21	Lab in Immunobiology	15	5	6	3	12
PMB19CL22	Lab in Molecular Biology and Microbial Genetics	15	3	5	7	14
PMB19C31	Medical Microbiology	15	11	9	5	11
PMB19C32	Clinical Lab Technology	15	5	15	4	15
PMB19C33	Genetic Engineering	15	4	8	10	15
PMB19CL31	Lab in Medical Microbiology	15	9	10	5	12
PMB19CL32	Lab in Genetic Engineering	10	8	8	11	18
PMB19C41	Bioprocess Technology	15	8	9	3	15
PMB19C42	Food and Agriculture Microbiology	15	15	15	2	15
PMB19C43	Environmental Microbiology	12	14	12	8	4
PMB19PJ41	Project					
PMB19CL41	Lab in Bioprocess Technology	15	14	14	5	15
PMB19CL42	Lab in Food, Agriculture and Environmental Microbiology	15	12	12	2	15
<b>Core Elective</b>						
PMB19CE1	Microbial Diversity and Taxonomy	15	14	14	2	15
PMB19CE2	Biological Techniques	15	10	10	5	15
PMB19CE3	Forensic Science	5	6	13	13	12
PMB19CE4	Cell biology	14	10	4	4	2
PMB19CE5	Biostatistics	4	12	11	13	8

# **M.Sc. Zoology**

**(Programme Code: PZO)**

## **Programme outcome-PO (Aligned with Graduate Attributes)- Master of Science (M.Sc.,)**

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### **Knowledge**

Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

### **Complementary skills**

Students will be able to engage in critical investigation through principle approaches or methods and through effective information search and evaluation strategies. Employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies;

### **Applied learning**

Students will be able to apply disciplinary or interdisciplinary learning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate;

### **Communication**

Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Able to comprehend and write reports, documents, make effective presentation by oral and/or written form.

### **Problem solving**

Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

### **Environment and sustainability**

Understand the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

### **Teamwork, collaborative and management skills.**

Recognise the opportunities and contribute positively in collaborative scientific research. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**Department of Zoology**

**Vision**

- Render exemplary quality education in Life Sciences and laboratory skills to produce generations of responsible, competent and employable graduates

**Mission**

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching positions in biological sciences.
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, effective oral and written communication abilities for students.
- To create a holistic understanding of the allied subjects through interdisciplinary learning.

**Programme Educational Objectives (PEO)**

The objectives of this programme is to equip/prepare the students

<b>PEO1</b>	Endow with a spirit of resource conservation and love for nature.
<b>PEO2</b>	Explicate the different forms of organisms their structure, physiology and adaptations. Interpret how ecological aspects of biotic and abiotic components are interrelated, their interactions as well as their influence in the functioning of ecosystem.
<b>PEO3</b>	Basics and current updates in the areas of Microbiology, Immunology, Biotechnology, Genetic Engineering are included to train the students and also sensitize them to scope for research.
<b>PEO4</b>	The laboratory training in addition to theory will equip the student for careers in the industry, agriculture, and applied research.
<b>PEO5</b>	Perform functions that demand higher competence in national/international organizations.

**Programme specific outcomes- M.Sc., Zoology**

On the successful completion of M.Sc., Zoology the students will

<b>PO1</b>	Proficient in core concepts, recent trends in different disciplines of life sciences like microbiology, biochemistry, cell and molecular biology, genetics and genetic engineering, evolution, entomology, IPR, bioethics, bioinformatics etc.,
<b>PO2</b>	Explain how organisms function at gene, genome, cell, tissue, organ and organ-system level of organization.
<b>PO3</b>	Possess theoretical basis and practical skills in the use of basic and advanced instruments. Further able to create, select and apply appropriate techniques, resources and modern technology in multi-disciplinary environment.
<b>PO4</b>	Apply theoretical knowledge gained for prominent career and for further academic study.
<b>PO5</b>	Appear for competitive exams like CSIR NET, SET etc and also to write research proposals for grants.

**Thiagarajar College, Madurai – 9**  
**An Autonomous Institution Affiliated to Madurai Kamaraj University**  
**Re-Accredited with ‘A’ Grade by NAAC**  
**M. Sc., Zoology Course Structure (w.e.f. 2019 batch onwards)**  
**Programme code:PZO**

**I semester**

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core1	PZO19 C11	Biological Chemistry & Biophysics	5	4	75	25	75	100
Core2	PZO19 C12	Microbiology	5	4	75	25	75	100
Core3	PZO19 C13	Genetics & Evolution	5	4	75	25	75	100
Core Elective1	PZO19 CE11	Animal Biology	6	4	90	25	75	100
Lab1	PZO19 CL11	Lab in Biological Chemistry and Biophysics	3	2	45	40	60	100
Lab2	PZO19 CL12	Lab in Microbiology	3	2	45	40	60	100
Lab3	PZO19 CL13	Lab in Genetics & Evolution	3	2	45	40	60	100
		<b>Total</b>	<b>30</b>	<b>22</b>				

**II Semester**

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core4	PZO19 C21	Entomology	5	4	75	25	75	100
Core5	PZO19 C22	Cell & Molecular Biology	5	4	75	25	75	100
Core6	PZO19 C23	Bioinstrumentation	5	4	75	25	75	100
Core Elective2	PZO19 CE21	Biostatistics	6	4	90	25	75	100
Lab4	PZO19 CL21	Lab in Entomology	3	2	45	40	60	100
Lab5	PZO19 CL22	Lab in Cell & Molecular Biology	3	2	45	40	60	100
Lab6	PZO19 CL23	Lab in Bioinstrumentation	3	2	45	40	60	100
		<b>Total</b>	<b>30</b>	<b>22</b>				

### III Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core7	PZO19 C31	Genetic Engineering and Biotechnology	5	4	75	25	75	100
Core8	PZO19 C32	Animal Physiology	5	4	75	25	75	100
Core9	PZO19 C33	Developmental Biology	5	4	75	25	75	100
Core Elective3	PZO19 CE31	Applied Zoology	6	4	90	25	75	100
Lab7	PZO19 CL31	Lab in Genetic Engineering and Biotechnology	3	2	45	40	60	100
Lab8	PZO19 CL32	Lab in Animal Physiology	3	2	45	40	60	100
Lab9	PZO19 CL33	Lab in Developmental Biology	3	2	45	40	60	100
		<b>Total</b>	<b>30</b>	<b>22</b>				

### IV Semester

Course	Code	Subject/Paper	Cont Hrs/w	Credit	T.No Hrs	Max Mark CA	Max Mark SE	Total
Core10	PZO19 C41	Immunology	5	4	90	25	75	100
Core11	PZO19 C42	Ecology and Biodiversity	5	4	90	25	75	100
Core 12	PZO19 C43	Bioinformatics	5	4	90	25	75	100
Core Elective 4	PZO19PJ41	Project	6	6	90	50	50	100
Lab10	PZO19 CL41	Lab in Immunology	3	2	45	40	60	100
Lab11	PZO19 CL42	Lab in Ecology & Biodiversity	3	2	45	40	60	100
Lab12	PZO19 CL43	Lab in Bioinformatics	3	2	45	40	60	100
		<b>Total</b>	<b>30</b>	<b>24</b>				

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	4	12
Project	1	6	06
Total			90

**Thiagarajar College, Madurai – 625 009**  
**Department of Zoology**  
 (For those joined M.Sc., Zoology on or after June 2019)  
**Programme code:PZO**

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C11	<b>Biological Chemistry and Biophysics</b>	Core-1	4	1	-	4
Year	Semester	Int. Marks	Ext.Marks		Total	
First	First	25	75		100	

### Preamble

Eloborates the structure and function of biomolecules. Illustrates the metabolic pathways and regulation of biochemical process. Brief about vitamins, enzymes and their regulation.

### Prerequisites

Basic knowledge on the structure and function of biomolecules, metabolic pathways, biochemical processes etc.,

### Course Outcomes

**On the completion of the course the student will be able to**

#	Course Outcome	Knowledge Level
<b>CO1</b>	Summarize the basics of formation of biological compounds and their metabolism.	K2
<b>CO2</b>	Explain and analyze the biosynthesis pathways and structural conformations of nucleic acids and proteins.	K2,K4
<b>CO3</b>	Interpret fat metabolism and their importance.	K5
<b>CO4</b>	Categorize vitamins, Discuss their structure & function of vitamins and enzyme kinetics	K4
<b>CO5</b>	Perceive a holistic knowledge on reactions involved in cellular energy synthesis and their application of thermodynamic laws.	K2,K3

**K1: Knowledge K2: Understand K3: Apply K4:Analyze K5: Evaluate**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	<b>M</b>	<b>S</b>	<b>---</b>	<b>L</b>	<b>M</b>
<b>CO2</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>---</b>	<b>M</b>
<b>CO3</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>---</b>	<b>M</b>
<b>CO4</b>	<b>S</b>	<b>---</b>	<b>M</b>	<b>L</b>	<b>L</b>
<b>CO5</b>	<b>S</b>	<b>S</b>	<b>M</b>	<b>L</b>	<b>L</b>

S- Strong M -Medium L-Low



<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

### **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  $\alpha$ -helix and  $\beta$ -pleated sheets, tertiary and quaternary. Ramachandran plot.Metabolism: Transamination, deamination and transmethylation.

### **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. Rastogi, S.C.2010. Biochemistry, 3<sup>rd</sup> Edition, Tata McGraw Hill Edition, New Delhi.
3. Nelson, D.L., and M.M.Cox, 2010, Lehninger Principles of Biochemistry, 5<sup>th</sup> 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. York.
7. Zubay, G. 1993, Biochemistry, third edition Won.C.Brown Communications Inc., Oxford, England.
8. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) ltd. New Delhi.
9. Ramarao, A.V.S.S. and Suryalakshmi, A 2009. Textbook of Biochemistry for Medical Students, 11<sup>th</sup> UVS Publishers Distributors Pvt. Ltd., New Delhi.
10. Deb, A.C. 2011. Fundamentals of Biochemistry, 10<sup>th</sup> Edition, New Central Book Agency Pvt. Ltd., Kolkata.
11. Conn, E.E., P.K.Stumpf, G.Bruening and R.H.DoI, 1999. Outline of Biochemistry, John Wiley & Sons Inc., New York.
12. Bose, S. 1982. Elementary Biophysics. Vijaya Printers, Madurai.
13. Casey, E.J. 1969. Biophysics – Concepts and mechanism. East West Press. New Delhi.
14. Morris, J.G. 1974. A Biologist's physical chemistry. II edition. Edward Arnold – A division of Holder and Stoughton, London.

**Course designer : Dr.C. Balasubramanian**

#### Course contents and lecture schedule

	Topic	Lecture hrs.
<b>Unit1</b>		
1.1	Water and properties	5
1.2	Carbohydrates classification	3
1.3	Carbohydrate metabolism	5
1.4	Regulations	2
<b>Unit II</b>		
2.1	Nucleic acid biosynthesis, metabolism	4
2.2	Aminoacid structure, classification , biosynthesis	5
2.3	Protein classification, structure	4
2.4	Metabolism	2
<b>Unit III</b>		
3.1	Lipids classification,structure	5
3.2	Biosynthesis	5
3.3	Metabolism	5
Unit IV		

4.1	Vitamins structure	3
4.2	Fat soluble	6
4.3	Water soluble	4
4.4	Enzymes classification and action	2
	Kinetics	2
Unit V		
5.1	Donnan and Gibbs equilibrium – membrane transport	3
5.2	Thermodynamics	4
5.3	High energy compound	6

**Thiagarajar College : Madurai – 625 009**  
**Department of Zoology**  
 (For those joined M. Sc., Zoology on or after June 2019)  
**Programme Code:PZO**

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL11	<b>Lab in Biological Chemistry and Biophysics</b>	Core Lab-1	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

### Preamble

The course encompasses qualitative and quantitative analyses of biomolecules in the biological samples. Explain the factors influencing enzyme activity.

