B.Sc. Microbiology

Programme Code - UMB

(SF)

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

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 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	To prepare a new generation of microbiologists, capable of excelling in careers of their choosing.
PEO2	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
PEO3	To undertake research studies, collect relevant literature, design experiment, use experimental techniques, analysis the results statistically, report and publish the findings
PEO4	Job opportunities in pharmaceutical, food and bioprocess industries
PEO5	Basics and current updates in the areas of Microbiology, Biochemistry, Molecular Biology, Immunology, Genetic Engineering, Industrial 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

PSO1	Comprehend the core concepts, methods & practices in life sciences especially Microbiology, Biotechnology etc.,
PSO2	Isolate, identify and characterize different types of microorganisms and their metabolites
PSO3	Interpret the etiology of infectious diseases, their transmission, treatment, control and prevention methods.
PSO4	Acquire theoretical basis and practical skills in the use of basic tools, technologies and methods common to different disciplines of life sciences.
PSO5	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. 2020 batch onwards)
Programme Code-UMB

Semester – I

Course	Code No	Subject	Hrs/ Week	Credit	Total Hrs	Max Marks CA	Max Marks SE	Total
Part I	U20P121	Tamil	6	3	90	25	75	100
Part II	U20EN11	English	6	3	90	25	75	100
Core 1	UMB20C11	General Microbiology	4	4	60	25	75	100
Core 2	UMB20C12	Bioinstrumentation	4	4	60	25	75	100
Core lab 1	UMB20CL11	Lab in Microbiology	2	1	30	40	60	100
Generic Elective	UCH20GE11Z	General Chemistry I	4	4	60	25	75	100
Generic Elective lab	UCH20GL21Z	Anc. Chemistry lab	2	-	30	-	-	-
EVS	U20ES11	Environmental Studies	2	2	30	15	35	50
TOTAL			**30**	**21**				

Semester – II

Course	Code No	Subject	Hrs/ Week	Credit	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U20P121	Tamil	6	3	90	25	75	100
Part II	U20EN21	English	6	3	90	25	75	100
Core 3	UMB20C21	Biochemistry	4	4	60	25	75	100
Core 4	UMB20C22	Cell Biology	4	4	60	25	75	100
Core lab 2	UMB20CL21	Lab in Biochemistry and Cell Biology	2	1	30	40	60	100
Generic Elective	UCH20GE21Z	General Chemistry II	4	4	60	25	75	100
Generic Elective lab	UCH20GL21Z	Chemistry Lab	2	2	30	40	60	100
	U20VE21	Value Education	2	1	30	15	35	50
TOTAL			**30**	**22**				

Semester –III

Course	Code No	Subject	Hrs/ Week	Credit	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U20P131	Tamil	6	3	90	25	75	100
Part II	U20EN31	English	6	3	90	25	75	100
Core 5	UMB20 C31	Molecular Biology	4	4	60	25	75	100
Core 6	UMB20 C32	Microbial Physiology and Metabolism	4	4	60	25	75	100
Core lab 3	UMB20 CL31	Lab in Molecular Biology	2	1	30	40	60	100
Generic Elective	UMB20 GE31	Agricultural Microbiology	4	4	60	25	75	100
Generic Elective lab	UMB20 GL31	Lab in Agricultural Microbiology	2	1	30	40	60	100
NME1	UMB20 NE31	Health Awareness	2	2	30	15	35	50
TOTAL			**30**	**22**				

Semester – IV

Course	Code No	Subject	Hrs/ Week	Credit	Total Hrs	Max Mark CA	Max Marks SE	Total
Part I	U20P141	Tamil	6	3	90	25	75	100
Part II	U20EN41	English	6	3	90	25	75	100
Core 7	UMB20C 41	Microbial Genetics	4	4	60	25	75	100
Core 8	UMB20C 42	Medical Bacteriology and Virology	4	4	60	25	75	100
Core lab 4	UMB20C L41	Lab in Microbial Genetics	2	1	30	40	60	100
Generic Elective	UMB20G 41	Environmental Microbiology	4	4	60	25	75	100
Generic Elective lab	UMB20G L41	Lab in Environmental Microbiology	2	1	30	40	60	100
NME2	UMB20N E41	Clinical Lab Technology	2	2	30	15	35	50
TOTAL			**30**	**22**				

Internship*

Semester --V

Course	Code No	Subject	Hrs/ Week	Credit	Total Hrs	Max Mark CA	Max Marks SE	Total
Core 9	UMB20C51	Mycology and Parasitology	5	5	75	25	75	100
Core 10	UMB20C52	Food Microbiology	5	5	75	25	75	100
Core 11	UMB20C53	Clinical Lab Technology	5	5	75	25	75	100
Core 12	UMB20C54	Microbial Quality Control in Industries / Probiotics and fermentation techniques	1+1*	1	15	15	35	50
Core lab 5	UMB20CL51	Lab in Mycology and Parasitology	2	1	30	40	60	100
Core lab 6	UMB20CL52	Lab in Food Microbiology	2	1	30	40	60	100
Core lab 7	UMB20CL53	Lab in Clinical Lab Technology	2	1	30	40	60	100
Core Elective	UMB20CE51 A / B	Epidemiology / Pharmacology	5	5	75	25	75	100
SBE I	UMB20SE51 A/B	Tissue culture techniques/ Biofertilizers	2	2	30	15	35	50
TOTAL			**30**	**26**				
	U20SS51	Soft Skills – Self Study Paper	-	5	-	-	100	100
	UMB20IN	Internship	-	2	-	15	35	50