### Prerequisites

Basic laboratory techniques in both chemistry and biology.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Define the nature of biomolecules present in the samples	K1
CO2	Estimate the amount of biomolecules present in the samples	K3
CO3	Test the influence of various factors that influence enzyme activity	K4
CO4	Demonstrate permeability of cell membrane	K2
CO5	Acquire hands on training needed to work in or start a clinical lab	K3

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	L	M
CO2	S	--	S	S	M
CO3	S	M	S	M	---
CO4	M	M	M	M	---
CO5	M	L	S	S	---

S- Strong M -Medium L-Low

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

**Reference Books:**

1. D.T.Plummer.2008 An Introduction 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.

**Thiagarajar College : Madurai – 625 009**  
**Department of Zoology**  
 (For those joined M. Sc., Zoology on or after June 2019)

**Programme Code PZO**

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C12	Microbiology	Core-2	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

**Preamble**

The course illustrates the basic concepts and history on the development of microbiology. The main focus of the course is on the classification and biology of microbes - bacteria, viruses, fungi and algae. Explains the significance of beneficial microbes and methods for the control of pathogenic microbes

**Prerequisites**

Basic knowledge on microbes, culture media, staining methods.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Level
CO1	Recognize the fundamental concepts, history and development of microbiology.	K1
CO2	Sketch the taxonomical classification of microbes (bacteria fungi, viruses and algae).	K2
CO3	Analyse the structural organization and importance of bacteria, fungi, viruses and algae.	K2,K3
CO4	Perceive the theoretical basis and demonstrate the practical skills in the use of tools, technologies and methods common to microbiology.	K2 ,K4
CO5	Illustrate the methods to be adopted to control microbes.	K3, K5

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	S	M
CO2	S	S	M	S	M
CO3	S	M	M	M	L
CO4	L	M	S	M	L
CO5	L	L	M	S	---

S- Strong M -Medium L-Low

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

**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, 5<sup>th</sup> edition. McGraw-Hill. Book Co. Singapore
2. Tortora, G.J., Funke, B.R. and Case, C.L. 2009. Microbiology: An Introduction. 9<sup>th</sup> edition, Pearson Education, Singapore

### Reference Books

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

**Course designers : Dr.RM.Murugappan**

### Course contents and lecture schedule

Units	Topic	Lecture hrs.
<b>Unit I</b>		
1.1	Introduction of Microbiology. History of Microbiology - Discovery of microorganisms (Robert Hooke & Leeuwenhoek).	3
1.2	Contributions of Francesco Redi, John Needham, Spallanzani, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich, Alexander Fleming, Dubos and Winogradsky	5
1.3	Classification based on – Carolus Linnaeus, Carl Woese and Robert H. Whittaker (Five Kingdom system).	5
<b>Unit II</b>		
2.1	Microbial Growth – Physical & Chemical requirements Phases of growth	4
2.2	Ultrastructure of a bacterial cell - cell wall, cell	4



	membrane, ribosomes, nucleoid, capsule, flagella, fimbriae, spores and cysts.	
2.3	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).	4
2.4	Distinguishing characteristics of Fungi – Filamentous, non-filamentous and dimorphic fungi; Morphology and structure of <i>Aspergillus niger</i> and <i>Saccharomyces cerevisiae</i>	4
<b>Unit- III</b>		
3.1	Metabolic diversity among organisms – Photoautotrophs, Photoheterotrophs, Chemoautotrophs, Chemoheterotrophs	4
3.2	Energy production –oxidation –Reduction reactions, Oxidative and Phosphorylation.	4
3.3	Metabolic pathways of energy production – Glycolysis, Entner –Doudoroff pathway	4
3.4	Aerobic and Anaerobic respiration, Photosynthetic metabolisms –Light & Dark reactions.	4
<b>Unit IV</b>		
4.1	Food Microbiology –Types of foods –Spoilage process (souring, putrefaction, rancidity and soft rot)	4
4.2	Preservation of foods (Physical and Chemical agents)	3
4.3	Food poisoning and Microbial toxins	4
4.4	Environmental Microbiology – Role of microorganisms in nutrient cycling -Nitrogen, Carbon, Sulphur and Phosphorous.	4
<b>Unit V</b>		
5.1	Applied Microbiology –Sewage Treatment, Biofertilizer (Rhizobium, Azolla) Production of Penicillin and SCP.	5
5.2	Microorganisms and Human disease – Causative agent, symptoms, transmission, prevention and control of Tuberculosis, Cholera, Typhoid	5
5.3	Microorganisms and Human disease – Causative agent, symptoms, transmission, prevention and control of AIDS, Hepatitis, Polio and Candidiasis.	5

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL12	Lab in Microbiology	Core Lab-2	-	-	3	2
Year	Semester	Int. Marks	Ext.Marks			Total
First	First	40	60			100

**Preamble**

Provide hands on training in microbiology laboratory techniques. The students will learn do and donot's in the laboratory. Students will be trained in preparing different media for culturing microorganisms. Explain different methods to identify, differentiate bacteria and fungi, their growth control methods.

**Prerequisites**

Basic knowledge on sterilization techniques, characteristics of different microbes (Bacteria fungi, yeast and viruses) and types of media.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Demonstrate an overview of the instruments, glasswares chemicals and media for culturing different types of microbes.	K2
CO2	Prepare various Culture media, brief various physical and chemical means of sterilization Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae.	K1,K3
CO3	Perform culture handling tasks safely and effectively Comprehend the various methods for identification of unknown microorganisms.	K2,K3
CO4	Interpret the Microbiology techniques in research or internship activities.	K5
CO5	Develops basic skills necessary to work in the microbiology laboratory or start a clinical lab.	K4

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5
CO1	L	---	S	S	---
CO2	L	---	S	S	---
CO3	M	---	S	S	---
CO4	L	L	S	S	---
CO5	M	---	S	S	---

S- Strong M -Medium L-Low

**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.

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

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C13	<b>Genetics and Evolution</b>	Core-3	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

**Preamble**

The course is designed to provide a holistic understanding of evolution, as a concept and its process. It educates the students on the patterns of inheritance, concept of linkage and disorders of genetic origin.

**Prerequisites**

Knowledge in simple Mendelian inheritance and Darwinian theory of Evolution.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Demonstrate Mendel's laws of inheritance and recognize the deviations from them	K2
CO2	Explain principles of genetic linkage and chromosome mapping.	K2,
CO3	Comprehend the nature of various genetic disorders , their diagnosis and origin	K4,K5
CO4	Relate the existing evidences of evolution with the process of evolution.	K3,K5
CO5	Summarize the concept of species, mechanisms of speciation and appreciate the evolution of man	K1,K2

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5
<b>CO1</b>	<b>M</b>	<b>---</b>	<b>---</b>	<b>S</b>	<b>S</b>
<b>CO2</b>	<b>M</b>	<b>M</b>	<b>---</b>	<b>M</b>	<b>S</b>
<b>CO3</b>	<b>M</b>	<b>L</b>	<b>---</b>	<b>M</b>	<b>M</b>
<b>CO4</b>	<b>S</b>	<b>L</b>	<b>---</b>	<b>M</b>	<b>M</b>
<b>CO5</b>	<b>S</b>	<b>L</b>	<b>---</b>	<b>M</b>	<b>S</b>

S- Strong M -Medium L-Low

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

**Unit I: Mendelian genetics**

Mendel’s study of Heredity ; Monohybrid Cross & Mendel’s laws of Dominance & Segregation;

Dihybrid cross & Mendel’s law of Independent Assortment. Simple Mendelian traits in Humans.

Deviations from Mendelian Inheritance: Incomplete Dominance – Flower color inheritance in snap dragons; Epistasis- Bateson & Punnet’s experiment on Cinnabar gene in Drosophila & fruit colour in summer squash plants; Multiple Allelic Inheritance – Blood group inheritance in Humans & Inheritance of coat colour in rabbits. Non –Mendelian Inheritance- polygenic Inheritance, Cytoplasmic Inheritance

**Unit II : Linkage, crossing over & recombination**

Concepts of Linkage, recombination & crossing over ; Autosomal linkage in Sweet pea flowers ; chromosome mapping – determination of distance between genes- two point test cross; Determination of gene order- Three point test cross.

Sex Linkage - X- Linked Inheritance- White eye trait in Drosophila ; X linked recessive traits in Humans- Haemophilia, Colour blindness ; Y -linkage - hairy pinna in males.

**Unit III: Cytogenetics**

Chromosomal aberrations- Numerical aberrations- Chromosomal non-disjunction, Euploidy & Aneuploidy; Down syndrome, Turner syndrome, Edward Syndrome , Klinefelter Syndrome. Structural aberrations- Inversion, Translocation, Deletion, Duplication.

Detection of chromosomal anomalies- Pedigree analysis, Human Karyotyping, Prenatal diagnostics – Amniocentesis, Chorionic Villus sampling. Concepts of Eugenics & Euthenics.

**Unit IV: Evolution & Natural Selection**

Evidences for evolution- homologous structures, analogous structures, vestigial organs, embryological evidences, physiological, biochemical & fossil evidences.

Theories of organic evolution: mutation theory, Lamarckism, Neo Lamarckism, Darwinism, Neo-Darwinism.

Concepts of Natural Selection - Modes of Natural Selection- stabilizing, directional & disruptive selection . Selection in action- Industrial Melanism, Adaptive radiation in Darwin’s Finches, mimicry & colouration . Sexual Selection , Kin Selection & Group Selection.

## Unit V: Population Genetics, Speciation & Human Evolution

Hardy Weinberg equilibrium- allele frequency, genetic drift, founder effect & bottle neck effect.

Species concept- types of speciation; Reproductive isolation – prezygotic & post zygotic isolating mechanisms.

Geological time scale; Evolution of Man – Australopithecus, Homo habilis, Homo erectus, Homo sapiens, Neanderthal & Cro-Magnon.

### Textbooks:

1. Peter J. Russell. 2010. Genetics: A Molecular Approach, 3rd Ed., Pearson Publications, USA
2. [D. Peter Snustad](#), [Michael J. Simmons](#), 2015. Principles of Genetics, 7th Edition, [John Wiley & Sons, Inc.](#),
3. Verma, P.S and Agarwal, V.K. 2012. Cell biology, Genetics and Evolution, S.Chand Publications. New Delhi

### References:

1. Peter E. Rosenbaum, 2010. Volpe's understanding evolution, McGraw-Hill, New York.
2. Theodosius Dodzhansky, Francisco J. Ayala, G.Ledyard Stebbins, James W. Valentine, 1977 Evolution, W.H. Freeman & company, San Francisco.
3. G.Ledyard Stebbins, 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 8Ed. John Wiley & Sons,

### Course Designer

Mrs. U. Soundarya

### Course contents and lecture schedule

	Topic	lecture hrs.
Unit I	<b>Mendelian Genetics</b>	
1.1	Mendel's study of Heredity ; Monohybrid Cross & Mendel's laws of Dominance & Segregation, Dihybrid cross & Mendel's law of Independent Assortment	3
1.2	Deviations from Mendelian Inheritance: Incomplete Dominance – Flower color inheritance in snap dragons	2
1.3	Epistasis- Bateson & Punnett's experiment on Cinnabar gene in Drosophila & fruit colour in summer squash plants	3
1.4	Multiple Allelic Inheritance – Blood group inheritance in Humans & Inheritance of coat colour in rabbits.	3
1.5	Simple Mendelian traits in Humans, Non –Mendelian Inheritance- polygenic Inheritance, Cytoplasmic Inheritance	4
Unit II	<b>Linkage, crossing over &amp; recombination</b>	
2.1	Concepts of Linkage, recombination & crossing over ; Autosomal linkage in Sweet pea flowers	3
2.2	Chromosome mapping – determination of distance between genes- two point test cross	3
2.3	Determination of gene order- Three point test cross.	3
2.4	Sex Linkage - X- Linked Inheritance- White eye trait in	4

	Drosophila ; X linked recessive traits in Humans- Haemophilia, Colour blindness.	
2.5	Y -linkage - hairy pinna in males.	2
Unit III	<b>Cytogenetics</b>	
3.1	Numerical aberrations- Chromosomal non-disjunction, Euploidy & Aneuploidy – Down syndrome, Turner syndrome, Edward Syndrome , Klinefelter Syndrome	4
3.2	Structural aberrations- Inversion, Translocation, Deletion, Duplication.	2
3.3	Detection of chromosomal anomalies- Pedigree analysis,	3
3.4	Human Karyotyping, Prenatal diagnostics – Amniocentesis, Chorionic Villus sampling.	3
3.5	Concepts of Eugenics & Euthenics.	2
Unit IV	<b>Evolution &amp; Natural Selection</b>	
4.1	Evidences for evolution- homologous structures, analogous structures, vestigial organs, embryological evidences, physiological, biochemical & fossil evidences.	4
4.2	Theories of organic evolution: mutation theory, Lamarckism, Neo Lamarckism	3
4.3	Darwinism, Neo-Darwinism.	2
4.4	Concepts of Natural Selection - Modes of Natural Selection- stabilizing, directional & disruptive selection .	2
4.5	Selection in action- Industrial Melanism, Adaptive radiation in Darwin's Finches, mimicry & colouration . Sexual Selection , Kin Selection & Group Selection.	4
Unit V	<b>Population Genetics, Speciation &amp; Human Evolution</b>	
5.1	Hardy Weinberg equilibrium- allele frequency, genetic drift, founder effect & bottle neck effect.	4
5.2	Species concept- types of speciation;	3
5.3	Reproductive isolation – prezygotic & post zygotic isolating mechanisms.	3
5.4	Geological time scale	2
5.5	Evolution of Man – Australopithecus, Homo habilis, Homo erectus, Homo sapiens, Neanderthal & Cro-Magnon.	3
	TOTAL HOURS	75

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code: PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL13	<b>Lab in Genetics and Evolution</b>	Core Lab-3	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

**Preamble**

The course evaluates the inheritance of genetic characters. Explain students on the inheritance pattern by designing lab experiments.

**Prerequisites**

Basic idea on inheritance of traits, population genetics and concepts in evolution

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Recognize simple Mendelian traits in human	K1
CO2	Determine the occurrence of sex linked traits in a population	K4,K5
CO3	Demonstrate natural selection and genetic drift	K2,K3
CO4	Examine the application of statistical tools in population genetics	K4
CO5	Interpret the overall human traits inheritance pattern and evolutionary significance	K2,K3

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5
CO1	M	---	S	S	M
CO2	S	S	---	M	M
CO3	S	---	M	S	M
CO4	L	---	S	M	---
CO5	S	S	---	M	M

S- Strong M -Medium L-Low



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

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

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code :PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CE11	<b>Animal Biology</b>	Core Elective-1	5	1	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

**Preamble**

Animals are a fascinating group of organisms that inhabit every niches across the globe. The course deals with the comparative physiology, morphology and anatomy of animals from protozoa to mammalian. On completion of the course, the students will have clarity on the fundamentals of zoology that facilitate them to understand the subject further to a greater extent.

**Prerequisites**

The students should have comparative knowledge on invertebrata and choradata.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Classify the animals upto class level	K1,K2
CO2	Realize the origin of life	K2
CO3	Compare physiology of diverse group of animals	K4,K5
CO4	Distinguish poisononous from non-poisonous snakes	K3,K4
CO5	Differentiate the larval forms of animals.	K4

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5
CO1	S	---	S	S	S
CO2	S	---	---	S	S
CO3	S	S	S	S	S
CO4	L	---	---	M	---
CO5	M	---	M	L	M

S- Strong M -Medium L-Low

**Blooms taxonomy: Assessment Pattern**

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

### **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, fight 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 and Nelson.
3. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10<sup>th</sup> edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
4. Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144 008, 942.

### 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, 7<sup>th</sup> 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 Dr. C. Ravi**

### Lecture schedule

Sl. No	Topic	Lecture hrs.
1.1	Origin of life	01
1.2	Unicellular to multicellular organization	01
1.3	Significance of metamerism and symmetry	02
1.4	Acoelom, pseudocoelom and eucoelom	02
1.5	Classification of animals up to class level and their general characteristics	05
1.6	Binomial nomenclature	02
1.7	Affinities and systematic position of cephalochordate, hemichordate and urochordata	02
2.1	Types of gills and lungs	02
2.2	Tracheal system	01
2.3	Respiratory pigments	02
2.4	Accessory respiratory organs	01
2.5	Types of respiration in frog	02
2.6	Circulatory system – open and closed – two, three and four chambered heart	02
2.7	Hemolymph and blood	01
2.8	Anatomy of artery, vein and capillary	01
2.9	Excretory organs – flame cells, nephridium, malphigian tubules - renal, rectal, antennal and coxal glands and kidneys	03
3.1	Nerve net in hydra	01

3.2	Ladder like structure in flat worms	01
3.3	Segmented nervous system in annelids	01
3.4	Ganglia in insects	01
3.5	Comparison of brain in vertebrates.	04
3.6	Locomotion, reproduction and economic importance of protozoa	03
3.7	Canal system in sponges – asconoid, syconoid, leuconoid and rhagon types,	03
3.8	Spicules in sponges	01
4.1	Comparison of reproduction in Obelia and Aurelia	02
4.2	Polymorphism in coelenterates	01
4.3	Peripatus and its evolutionary significance	01
4.4	Metamerism in Annelida	01
4.5	Foot, torsion and filter feeding in Mollusca	03
4.6	Mechanism of pearl formation	01
4.7	Limulus and its significance	01
4.8	Crustacean larval forms – nauplius, metanauplius, zoea, cypris, mysis, megalopa, phyllosoma and alima	03
4.9	Affinities of Peripatus	01
4.10	Water vascular system in Echinodermates	01
5.1	Feeding in Amphioxus	01
5.2	Retrogressive metamorphosis in Ascidian	01
5.3	Comparison between Lampreys and Hag fishes	01
5.4	Placoid scales of Shark	01
5.5	Parental care and migration in Fishes	02
5.6	Parental care in Amphibians	01
5.7	Poison apparatus and biting mechanism in Snakes	01
5.8	Key for identification of poisonous and nonpoisonous Snakes	01
5.9	Significance of Archaeopteryx	01
5.10	Flight adaptation and migration in Birds	02
5.11	Placentation and adaptive radiation in Mammals	02
5.12	Egg laying mammals	01

**Thiagarajar College : Madurai – 625 009**  
**Department of Zoology**  
 (For those joined M. Sc., Zoology on or after June 2019)  
 Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C21	Entomology	Core-4	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

### Preamble

The course delivers a comprehensive insight on the basic and applied aspects of Entomology. One half of the syllabus offers morphological as well as molecular based taxonomy and systematic of insects; and also their anatomical and functional details. The other half corroborates insects harmful nature and their management, besides having entrepreneurial aspects of entomology.

### Prerequisites

Basic knowledge on the morphology and classification of insects.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Discuss the morphology based variation and diversity among all insect groups	K4
CO2	Emphasize and compare the structural and functional aspects of insects	K3,K5
CO3	Eplain the trophic interaction of insects with their host plants their management and tools of control	K1, K2
CO4	Apply/Utilize natural enemies for the control of insect pests	K3
CO5	Appear for compatative examinations and/ or become an entreprenauer,	K5

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	S	S
CO2	S	L	M	S	S
CO3	S	---	S	S	---
CO4	S	---	S	S	---
CO5	M	---	M	S	S

S- Strong M -Medium L-Low

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

### Unit I

Classification of Insects-General characteristics of class Insecta and classification up to Order level – characteristics of each order with examples. Modern scheme of insect classification: Apterygota- Pterygota: Exopterygota (Hemimetabolous): Paleopteroid, Orthopteroid, Hemipteroid orders -Endopterygota (Holometabolous): Coleopteroid, Neuropteroid, Panorpid and Hymenopteroid 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 deference, aedeagus; Female – panoistic, meroistic, telotrophic, polytrophic ovaries, spermatheca, - Endocrine system: Structure of Corpora cardiac(CC), Corpora allata (CA) and neurosecretory 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 biguttata*, *Aphis sp.*) Brinjal- (*Leucinodes orbanals*, *Pthemberules 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. Ananthkrishnan, 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 : Dr.P.Suresh**

### Course contents and lecture schedule

	Topic	Lecture hrs.
1.1	Classification of insects	12
1.2	Molecular relationships	3
2.1	Respiratory	4
2.2	Excretory	4
2.3	Reproductive	4
2.4	Endocrine system	3
3.1	Pests	10
3.2	IPM	3
3.3	Insecticides	2
4.1	Biocontrols	8
4.2	Bacteria	5
4.3	Fungi	2
5.1	Silkworm rearing	4
5.2	Non mulberry silkworm	4
5.3	Field visit	7



**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL21	Lab in Entomology	Core Lab-1	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	40	60	100

**Preamble**

Provide hands-on-training on the collection, identification and preservation of insects. Demonstrate on dissection and display of different parts of insects. Differentiate beneficial and harmful insects.

**Prerequisites**

Knowledge on the types, classification of insects and their organization.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Collect, identify and preserve insects	K1
CO2	Dissect and display insects	K3,K4,K5
CO3	List the pest population in the field and determine the threshold level.	K2
CO4	Report suitable pest control measures for the benefit of farmers	K4,K5
CO5	Execute experimental protocols learnt in field studies.	K3,K5

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	---	M	S	S	---
CO2	M	S	S	S	---
CO3	M	---	S	S	---
CO4	S	L	S	S	---
CO5	S	M		S	---

S- Strong M -Medium L-Low

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 – LC<sub>50</sub> 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.

**Thiagarajar College: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined M. Sc., Zoology on or after June 2019)  
 Programme Code :PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C22	<b>Cell and Molecular Biology</b>	Core-5	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

### Preamble

The course is intended to elaborate the different types, structure and functions of cells and biomolecules. Explains the types and stages of cell cycle. Explain cell signaling pathways in normal and cancerous cell. Spell gene expression and protein synthetic machinery.

### Prerequisites

Knowledge on prokaryotic and eukaryotic cells, cell organelles, nucleic acids and central dogma of protein synthesis.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Identify and illustrate the working mechanism of various cell imaging instruments or microscopes	K1,K2
CO2	Distinguish prokaryotes and eukaryotes. Define gene organization, expression & regulation	K2,K3
CO3	Explain the structure and functions of cell, cell organelles, biological membranes and intercellular communication.	K2,K4
CO4	Emphasis the structure, forms, types and function of nucleic acids; mitosis and meiosis, central dogma of protein synthesis and gene regulation	K4,K5
CO5	Demonstrate how biochemistry, genetics and molecular biology are used to elucidate the function of cells and their organization into tissues	K2,K5

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	S	S	---
CO2	S	S	S	S	M
CO3	S	S	---	S	S
CO4	S	S	S	S	S
CO5	S	L	---	S	S

S- Strong M -Medium L-Low

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

**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 TGFβ 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 2<sup>nd</sup> 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 (3<sup>rd</sup> edition). Garland Publishing, Inc., New York.
2. De Robertis E.D.P and E.M.F.De Robertis 2011. Cell and Molecular Biology. 8<sup>th</sup> 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 (6<sup>th</sup> Edition). Sinauer Associates, Inc.
8. Haddin J. et al. 2011 Becker's World of the Cell (8<sup>th</sup> 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

	Topic	Lecture hrs.
Unit I		
1.1	Microscopy: Working mechanism and applications of light, phase-contrast, fluorescent, electron (TEM & SEM) and confocal microscopy	4
1.2	Cell theory ; Ultrastructure of plant and animal cells	3
1.3	Structure and function of organelles - Nucleus, endoplasmic reticulum, golgi complex,	3
1.4	mitochondria, ribosomes, lysosomes,	3
1.5	Cytoskeletal structures	2
Unit II		
2.1	The cell membrane & its properties ; Fluid mosaic model of Plasma membrane; Integral & peripheral membrane proteins.	4
2.2	Cell junctions- gap junctions, tight junctions & anchoring junctions	3

2.3	Transport of molecules across the membrane- diffusion & facilitated diffusion & active transport( Sodium Potassium ATPase pumps )	3
2.4	Intracellular Vesicular Trafficking	2
2.5	Structural organization of Eukaryotic Chromosome ; giant chromosomes.	3
Unit III		
3.1	Cell signalling- G-protein coupled and TGF $\beta$ receptor system	3
3.2	JAK/STAT, Ras and MAP kinase pathway	3
3.3	Cell cycle & its regulation- mitosis and meiosis	3
3.4	Molecular and biochemical characteristics of cancer cells	3
3.5	Cell ageing, Cell death and its regulation	3
Unit IV		
4.1	Experimental evidence for DNA as genetic material	2
4.2	DNA- structure, types, replication (both prokaryotes and eukaryotes)	4
4.3	Holliday model of recombination	2
4.4	RNA –structure, types and function	3
4.5	Mutation- types & repair mechanisms	4
Unit V		
5.1	Transcription of mRNA prokaryotes and eukaryotes & post transcriptional modification	3
5.2	Translation in prokaryotes and eukaryotes & Post translational modification	3
5.3	Bacterial Genetics- Regulation of gene expression - prokaryotes: lac and trp operon	4
5.4	Plasmids – types and function	2
5.5	Mechanisms of Gene transfer in bacteria - transformation, conjugation and transduction Mobile Genetic Elements	3

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code :PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL22	<b>Lab in Cell and Molecular Biology</b>	CoreLab-5	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	60	100

**Preamble**

Provides a basic understanding on the organization of different tissues and cells. Helps to visualize the different stages of cell division. Provide hands on training on gene transfer mechanism.

**Prerequisites**

Knowledge on tissues, cells, biomolecules etc.,

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Differentiate the types of tissues and cells	K4
<b>CO2</b>	Appraise the different gene transfer methods	K5
<b>CO3</b>	Summarise safe laboratory practices and perform basic molecular biology techniques	K1, K2
<b>CO4</b>	Distinguish mutant and wild bacterial colonies	K3, K5
<b>CO5</b>	Isolate nucleic acids from cells and quantify.	K4

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	S	L	S	S	L
<b>CO3</b>	M	---	S	S	L
<b>CO4</b>	M		S	S	L
<b>CO5</b>	M	S	S	S	---

S- Strong M -Medium L-Low

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. Univerrrsity Press, Hyderabad., India
6. Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi



**Thiagarajar College (Autonomous):: Madurai – 625 009**  
**Department of Zoology**  
 (For those joined M. Sc., Zoology on or after June 2019)  
 Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C23	<b>Bioinstrumentation</b>	Core-6	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

### Preamble

The course familiarizes the students with the analyses and design of different instrument. Explain the principle and working mechanism behind various instruments used in life science.

### Prerequisites

Know and identify various instruments. Basic knowledge on chemical preparation methods.

### Course Outcomes

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Explain the principles and applications of the various instruments used in biology	K1,K2
CO2	Portray the schematic representation on the working mechanism of various instruments	K3,K4
CO3	Proficient in use/handling basic and advanced instruments	K2,K3
CO4	Use appropriate instruments for the laboratory and project work	K4,K5
CO5	Interpret the results obtained on analyses after thorough scrutiny .	K5

K

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	S	M	L
CO2	M	---	M	S	---
CO3	---	---	S	S	L
CO4	M	----	S	S	---
CO5	S	---	S	S	L

S- Strong M -Medium L-Low

**Blooms taxonomy: Assessment Pattern**

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

**Principle, working mechanism and applications of:****Unit I**

Basic principles of light rays – Reflection, Refraction, Diffraction, Dispersion and Polarisation. 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
5. Gupta A. 2009. Instrumentation and Bio-Analytical Techniques. PragatiPrakashan, Meerut.
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. Palanichamy, S. and Shanmugavelu, M. 2011. Principles of Biophysics, 2<sup>nd</sup> Edition, Palani Paramount Publications, Palani.
8. Palanivel, P. 2000. Laboratory Manual for Analytical Biochemistry & Separation Techniques. School of Biotechnology, Madurai Kamaraj University, Madurai.
9. Plummer, D.T. 2008. An Introduction to Practical Biochemistry. Tata McGraw Hill Publications, New Delhi.
10. Sandhu, G.S. 1990. Research Techniques in Biological Sciences. Anmol Publications, New Delhi.
11. Sawhney, S.K. and Singh, N. 2000. Introductory Practical Biochemistry. Narosa Publishing House, New Delhi.
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, 5<sup>th</sup> Edition Cambridge University Press, New York.

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

**Course contents and lecture schedule**

Sl. No	Topic	Lecture hrs.
1.1	Basic principles of light rays – Reflection, Refraction, Diffraction, Dispersion and Polarisation	03
1.2	Dark field Compound Microscopy	01
1.3	Light field Compound Microscopy	01
1.4	Phase Contrast Microscopy	02
1.5	Fluorescent Microscopy	02
1.6	Polarised Microscopy	02
1.7	TEM	01
1.8	SEM	01
1.9	Confocal Microscopy	01
1.10	Micrometry	01
2.1	pH meter	01
2.2	Centrifuge (Clinical, Density gradient and Ultra)	02
2.3	Preparative and analytical centrifuge	01
2.4	Sedimentation coefficient, RCF, RPM	01
2.5	Incubator, Hot air oven, Autoclave	02
2.6	Quebec colony counter	01
2.7	GM counter	01
2.8	Liquid Scintillation counter	01
2.9	Sonicator, Lyophilizer	02
2.10	Micropipettes	01

2.11	Filters (HEPA, membrane)	02
3.1	Colorimeter	02
3.2	Beer & Lamberts law	02
3.3	UV-visible Spectrophotometer	02
3.4	FT-IR	02
3.5	Flame Photometer	02
3.6	Atomic Absorption and Mass Spectrophotometer	02
3.7	ELISA reader	02
3.8	Sphygmomanometer	01
4.1	Introduction to Chromatography	01
4.2	Ascending Paper Chromatography	01
4.3	Circular Paper Chromatography	01
4.4	Thin layer Chromatography	01
4.5	Column Chromatography	02
4.6	Gel filtration Chromatography	02
4.7	Ion exchange Chromatography	02
4.8	Gas Chromatography	02
4.9	High Performance Liquid Chromatography	01
4.10	Kjeldahl apparatus	02
5.1	Introduction to Electrophoresis	01
5.2	SDS-PAGE	02
5.3	Native PAGE	01
5.4	Agarose Gel Electrophoresis	02
5.5	2D Gel Electrophoresis	01
5.6	Gel Documentation	01
5.7	Southern blotting	01
5.8	Western blotting	02
5.9	Northern blotting	01
5.10	PCR	02
5.11	FACS	01

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code :PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL23	<b>Lab in Bioinstrumentation</b>	Core Lab-6	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	40	60	100

**Preamble**

Elaborates the principle and working mechanism of various instruments used in life sciences. Provide hands-on- training on the use of instruments for lab and project purpose.

**Prerequisites**

Knowledge on the different components and working principle of different instruments

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Explain the theoretical principle and working mechanism of various instruments used in various disciplines of biology	K1,K2
<b>CO2</b>	Make use of various instruments for their routine practical and project work	K3,K4
<b>CO3</b>	Isolate, separate, purify and analyze nucleic acids and proteins	K4,K5
<b>CO4</b>	Separate, purify and quantify sugars, amino acids and lipids,	K2,K4
<b>CO5</b>	Enumerate and preserve the microbes isolated from the samples	K3

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5
<b>CO1</b>	S	---	S	S	M
<b>CO2</b>	M	---	S	S	L
<b>CO3</b>	L	M	S	S	---
<b>CO4</b>	L	M	S	S	---
<b>CO5</b>	---	---	S	S	---

S- Strong M -Medium L-Low

**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 (Demonstration only)
11. Separation of DNA by agarose gel electrophoresis (Demonstration only)

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CE21	Biostatistics	Core Elective-2	4	2	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	25	75	100

### Preamble

The goal of the skill based elective course in Biostatistics is to prepare students to comprehend, develop and apply, quantitative and qualitative techniques in mathematics, statistics, and computing to handle biological data collection and analysis. The course strives to emphasize the understanding of inherent variation, bias, and uncertainty in sampling. Distribution patterns in experimental data generation, probability of results obtained and the required statistical action to arrive at a best possible conclusion.

### Prerequisites

A basic knowledge of high school mathematics

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Define variability and uncertainty in sampling and data collection	K1
CO2	Categorize the type of variables, summarize the data and construct graphical and diagrammatic representation of data.	K3,K4
CO3	Apply probability principles for setting significance levels and testing hypothesis using statistical tests	K5
CO4	Analyse results of statistical test and interpret experimental conclusion	K4
CO5	Perform basic statistical test using MS-Office Excel at ease and independently	K2,K5

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	M	---	L	S	M
CO2	M	---	M	M	M
CO3	L	---	L	M	M
CO4	---	---	S	S	M
CO5	S	---	M	S	S

S- Strong M -Medium L-Low

### Blooms taxonomy: Assessment Pattern

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

### **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 Aposteriori 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

Sl. No	Topic	lecture hrs.
1.1	Entry behavior assessment&Description of scope of the course and expectations	01
1.2	Types of biological data-ratio, interval, ordinal, nominal, discrete and continuous	03
1.3	Sampling methods – Random and non-random sampling methods	02
1.4	Frequency distribution and probability consideration	02
1.5	Diagrammatic representation of data	03
1.6	Graphical representation of data	04
2.1	Measures of central tendency –mean, median and mode;	04
2.2	Measures of dispersion –range and standard deviation	02
2.3	Measures of dispersion – variance and standard error	02
2.4	Probability distribution – binomial, Poisson (definition) and normal distribution (detailed). Symmetry- skewness and kurtosis(definition),	03
2.5	Proportions of a normal curve- Z scores, assessing normality, confidence limits.	02
2.6	Practical training using MS-Office excel	02
3.1	Testing of hypothesis – Null and alternate hypothesis, null hypothesis,	02
3.2	Student ‘t’ distribution, Two tailed and one tailed hypotheses concerning mean, confidence limits for the population mean, variability about the mean;	05
3.3	One sample t-test, paired and unpaired t-tests.	05
3.4	Practical training using MS-Office excel	03

4.1	Single factor ANOVA; basic assumptions under ANOVA, loss of replications	05
4.2	ANOVA with two treatments. Practical training using MS-Office excel.	05
4.3	Tests for Aposteriori comparisons/Multiple comparisons- Tukey test.	02
4.4	Problems and solutions	02
4.5	Practical training using MS-Office excel.	01
5.1	Correlation – types, methods of correlation – graphical method, mathematical method; Karl Pearson’s Rank;, , test of independence;	03
5.2	Correlation -mathematical method, ; Karl Pearson’s Rank correlation	03
5.3	Regression analysis – equation, estimation of unknown value from known value;	02
5.4	Mann-Whitney U test	02
5.5	Chi-square test	02
5.6	Data transformations. Arcsine, logarithmic and square root transformations.	01
5.7	Practical training using MS-Office excel	02

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

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C31	Genetic Engineering and Biotechnology	Core-7	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

**Preamble**

Explain the basic principles of genetic engineering. Elaborate the fundamental steps in gene cloning and manipulation. Elaborates on construction and application of genetic engineering and helps to expertize in various gene transfer concepts.

**Prerequisites**

Knowledge on the principle and application of basic molecular and biotechnological methods

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Outline the various techniques used in genetic engineering	K1,K2
CO2	Eplain how scientific methodologies are used to conduct experiments and develop products	K2,K3
CO3	Distinguish various gene transfer methods.	K3,K4
CO4	Screen and select the recombinants and make use of them in various fields.	K2,K5
CO5	Attain knowledge to take responsibilities associated with different jobs in biotechnology	K3

**K1: Knowledge K2: Understand K3: Apply K4:Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	S
CO2	L	---	S	S	M
CO3	L	M	S	S	M
CO4	M	S	S	S	M
CO5	---	---	M	S	S

S- Strong M -Medium L-Low

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

**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 -lamda ; 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, 2<sup>nd</sup> 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, NewDelhi
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

## Lecture schedule

	Topic	Lecture hrs.
1.1	Tools in Genetic engineering	2
1.2	Properties of cloning vectors, Vectors used in cloning plasmids,	1
1.3	recombinant Plasmids -PBR322, PUC	2
1.4	plant plasmid vector-Ti	1
1.5	Lambda Phage vectors, hybrid vectors- phagmeids and Cosmids	2
1.6	Expression vectors –pET and shuttle vectors- YACs , BAC	2
1.7	Animal viral vectors –adeno based vectors	2
2.1	Steps involved in producing recombinant clones	2
2.2	Preparation of Genomic and cDNA libraries.	2
2.3	Direct transformation in bacterial host	2
2.4	<i>A.tumefaciens</i> based indirect transformation	2
2.5	physical gene delivery methods-PEG mediated, microinjection, particle gun.	2
2.6	Transfection in fertilized eggs and cultured stem cells	2
3.1	Selection of recombinants using antibiotic sensitivity and blue white screening.	3
3.2	Radioactive and non-radioactive probes. DNA and antibody based molecular probes in screening of recombinants	2
3.3	Expression and purification of cloned products.	2
3.4	Applications of animal cell culture as models for microbial biotechnology, genetic studies, drug testing, gene therapy,	3

	pharmaceutical products.	
3.5	Animal bioreactors and molecular Pharming.	2
4.1	Animal cell culture: Primary and Continuous Cell culture, adherent and suspension cultures.	1
4.2	Functional characteristics of cultured cells. Composition of animal cell culture media.	2
4.3	Cryopreservation of animal cells, Organ culture, whole embryo culture and tissue engineering (artificial skin and cartilage).	3
4.4	Transgene, transgenesis, Animal cloning (nuclear transfer method -Dolly).	3
4.5	Transgenic animals (Sheep and fish) and Plants (Bt cotton, drought resistant plants and its applications.	3
5.1	Principle behind nested and RT PCR, its applications	2
5.2	DNA finger printing (RAPD and RFLP),	2
5.3	DNA sequencing methods- (Maxam Gilbert, Sanger's, Automated and NGS),	4
5.4	Principles and applications of DNA microarray, RNA interference and Gene editing-Crispr cas-9.	4

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL31	<b>Lab in Genetic Engineering and Biotechnology</b>	CoreLab-7	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
Secondt	Third	40	60	100

**Preamble**

Demonstrate the basic techniques in genetic engineering and biotechnology.

**Prerequisites**

Basic knowledge on cell and molecular biology techniques.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Perform basic techniques in genetic engineering and biotechnology.	K2,K3
<b>CO2</b>	Explain the Central Dogma of Biology and its importance in genetic engineering	K2
<b>CO3</b>	Isolate genetic material from tissues and microbes.	K1,K2
<b>CO4</b>	Make use of instruments applicable in biotechnology.	K3,K4
<b>CO5</b>	Take responsibilities associated with different jobs in biotechnology	K5

**K1: Knowledge K2: Understand K3: Apply**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	<b>M</b>	<b>M</b>	<b>S</b>	<b>S</b>	<b>S</b>
<b>CO2</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
<b>CO3</b>	<b>M</b>	---	<b>S</b>	<b>M</b>	<b>M</b>
<b>CO4</b>	---	---	<b>M</b>	<b>S</b>	<b>S</b>
<b>CO5</b>					

S- Strong M -Medium L-Low

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

## **References**

1. Ausubel, F.M.1997. Short Protocols in Molecular Biology, Second Edition, John Wiley & Sons. Harvard Medical School.
2. Brown, T.A. 1998. Molecular Biology Lab Fax II Gene analysis, Second Edition, Academic Press, UK.
3. Glover, D.M. and Hames, B.D. 1995. DNA cloning – A practical approach, Vol. 1 - 4, IRC Press.
4. 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 (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C32	Animal Physiology	Core-7	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

**Preamble**

The course provide an insight into the mechanisms behind various physiological processes of an organism

**Prerequisites**

Knowledge on the organization of different organ systems

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledg Level
CO1	Explain the structural organization of different systems within body	K1,K2
CO2	Categorize the functions of different organ systems in animals.	K4,K5
CO3	Spell the role of body fluids	K1
CO4	Expalin how an organism/individual respond to external stimuli	K3,K5
CO5	Distinguish animal behavioral pattern	K4,K5

**K1: Remember K2: Understand K3: Apply K4: Analyze K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	---	L	M	M
CO2	M	---	L	M	M
CO3	M	---	---	M	---
CO4	S	M	---	M	M
CO5	S	M	L	M	M

S- Strong M -Medium L-Low

## Blooms taxonomy: Assessment Pattern

Blooms Taxonomy			
	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

### 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

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

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

(For those joined M. Sc., Zoology on or after June 2019)

Programme CodePZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL32	Lab in Animal Physiology	Core Lab-8	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	40	60	100

**Preamble**

Provide hands on training on various experiments that elaborates how physiological systems in animals operate and are regulated.

**Prerequisites**

Knowledge on various biomolecules, organs and organ systems

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Explain the influence of different systems in the normal functioning of the body	K1,K2
CO2	Estimate the level of biomolecules in body fluids and determine the influence of various factors on physiological activity of animals.	K3
CO3	Elaborate on the principal physiological systems in animals, how they operate and how they are regulated.	K3,K4
CO4	Design, conduct experiments, analyze and interpret data for investigating problems in physiological systems and allied fields	K4,K5
CO5	Entrepreneurship ventures such as consultancy, medical lab and training centres can be opened .	K5

**K1: Remember K2: Understand K3: Apply K4: Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	M	M	S
CO2	M	---	L	M	L
CO3	M	L	---	L	L
CO4	M	---	S		M
CO5	---	---	M	S	S

S- Strong M -Medium L-Low

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 (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme code:PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C33	<b>Developmental Biology</b>	Core-9	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

**Preamble**

Provides an insight into the development of an organism starting from gametogenesis to organogenesis. The course highlights the concepts of regeneration, metamorphosis and assisted reproductive technology

**Prerequisites**

Basic knowledge on organs associated with reproductive system and cell biology

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Elaborates the various stages of embryogenesis and organogenesis	K1,K2
CO2	Explain the basis of organ differentiation . Trace the sequence of events in fertilization	K2,K3
CO3	Illustrate the methods of assisted reproductive technology	K2,K4
CO4	Appraise on metamorphosis, regeneration and ageing as a part of post embryonic development	K5
CO5	Emphasize the modern implications of developmental biology in terms of teratogenesis, <i>in-vitro</i> fertilization, stem cell research and amniocentesis	K4,K5

**K1: Remember K2: Understand K3: Apply K4: Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	S
CO2	S	S	L	L	M
CO3	M	---	S	S	M
CO4	M	---	---	---	M
CO5	L	M	S	S	L

S- Strong M -Medium L-Low

## Blooms taxonomy: Assessment Pattern

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply -K3	30% (18)	30% (18)	20% (30)
Analyze -K4	20% (12)	20% (12)	20% (30)
Evaluate -K5	20% (12)	20% (12)	20% (30)
	<b>60</b>	<b>60</b>	<b>150</b>

### **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-phenotype relationship, autophenotype, allophenotype 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,
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**

**Lecture schedule**

Sl. No	Topic	Lecture hrs.
1.1	Introducing the course	01
1.2	Historical thoughts and concepts, scope of embryology	02
1.3	Primordial germ cells	02
1.4	Sperm - structure, types	02
1.5	Spermatogenesis	02
1.6	Egg- morphology, organization	03
1.7	Oogenesis	03
2.1	Fertilization, Chemotaxis,	02
2.2	Fertilizing-antifertilizing reaction	01
2.3	Acrosome reaction, cortical reaction	01
2.4	Parthenogenesis	02
2.5	Salient features and planes of cleavage	01
2.6	Patterns of cleavage and factors affecting cleavage	01
2.7	Metabolic and molecular changes during gastrulation,	02
2.8	Gastrulation in amphioxus	01
3.1	Construction of fate-map in amphibians	03
3.2	development of brain, heart and kidney in frog	04
3.3	Placentation- classification, distribution of villi	02
3.4	Types of tissues of Placenta	01
3.5	Physiology of placenta	01
4.1	Induction, competence, determination	02
4.2	Amphibian metamorphosis	03
4.3	Types, events and factors in regeneration	02
4.4	Teratogenesis	02
4.5	Autophene, allophene and teratogenic agents	02
5.1	Male Reproductive System in human	02
5.2	Female Reproductive System in human	02
5.3	Estrous and menstrual cycle,	01
5.4	Hormonal regulation of ovulation.	01
5.5	Assisted Reproductive Technology	03
5.6	Contraceptive devices and vaccines	02



**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme CodePZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL33	<b>Lab in Developmental Biology</b>	Core Lab-9	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	40	60	100

**Preamble**

Explain the development of organ and organ system using slides , spotters and models

**Prerequisites**

Basic knowledge on embryogenesis and organogenesis

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Make use of microscope and mount a specimen	K1,K2
<b>CO2</b>	Identify the different stages of development –model organism	K3
<b>CO3</b>	Summarise,distinguish the structural organization of different organ and organ system	K4,K5
<b>CO4</b>	Spell the influence of hormones in development	K2,K3
<b>CO5</b>	Work in a clinical lab and perform experiments related to histology and developmental biology	K4,K5

**K1: Remember K2: Understand K3: Apply K4: Analyze K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	---	---	M	L	---
<b>CO2</b>	M	M	M	M	---
<b>CO3</b>	S	M	---	M	L
<b>CO4</b>	M	---	---	M	---
<b>CO5</b>	M	---	S	S	M

S- Strong M -Medium L-Low

1. Observation of different stages of chick blastoderm (24, 48, 72 and 96 hrs)
2. Temporary mounting of chick blastoderm (24, 48, 72 and 96 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 (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CE31	Applied Zoology	Interdisciplinary Paper-1	5	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Third	25	75	100

**Preamble**

Branch of biology deals with animals and animals life, including the study of the structure, physiology, development of economicall important animals

**Prerequisites**

Basic knowledge on different animal rearing methods.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Explain about economically important insects and familiar with the different types of animal cultures.	K1,K2
CO2	Make use of various animal culture techniques for heir livelihood.	K3
CO3	Tackle problems related to sustainable live stock development.	K4, K5
CO4	Develop as a skilled professional and animal scientists.	K3,K5
CO5	Establish animal farm or get job opportunities in animal husbandary firms, pursue research as their career prospective.	K5

**K1: Remember K2: Understand K3: Apply K4: Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	---	L	M	M
CO2	M	---	S	M	M
CO3	L	---	M	M	---
CO4	---	---	M	M	L
CO5	M	---	M	M	M

S- Strong M -Medium L-Low

## Blooms taxonomy: Assessment Pattern

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

### **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**

#### Lecture schedule

Sl. No	Topic	Lecture hrs.
1.1	Protozoan and Helminthic parasites Introduction Major infectious and communicable disease: Pathogenicity, symptoms, treatment, prevention of Syphilis & AIDS	2
1.2	Biology, pathogenicity and control measures of <i>Plasmodium vivax</i>	04
1.3	Biology, pathogenicity and control measures of <i>Entamoeba Histolytica</i> ,	03
1.4	Biology, pathogenicity and control measures of <i>Wuchereria bancrofti</i> & <i>Ascaris lumbricoides</i> .	03
1.5	Biology, pathogenicity and control measures of <i>Ascaris lumbricoides</i> .	03
2.1	Agricultural insect pest: Biology, damage caused and control Introduction	01
2.2	Agricultural insect pest: Biology, damage caused and control measures of any one insect pest of paddy ( <i>Scirpophaga incertulas</i> )	02
2.3	Agricultural insect pest: Biology, damage caused and control measures of any one insect pest of cotton ( <i>Helicoverpa armigera</i> )	02
2.4	Agricultural insect pest: Biology, damage caused and control measures of any one insect pest of sugarcane ( <i>Chilo infuscatellus</i> ).	02
2.5	Veterinary parasites: Biology, damage caused and control measures <i>Tabanus striatus</i> .	02
2.6	Veterinary parasites: Biology, damage caused and control measures <i>Bovicola bovis</i>	03
2.7	Veterinary parasites: Biology, damage caused and control measures <i>Haematobia irritans</i>	03
3.1	Apiculture: Species of honey bees - Newton's bee hive - rearing of honey bees - economic importance of honey..	05
3.2	Sericulture: Types of silk - life cycle of mulberry silkworm ( <i>Bombyx mori</i> ) and rearing.	05

3.3	Lac culture: Strains of lac insects - cultivation of lac insect and economic importance.	05
4.1	Induction on Aquaculture	02
4.2	Fish culture: Types of fish farming	03
4.3	Cultivable freshwater fishes of catla, mrigal & rohu - economic importance of fishes.	03
4.4	Prawn culture: Types of prawn fishery –Species of prawns- culture of fresh water prawns.	03
4.5	Pearl culture: Types of pearl oysters and their occurrence - pearl formation - pearl culture techniques. Teratogenesis	04
5.1	Vermiculture: Cultivable earthworm -	03
5.2	culture technique - economic importance.	03
5.3	Poultry: Housing - food and feeding of fowls -	03
5.4	breeds of poultry (layers and broilers)	03
5.5	disease control (Ranikhet & Pullorum).	03

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C41	<b>Immunology</b>	Core-10	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	25	75	100

**Preamble**

Immunology, also known as immunobiology, is the study of the vertebrate immune system. The immune system is the organ system responsible for protecting the organism from infection by micro-organisms, viruses, and parasites. As such, it covers a wide range of topics, from history of Immunology, Types of Immunity & Immunotechniques, Transplantation & Tumour Immunology, Immunological disorders & Vaccinology. This course will be an overview of a variety of topics that together describe the development and function of the immune system.

**Prerequisites**

Basic knowledge on organ and immune system

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Acquire indepth knowledge on the biology of the cells of immune system, including their development and specific functions	K1,K2
CO2	Interpret how cells interact with each other in the formation of an immune system.	K2,K3
CO3	Explain the molecular basis of how immune system identifies pathogens	K2,K5
CO4	Appraise the importance of immunodiagnosis, immunotherapy and vaccination.	K4,K5
CO5	Skilled at immunological techniques, experimental basis and reasoning that underlies the materials in the course.	K3,K5

**K1: Remember K2: Understand K3: Apply K4: Analyze K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	M
CO2	M	S	L	M	---
CO3	S	S	L	M	L
CO4	L	---	L	L	---
CO5	S	---	S	S	L

S- Strong M -Medium L-Low

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Remember -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
	<b>60</b>	<b>60</b>	<b>150</b>

**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.

**Lecture schedule**

	<b>Topic</b>	<b>lecture hrs.</b>
1.1	Immunology overview, Types of Immunity.	2
1.2	Innate and Adaptive Immunity-Characteristic features	2
1.3	Organs of Immune system ; Ontogeny and development of immune cells	4
1.4	Antigens ,Haptens ,Adjuvants and Immunogens- Types and properties: Antibodies- Types, structural and functional properties	4
2.1	B cell maturation, activation and differentiation ,BCR complex	4
2.2	T cell maturation, activation and differentiation, TCR complex	4
2.3	MHC , antigen processing and presentation	2
2.4	Antigen Antibody interactions -principle	2
3.1	Cytokines – functional properties, cytotoxic T cells, NK cells and ADCC	1

3.2	Complement activation-Classical pathway	2
3.3	Alternate pathway of complement activation. Lectin pathway	2
3.4	Hypersensitivity Reactions –Type I- Type IV	3
3.4	Immunology of infectious diseases – Viral, bacterial	2
3.5	Immunology of infectious diseases – protozoan ,fungal and helminthes.	2
4.1	Tolerance , Autoimmunity and types	2
4.2	Immunodeficiency diseases – Phagocytic, complement deficiencies	2
4.3	Immunodeficiency diseases – humoral, cell mediated, combined immune deficiencies, Acquired Immunodeficiency	3
4.4	Immunization –active and passive ,Microbiome, Types of vaccine	2
4.5	Tumour antigens ,Immunity to Tumour ,Tumour Immune evasion strategies ,Tumour Immuno diagnosis.	3
5.1	Transplantation antigens and Types of Transplantations, Mechanism of Transplantation acceptance and Rejection	3
5.2	Immunotechniques and Immunotechnology	3
5.3	Hybridoma technology, Antibody engineering	4
5.4	Immunoinformatics	2

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code: PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL41	Lab in Immunology	Core Lab-10	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	40	60	100

### Preamble

Brief about different immunological techniques. Explain how our immune system protect us from infection and disease. Employ laboratory techniques that basically develop the preanalytical, analytical and post analytical skills for the performance of the tests.

### Prerequisites

Basic skills related to animal physiology and immune system.

### Course Outcomes

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Differentiate different lymphoid organs.	K1,K2
CO2	Demonstrate antigen for immune response.	K2,K3
CO3	Demonstrate agglutination assays	K2,K3
CO4	Portray preanalytical, analytical and post analytical skills for the performance of the various diagnostic tests.	K3,K4
CO5	Start an diagnostic lab or to get a job opportunity in clinical labs	K5

**K1: Remember K2: Understand K3: Apply K4: Analyse K5: Evaluate**

### Mapping of Course Outcomes with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	---	M	---
CO2	M	---	S	---	L
CO3	M	---	S	---	L
CO4	M	---	S	S	L
CO5	L	---	M	S	M

S- Strong M -Medium L-Low

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), 3<sup>rd</sup> ed., Blackwell Publishing, London.
2. Garvey J.S., Cremer N.E and Sussdorf D.H., Methods in Immunology, (1983), 3<sup>rd</sup> 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.

**Thiagarajar College (Autonomous):: Madurai – 625 009**

**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code PZO

CourseCode	Course Title	Category	L	T	P	Credit
PZO19 C42	<b>Ecology and Biodiversity</b>	Core-11	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	25	75	100

**Preamble**

The course explains the basic concepts, components of ecosystems, types of biodiversity and different indices. The main focus of the course is on the ecology of ecosystem, community ecology, bio-geographical zones of India, global environmental change and biological diversity. It also explains the in-situ and ex-situ conservation of bio-resources and Environmental Legislation.

**Prerequisites**

Basic knowledge on environmental science, species distribution and biodiversity.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Compare the biotic and abiotic interactions, theory and principles of ecosystem ecology and Community Ecology.	K1,K2
<b>CO2</b>	Demonstrate an understanding of key ecological interactions and processes: Population Ecology – Characterization, growth curves, population regulation, life history strategies of metapopulation.	K2, K3
<b>CO3</b>	Interpret the application of tools for Pollution measures like cytogenetic bioassay, Ames test, DNA probes and immunoassay, BOD and Gas biosensors, for monitoring the environmental pollution.	K3,K5
<b>CO4</b>	Explain scales and patterns and threats in biological diversity with the sustainable management aiming at the conservation of species and habitats.	K4, K5
<b>CO5</b>	Know and apply the rules and recommendations related to environmental protection.	K2, K1

**K1: Remember K2: Understand K3: Apply K4: Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5
<b>CO1</b>	S	S	---	L	M
<b>CO2</b>	S	---	M	M	M
<b>CO3</b>	L	---	S	S	L
<b>CO4</b>	M	---	L	M	L
<b>CO5</b>	S	---	L	S	M

S- Strong M -Medium L-Low

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

### **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, interdemic 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

### lecture schedule

	Topic	lecture hrs.
1.1	<b>The Environment:</b> Physical environment; biotic environment; biotic and abiotic interactions.	1
1.2	<b>Ecosystem Ecology:</b> 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).	3
1.3	<b>Community Ecology:</b> Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.	2
2.1	<b>Ecological Succession:</b> Types; mechanisms; changes involved in succession; concept of climax.	1
2.2	<b>Habitat and Niche:</b> Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.	2

2.3	<b>Population Ecology:</b> Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.	2
2.4	<b>Species Interactions:</b> Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.	1
3.1	<b>Biogeography:</b> Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.	2
3.2	<b>Applied Ecology:</b> 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).	2
3.3	<b>Pollution monitoring/measurement:</b> plant and animal test systems in bioassays, cell biology, molecular biology and biosensors in environmental monitoring.	2
4.1	<b>Biological diversity:</b> 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.	3
4.2	<b>Threats of biodiversity:</b> habitat loss, poaching of wildlife, man-wildlife conflicts; IUCN categories of threat, engendered and endemic species of India, red data book	2
4.3	Hot spots of biodiversity; India as a mega-diversity nation.	1
5.1	<b>Wild Life/Biodiversity Conservation:</b> Necessity for conservation; organization involved in wildlife conservation – IUCN, UNEP, MAB, WWF, EPA, NWAP.	1
5.2	<b>Types of conservation of Biodiversity:</b> <i>in-situ</i> (biosphere reserves, national parks, wild life sanctuaries, sacred grooves) and <i>ex-situ</i> conservation (Zoological and Botanical gardens, cryopreservation, tissue culture);	2
5.3	Indian case studies on conservation/management strategy (Project Tiger and Elephant).	1
5.4	<b>Environmental Legislation:</b> Wildlife (Protection) Act, 1972 and Environmental (Protection) Act, 1986.	2



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**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code: PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL42	<b>Lab in Ecology and Biodiversity</b>	Core Lab-11	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	40	60	100

**Preamble**

Elaborates on scientific methods appropriate to environmental issues and improvement.  
Provide field and laboratory experience

**Prerequisites**

Knowledge on different ecosystem and animal diversity

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Make a survey and abundance of an organism in a geographical area.	K1,K3
CO2	Analyse the quality of water and pollution status of different environment.	K2,K4
CO3	Analyse the biodiversity data statistically and present graphically.	K2,K4
CO4	Apply the skills acquired to meet the needs of oneself and society	K4,K5
CO5	Assume job in companies or organisation involved in environmental monitoring. Employ the skills acquired to carry out research projects	K3

**K1: Remember K2: Understand K3: Apply K4: Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	---	M	M
CO2	S	---	S	S	M
CO3	M	---	S	L	---
CO4	M	---	S	S	M
CO5	L	---	S	S	L

S- Strong M -Medium L-Low

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.
  - a. Calculation of diversity indices. Survey on domestic biodiversity

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**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code: PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 C43	<b>Bioinformatics</b>	Core-12	4	1	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	25	75	100

**Preamble**

Bioinformatics is an interdisciplinary course that emphasizes the integration of computer science with biology. A foundation in biology, computer science, and statistics provides the basis for developing and applying computational methods to test biological hypotheses.

**Prerequisites**

Basic knowledge on softwares. Nucleic acids and proteins organization

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
<b>CO1</b>	Familiarise with network concepts, in silico approaches, biological databases available	K1,K2
<b>CO2</b>	Assume computer knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics	K2,K4
<b>CO3</b>	Determine“sequence to structure prediction” –concept	K4,K5
<b>CO4</b>	Extract information from large databases and to use this information in computer modelling	K2,K3
<b>CO5</b>	Assess and apply bioinformatic tools in biomedical research	K2,K5

**K1: Remember K2: Understand K3: Apply K4: Analyse K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	M	S	S	S
<b>CO2</b>	---	---	S	S	M
<b>CO3</b>	S	S	S	M	L
<b>CO4</b>	---	---	S	L	---
<b>CO5</b>	S	---	S	S	M

S- Strong M -Medium L-Low

## Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	15% (9)	15% (9)	20% (30)
Understand -K2	15% (9)	15% (9)	20% (30)
Apply-K3	30% (18)	30% (18)	20% (30)
Analyze-K4	20% (12)	20% (12)	20% (30)
Evaluate-K5	20% (12)	20% (12)	20% (30)
Create-K6	<b>60</b>	<b>60</b>	<b>150</b>

### 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., New Delhi

### Reference Books

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

**Course Designers :Dr. RM.Murugappan, Dr.Poornima kkani and Dr.M.Karthikeyan**

	<b>Topic</b>	<b>lecture hrs.</b>
<b>Unit I</b>		
1.1	Internet concepts, Bioinformatics a multidisciplinary approach.	2
1.2	Scope and applications of Bioinformatics.	2
1.3	Biological databases- Nucleic acid databases (Genbank,DDBJ and EMBL)	4
1.4	Protein databases - primary, composite, secondary Specialized databases-SGD,TIGR	4
1.5	Structural databases -PDB, CATH ModBASE.	3
2.1	Sequence similarity search (FASTA and BLAST). Significance of E-value	5
2.2	Introduction to ORF and primer designing.	5
2.3	Secondary structure prediction:	3
2.4	GOR, Chou –Fasman, Hidden Markov method	7
<b>Unit III</b>		
3.1	Multiple sequence alignment (CLUSTAL W)	5
3.2	Conserved domain search (Motif).	3
3.3	Conserved domain search (Motif).Phylogenetic analysis- phylogenetic tree construction (Neighbor Joining method and Maximum parsimony).	7
<b>Unit IV</b>		
	Homology modeling - SPDB viewer.	4
	Ramachandran plot for evaluation of predicted structure.	4
	Data mining for drug designing and docking analysis.	4
	Sturcture visualization tool-RASMOL	3
<b>Unit V</b>		
5.1	Genomics-scope and applications of structural,comparative and functional genomics,	4
5.2	Microarray technology	4
5.3	Proteomics scope and applications of structural and functional-2D gel electrophoresis,	4
5.4	Mass spectroscopy and MALDI- TOF	3
	<b>Total</b>	<b>75</b>

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**Department of Zoology**

(For those joined M. Sc., Zoology on or after June 2019)

Programme Code: PZO

Course Code	Course Title	Category	L	T	P	Credit
PZO19 CL43	Lab in Bioinformatics	Core-12	-	-	3	2

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	4	60	100

**Preamble**

Provides hands on training on basic in silico analyses. Elaborates how bioinformatic tools can be utilized in biomedical research.

**Prerequisites**

Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Knowledge Level
CO1	Retrieve nucleic acid and protein sequences	K3
CO2	Predict evolutionary relationship between different species	K3,K4
CO3	Predict and validate the structure of a protein, drug design	K3,K4
CO4	Outline the intersection of life and information sciences	K1,K5
CO5	Work in a lifescience division of software, pharmaceutical industry	K3

**K1: Remember K2: Understand K3: Apply K4: Analyze K5: Evaluate**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	---	---	S	S	M
CO2	S	----	---	L	---
CO3	L	S	S	M	L
CO4	S	M	---	M	---
CO5	---	---	S	S	L

S- Strong M -Medium L-Low

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**

(For those joined M. Sc., Zoology on or after June 2019)

**Programme Code PZO**

Course Code	Course Title	Category	L	T	P	Credit
PZO19PJ41	<b>Project</b>	CoreElective-4	-	-	6	6

Year	Semester	Int. Marks	Ext.Marks	Total
Second	Fourth	50	50	100

**Preamble**

Expose to collect and read literature pertaining to their project work. Train the students to do lab exercise individually under the guidance of their project guide

**Prerequisites**

Basic knowledge on the Laboratory techniques related to Life Sciences .Interpretation of data using statistical tools

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Level
<b>CO1</b>	Collect and analyse the scientific literature from web resources	K1,K2
<b>CO2</b>	Explain the theoretical basis of the tools, technologies and methods common to microbiology;	K2,K5
<b>CO3</b>	Demonstrate practical skills in the use of tools, technologies and methods common to microbiology,	K3,K4
<b>CO4</b>	Apply the scientific method and hypothesis testing in the design and execution of experiments.	K3
<b>CO5</b>	Construct a summative project or paper that draws on current research, and/or techniques in life sciences.	K5

**K1: Remember K2: Understand K3: Apply K4: Analyze K5: Evaluate**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	<b>M</b>	<b>L</b>	<b>S</b>	<b>L</b>	<b>-</b>
<b>CO2</b>	<b>S</b>	<b>-</b>	<b>S</b>	<b>S</b>	<b>L</b>
<b>CO3</b>	<b>S</b>	<b>-</b>	<b>S</b>	<b>L</b>	<b>L</b>
<b>CO4</b>	<b>S</b>	<b>-</b>	<b>L</b>	<b>L</b>	<b>-</b>
<b>CO5</b>	<b>S</b>	<b>M</b>	<b>S</b>	<b>S</b>	<b>L</b>

S- Strong M -Medium L-Low



## M.Sc., Zoology

Assessment values of course learning outcomes and their mapping with program specific outcomes (PSOs)

Code	Course Name	PSO1	PSO2	PSO3	PSO4	PSO5
PZO19C11	Biological chemistry and biophysics	12	10	8	3	8
PZO19CL11	Lab in Biological chemistry and biophysics	10	7	14	11	4
PZO19C12	Microbiology	11	9	12	13	6
PZO19CL12	Lab in microbiology	7	1	15	15	0
PZO19C13	Genetics and evolution	12	5	0	11	13
PZO19CL13	Lab in Genetics and evolution	12	6	8	12	8
PZO19CE11	Animal biology	12	3	8	12	11
PZO19C21	Entomology	14	2	13	15	9
PZO19CL21	Lab in Entomology	8	9	12	15	0
PZO19C22	Cell and molecular biology	14	10	9	15	11
PZO19CL22	Lab in Cell and molecular biology	12	8	15	15	6
PZO19C23	Bioinstrumentation	9	0	14	14	3
PZO19CL23	Lab in Bioinstrumentation	7	4	15	15	3
PZO19CE21	Biostatistics	8	0	9	13	11
PZO19C31	Genetic engineering and Biotechnology	6	8	14	15	12
PZO19CL31	Lab in Genetic engineering and Biotechnology	7	5	11	11	11
PZO19C32	Animal physiology	13	4	3	10	8
PZO19CL32	Lab in Animal physiology	8	2	8	8	10
PZO19C33	Developmental biology	10	8	9	10	10
PZO19CL33	Lab in Developmental biology	9	4	7	10	3
PBO19ID31	Plant Tissue Culture					
PZO19C41	Immunology	12	8	8	10	4
PZO19CL41	Lab in Immunology	10	3	11	8	5
PZO19C42	Ecology and Biodiversity	12	3	7	11	8
PZO19CL42	Lab in Ecology and Biodiversity	10	1	12	12	7
PZO19C43	Bioinformatics	9	5	15	12	8
PZO19CL43	Lab in Bioinformatics	7	5	9	11	4
PZO19PJ41	Project	14	3	13	9	3
PZO19ID31	Applied Zoology (for II M.Sc Botany students)					

## Diploma course

Course Name	PSO1	PSO2	PSO3	PSO4	PSO5
Clinical lab technology	13	2	15	14	6
Lab in clinical lab techniques	10	0	15	15	8

## M.Phil., Zoology

Code	Course Name	PSO1	PSO2	PSO3	PSO4	PSO5
MZO19C11	Research Methodology I	-	14	12	15	11
MZO19C12	Applied Entomology	15	12	14	13	5
MZO19C13	Research Methodology II	4	10	12	14	8
MZO19PJ21	Project	11	12	13	6	4

# **M.Phil., Zoology**

**(Programme Code: MZO)**

# **Programme outcome-PO (Aligned with Graduate Attributes)- Master of Philosophy (M.Phil.)**

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## **Knowledge and critical thinking**

Acquire, analyse, evaluate and interpret data using appropriate techniques. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

## **Problem solving**

Critically evaluate information and ideas from multiple perspectives. Employ conceptual, analytical, quantitative and technical skills in solving the problems and are adept with a range of technologies

## **Complementary Skills**

Recognize the need for information, effectively search for, retrieve, evaluate and apply that information gathered in support of scientific investigation or scholarly debate.

## **Communication efficiency**

Communicate and disseminate clearly and convincingly the research findings effectively in the academic community and to stakeholders of their discipline in written and or oral form. Elaborate on the ideas, findings and contributions in their field of interest to expert and non-expert audiences.

## **Environment, Ethical and Social relevance**

Apply ethical principles for societal development on environment context. Demonstrate the knowledge of and need for sustainable development.

## **Life-Long Learning**

Recognize the need, and have the ability, to engage in continuous reflective learning in the context of technological advancement.

## **Team work**

Work effectively in teams, both collaboratively and independently to meet a shared goal with people whose disciplinary and cultural backgrounds differ from their own. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

**THIAGARAJAR COLLEGE, MADURAI – 9.**  
**(Re-Accredited with ‘A’ Grade by NAAC)**  
**Department of –Zoology and Microbiology**

**Vision**

- Render exemplary quality education in Life Sciences and laboratory skills to produce generations of responsible, competent and employable graduates

**Mission**

- To provide a comprehensive set of courses in biological sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To prepare the students for entry-level research and teaching positions in biological sciences.
- To provide an educational environment that fosters the development of appropriate scientific vocabulary, reasoning skills, effective oral and written communication abilities for students.
- To create a holistic understanding of the allied subjects through interdisciplinary learning.

**Programme Educational Objectives (PEO)**

The objectives of this programme is to equip/prepare the students

PEO1	Engage in critical intellectual enquiry
PEO2	Demonstrate a thorough understanding of research methodologies and techniques at an advanced level
PEO3	Conduct innovative, high-impact and leading edge research
PEO4	Provide novel solutions to complex problems
PEO5	Work with others and make constructive contributions. Demonstrate leadership and advocacy skills

**Programme specific outcomes- M.Phil Zoology**

On the successful completion of M.Phil., Zoology the students will

PSO1	Design , write and execute research proposal Demonstrate practical fieldwork skills (e.g. ecological survey techniques, species identification and ecological impact assessments)
PSO2	Develop research orientation and familiar/acquaint with the principle, working mechanism and application of biological instruments
PSO3	Identify and define emerging problems in the field concerned. Offer innovative and original solutions to problems and issues Further able to apply appropriate techniques in multi-disciplinary research environment.
PSO4	Engage in intellectual exchange with researchers from other disciplines to address important research issues Collaborate effectively with researchers
PSO5	Appear for competitive exams like CSIR NET, SET etc and also to write research proposals for grants.

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

(For those joined M. Phil., Zoology on or after June 2019)

Programme Code MZO

Course Code	Course Title	Category	L	T	P	Credit
MZO19 C11	<b>Research Methodology I</b>	Core-1	6	-	-	6

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

**Preamble**

Research Methodology is a hands-on training course designed to impart knowledge in the foundational methods and techniques of academic research in various disciplines of Life sciences. The course imparts a research orientation among the scholars and to acquaint them with fundamentals of research methods.

**Prerequisites**

Basic idea about principle, working mechanism and application of biological instruments

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Level
<b>CO1</b>	Comprehend the working principle and applications of various analytical instruments.	K2
<b>CO2</b>	Spell the importance of animal cell culture techniques	K1,K5
<b>CO3</b>	Apply various nucleic acid analyses techniques	K4
<b>CO4</b>	Make use of the techniques learnt for execution of the project work	K3
<b>CO5</b>	Work in an educational institution or to pursue doctoral studies.	K6

**K1: Knowledge K2: Understand K3: Apply K4: Analyse K5: Evaluate K6: Create**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	---	S	S	S	S
<b>CO2</b>	---	S	S	S	M
<b>CO3</b>	---	S	M	S	M
<b>CO4</b>	---	S	S	S	S
<b>CO5</b>	----	M	L	S	L

S- Strong M -Medium L-Low

**Blooms taxonomy: Assessment Pattern**

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	20	20	-
Understand -K2	20	20	40
Apply-K3	20	20	40
Analyze-K4	20	20	40
Evaluate-K5	20	20	40
Create-K6	20	20	40
<b>Unit I</b>	<b>Total Marks</b>	<b>120</b>	<b>120</b>
			<b>200</b>

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. Kuby, J. 2003, Immunology 5th edition , W.H. Freeman and Company, Newyork.
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

	Topic	lecture hrs.
<b>Unit I</b>		
1.1	Working principle and applications of: Compound, Phase Contrast, Fluorescent, Polarised, Electron (Transmission and Scanning) and Confocal Microscopy.	3
1.2	Micrometry, cytophotometry and flow cytometry, live cell imaging.	3
1.3	Principles and techniques involved in histological and histochemical staining of animal tissues.	3
1.4	Microbial staining techniques – simple, differential, spore and capsule staining.	3
<b>Unit II</b>		
2.1	Working principle and applications of: pH meter	1
2.2	Centrifuge (Density gradient and Ultra) - preparative and analytical - sedimentation coefficient, RCF, RPM	2
2.3	GM counter, Liquid Scintillation counter, Sonicator,.	2
2.4	Lyophilizer and Micropipettes	1
2.5	Colorimeter, Spectrophotometer (visible, ultraviolet),	2
	FTIR,	1
2.6	Flame Photometer,	1

2.7	Atomic Absorption and Mass Spectrophotometer	2
<b>Unit III</b>		
3.1	Chromatographic techniques: Paper, Thin layer, Column, Gel filtration, Ion exchange, Gas and High Performance Liquid Chromatography.	4
3.2	Electrophoretic techniques: SDS-PAGE, Native PAGE, Agarose Gel Electrophoresis, 2D Gel Electrophoresis	4
3.3	Gel Documentation Blotting techniques: Southern, Northern and Western blotting.	4
<b>Unit IV</b>		
4.1	Animal cell culture techniques: Media types, primary and secondary culture, cell lines, types of culture.	2
4.2	Culture of mammalian cells, tissues and organs, somatic cell cloning and hybridization, transfection and transformation of cells.	2
4.3	Commercial scale production of animal cells, application of animal cell culture.-	2
4.4	<i>in vitro</i> testing of drugs and toxicity of pollutants.	2
4.5	Production of vaccines and pharmaceutical products.	2
4.6	Stem cells – types – isolation - culture and applications	2
<b>Unit V</b>		
5.1	PCR – working principle, types and applications.	1
5.2	DNA sequencing methods – Maxam and Gilbert, Sanger and automation methods, next generation sequencing	2
5.3	Protein sequencing.	1
5.4	DNA and protein microarray	1
5.5	Immunotechniques: Agglutination and precipitation assays – immunoelectrophoresis – immunofluorescence – immunohistochemistry-ELISA-RIA.	2
5.6	Hybridoma technology	1
5.7	Antibody engineering – Phage display techniques	2
	Total	60



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

(For those joined M. Phil., Zoology on or after June 2019)

Programme Code MZO

Course Code	Course Title	Category	L	T	P	Credit
MZO19 C12	Applied Entomology	Core-2	6	-	-	6

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

**Preamble**

It provides the detailed information on economically important insect orders, including their characteristic feature. Applied entomology elaborate the impact of insects (both positive and negative) on human health, agriculture, and the environment. Discuss the techniques and methods that are useful for the management of harmful insects that cause significant damage to the crops. It also explain the detailed account on the management of harmful insects by adopting various methods, including IPM.

**Prerequisites**

The student should identify common insect in the crop fields and should possess knowledge on common pest control measures.

**Course Outcomes**

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Classify and identify the insects on agricultural crops	K1
CO2	Plan and implement plant protection and pest control measures according to the IPM principles in different crop ecosystem	K2,K4
CO3	Elaborate on Insect host relationship	K3
CO4	Demonstrate practical fieldwork skills (e.g. ecological survey techniques, species identification and ecological impact assessments)	K2,K5
CO5	Implement the theoretical knowledge learnt in the farm. Lab- to-land approach	K5,K6

**K1: Knowledge K2: Understand K3: Apply K4: Analyse K5: Evaluate K6: Create**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	M
CO2	S	M	S	S	L
CO3	S	M	S	M	L
CO4	S	M	S	M	L
CO5	S	S	S	S	---

S- Strong M -Medium L-Low

## Blooms taxonomy: Assessment Pattern

Blooms Taxonomy	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20	20	-
Understand -K2	20	20	40
Apply-K3	20	20	40
Analyze-K4	20	20	40
Evaluate-K5	20	20	40
Create-K6	20	20	40
	120	120	200

**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 Willy & 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.RM.Murugappan Dr.C.Balasubramanian**

	<b>Topic</b>	<b>lecture hrs.</b>
<b>Unit I</b>		
1.1	An outline classification and taxonomy of Class Insecta down to order level	6
<b>Unit II</b>		
2.1	<b>Helpful insects</b> Productive insects – Honey bee and lac insect-	4
2.2	Insect pollinators	1
2.3	Predators and parasites-Weed killers-Soil builders-Scavengers	2
2.4	Aesthetic and scientific values of insects	1
2.5	<b>Harmful insects</b> - Insects pests of crops and control measures	2
2.6	Pests of rice-Pests of cotton- Pests of sugarcane- Pests of stored products	4
2.7	Insect pest in relation to public health and household with reference to Mosquito and Housefly	4
<b>Unit III</b>		
3.1	The idea of insect population Ecosystem and agro ecosystems	2
3.2	The ecological role of insect outbreak-	2
3.3	Regulation of insect population.	

3.4	Regulation of insect population Economic decision levels for Insect Pest- populations, Economic damage, Economic injury level, Economic threshold, Calculation of economic decision level..	3
3.5	Insect pest management - theory and practice	2
3.6	The concept and development of insect pest management- Ecological management of the crop environment	2
<b>Unit IV</b>		
4.1	Plant resistance and insects:.	1
4.2	Insect and host relationships.-Mechanism of resistance; Non – preference, antibiosis, tolerance, Factors mediating the expression of resistance	2
4.3	Physical and biological pest control: Methods and principle of pest control.	2
4.4	Natural control Application of artificial or direct method-	1
4.5	Biological control Integrated control-Role in juvenile mimics and pheromones in the management of insect pests-	2
4.6	Recent advances in using plant products in the management of insect pests-	2
4.7	Microbial bio insecticides	1
4.8	IPM in cotton	2
<b>Unit V</b>		
5.1	Insecticides classification of Insecticides	2
5.2	Classification based on mode of entry	2
5.3	-Classification based on mode of action	2
5.4	Classification based on chemical nature	2
5.5	Plant production appliances: Dusting and dusters-Aerosols- Spraying and sprayers- Vaporisers	3
	Total	60

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

(For those joined M. Phil., Zoology on or after June 2019)

Programme Code MZO

Course Code	Course Title	Category	L	T	P	Credit
MZO19C13	Research Methodology II		4	2	-	4

Year	Semester	Int. Marks	Ext.Marks	Total
First	First	25	75	100

**Preamble**

Research scholars will be exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, report writing, and presentation. Specifically, the course introduces them to the basic concepts used in research. It includes discussions on sampling techniques, research designs and techniques of analysis.

**Prerequisites**

Basic idea on research design, thesis writing and data analyses

**Course Outcomes**

On the completion of the course the student will be able to

	Course outcomes	Knowledge Level
CO1	Identify, design and execute research problems suggested.	K2,K3
CO2	Search and collect relevant literature from various sources	K1,K3
CO3	Elaborate their findings in conferences.	K5,K6
CO4	Analyse and Prepare research report and thesis	K4,K5,
CO5	Placed in a research institute to conduct disciplined research under supervision in an area of their choosing.	K3

**K1: Knowledge K2: Understand K3: Apply K4: Analyse K5: Evaluate K6: Create**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	---	S	M	S	---
CO2	M	S	S	S	M
CO3	---	L	M	M	M
CO4	---	L	M	S	M
CO5	M	M	S	S	M

S- Strong M -Medium L-Low

<b>Blooms Taxonomy</b>			
	<b>CA</b>		<b>End of Semester Marks</b>
	<b>I Internal Marks</b>	<b>II Internal Marks</b>	
Knowledge -K1	20	20	-
Understand -K2	20	20	40
Apply-K3	20	20	40
Analyze-K4	20	20	40
Evaluate-K5	20	20	40
Create-K6	20	20	40
	120	120	200

**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 Schinzing.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

	Topic	lecture hrs.
<b>Unit I</b>		
1.1	Objectives and significance of research,	2
1.2	types of research – descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical	5
1.3	Literature review - various sources of information; .	3
1.4	Defining and devising of research problem.	2
<b>Unit II</b>		
2.1	Hypothesis - null and alternate hypothesis - hypothesis testing	2
2.2	Exploratory and descriptive research design - concept, types and uses.	2
2.3	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,	3
2.4	Determining size of the sample - practical considerations in sampling and sample size;	2
2.5	Sample collection, transport, handling and preservation of microorganisms, planktons, insects, animals from natural	3

	and lab bred population; Biological models	
<b>Unit III</b>		
3.1	Observation and collection of data - methods of data collection	1
3.2	Data Processing and analysis strategies - univariate analysis (frequency tables, bar charts, pie charts, percentages), measures of central tendency and dispersion.	3
3.3	bivariate analysis - cross tabulations and chi-square test including testing hypothesis of association	3
3.4	Correlation, Regression,	3
3.5	ANOVA – one and two way, DMRT, Tukey test; R software.	2
<b>Unit IV</b>		
4.1	Thesis writing - Introduction, Review of literature, Methodology, Results - illustrations and tables, Discussion, Bibliography, Foot notes and proof correction.	4
4.2	Oral presentation - planning and preparation - use of visual aids - importance of effective communication	4
4.3	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	4
<b>Unit V</b>		
5.1	Impact of research on environment - GMO; Biosafety measures – risk assessment and management	3
5.2	Institutional biosafety - ethical and animal welfare committee; Ethical, legal and social issues related to research; Ethical implications of biotechnological products and techniques	3
5.3	IPR - copy right - patent - patent law – patenting of biological process and products in India – trademark - WIPO;	3
5.4	Reproduction of published material - Plagiarism – Acknowledgement	3
	Total	60



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

(For those joined M.Phil., Zoology on or after June 2019)

**Programme Code : MZO**

Course Code	Course Title	Category	L	T	P	Credit
MZO19 PJ21	Project		-	-	6	6

Year	Semester	Int. Marks	Ext.Marks	Total
First	Second	100	100	200

**Preamble**

Learn to collect and read literature pertaining to their project work. Train the students to do lab exercise individually under the guidance of their project guide. Design an experiment to meet the objective of the project.

**Prerequisites**

Basic knowledge on the Laboratory techniques related to Life Sciences .Interpretation of data using statistical tools, basic computer literacy.

**Course Outcomes**

**On the completion of the course the student will be able to**

	Course outcomes	Level
<b>CO1</b>	Collect and analyse the scientific literature from web resources. Critically evaluate information and ideas from multiple perspectives Integrate knowledge at the forefront of a particular field	K1,K2
<b>CO2</b>	Design an original research that takes a new technological, methodological, or theoretical approach	K2,K5
<b>CO3</b>	Demonstrate theoretical basis and practical skills in the use of tools, technologies and methods common to life sciences	K3,K4
<b>CO4</b>	Apply the scientific method and evaluate and interpret the results obtained using statistical tools.	K3,K5
<b>CO5</b>	Articulate analyses and propose a summative project or paper that propose solutions in response to social issues . Communicate and disseminate research findings effectively in the academic community and to stakeholders in society	K5,K6

**K1: Remember K2: Understand K3: Apply K4: Analyze K5: Evaluate K6 Create**

**Mapping of Course Outcomes with Programme Specific Outcomes**

	PO1	PO2	PO3	PO4	PO5
<b>CO1</b>	S		S	L	-
<b>CO2</b>	S	S	S	L	-
<b>CO3</b>	M	S	L	L	M
<b>CO4</b>	M	S	S	L	M
<b>CO5</b>	S	S	S	M	-

S- Strong M -Medium L-Low

## **M.Phil., Zoology**

<b>Code</b>	<b>Course Name</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
MZO19C11	Research Methodology I	-	14	12	15	11
MZO19C12	Applied Entomology	15	12	14	13	5
MZO19C13	Research Methodology II	4	10	12	14	8
MZO19PJ21	Project	11	12	13	6	4