Semester-VI

Course	Code No	Subject	Hrs/ Week	Credit	Total Hrs	Max Mark CA	Max Marks SA	Total
Core 12	UMB20 C61	Immunology	5	5	75	25	75	100
Core 13	UMB20 C62	Industrial Microbiology	5	5	75	25	75	100
Core 14	UMB20 C63	rDNA technology and Genomics	5	5	75	25	75	100
Core 15	UMB20 C64	Bioethics and Biosafety /IPR	1+1*	1	15	15	35	50
Core lab 8	UMB20 CL61	Lab in Immunology	2	1	45	40	60	100
Core lab 9	UMB20 CL62	Lab in Industrial Microbiology	2	1	45	40	60	100
Core Lab 10	UMB20 CL63	Lab in rDNA technology and Genomics	2+1*	1	45	40	60	100
Core Elective II	UMB20 CE61 A / B	Biostatistics and Bioinformatics / Microbial Genomics	5	5	75	25	75	100
SBE II	UMB20 SE61 A / B	Biopreservative and Biopackaging / Bionanotechnology /	2	2	30	15	35	50
TOTAL			**30**	**26**				
Part V	-		-	1		75	25	100

*tutorial class

A) Consolidation of contact hours and credits: UG

Semester	Contact Hrs/ Week	Credits
I	30 hrs	21
II	30 hrs	22
III	30 hrs	22
IV	30 hrs	22
V	30 hrs	26
VI	30 hrs	26
Part - V	-	01
Total	180 hrs	140
V	Additional credit (Self study paper)	5
	Internship	2

B) Curriculum Credits: Part wise

		No of papers	Credits per paper	Total credits
Part I	**Tamil**	**4**	**3**	**12**
Part II	**English**	**4**	**3**	**12**
Part III	**Core Theory**	**8+6+2**	**4/5/1**	**64**
	Core lab	**10**	**1**	**10**
	Core Elective	**2**	**5**	**10**
	Generic Elective Theory	**4**	**4**	**16**
	Generic Elective Theory	**2**	**2**	**4**
Part IV	**AECC**	**1+1**	**2+1**	**3**
	NME	**2**	**2**	**4**
	SEC	**2**	**2**	**4**
	VE	**1**	**1**	**1**
Part V (NSS / NCC / Physical Education)				**1**
Grand total				**140**

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B. Sc., Microbiology on or after June 2020)
Programme Code-UMB

CourseCode	Course Title	Category	L	T	P	Credit
UMB20C31	Molecular Biology	Core 5	4	-	-	4

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course illustrates the ideology of genetic material in all life forms and the essence of central dogma of Molecular Biology. 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	Expected Proficiency %	Expected Attainment %
CO1	Explain the organization of chromosomes,early findings and topologyof DNA	75	70
CO2	Illustrate the chemical composition, structure and function of RNA	75	70
CO3	Summarize the molecular mechanisms, types and enzymes involved in the replication.	70	60
CO4	Explain the mechanismsof prokaryotic and eukaryotic transcription.	75	65
CO5	Illustrate the deciphering of genetic code and explain the process of mRNA decoding into proteins.	75	65

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**M**	**S**	**M**	**S**	--	**S**
CO2	**M**	**S**	**M**	**S**	--	**S**
CO3	**L**	**S**	**M**	**M**	--	**M**
CO4	**L**	**M**	**M**	**M**	--	**M**
CO5	**L**	**M**	**M**	**M**	--	**M**

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Molecular Biology

Unit I

Structural organization of chromosomes: prokaryotes (circular and linear) and eukaryotes, DNA as genetic material (Griffith and Hershey - Chase experiment), Physical and chemical properties of DNA, Chargaff rule, Watson-Crick model, DNA conformation: A, B, Z.Topology of DNA, denaturation and renaturation, hypo and hyperchromicity, C-value paradox, Organelle DNA: Chloroplast and Mitochondria. Introduction and function of DNases.

Unit II

RNA as genetic material (Gierer and Schramm; Fraenkel-Conrat and Singerexperiment), Structures of RNA: (m-RNA (polycistronic and monocistronic), r-RNA, t-RNA).Split genes, concept of introns and exons, RNA splicing, spliceosome machinery, concept of alternative splicing, poly-adenylation and capping, processing of rRNA, RNA interference: si RNA and miRNA and their significance. Structure and function of tmRNA,introduction and function of RNases,introduction to CRISPR.

Unit III

Modes of replication: conservative, semiconservative (Meselson and Stahl experiment) and dispersive method. Enzymes and proteins involved in DNA replication: DNA polymerases, ligase, primase, topoisomerase, telomerase-replication of linear ends. Stages of replication, types and enzymology of DNA polymerase, Okazaki fragments, origin of replication, initiation, elongation, and termination. Types of replication: unidirectional, bidirectional and Plasmid (theta and rolling) replication. Inhibitors of replication.

Unit IV

Transcription in prokaryotes and eukaryotes, RNA polymerases and general transcription factors, Transcription signals, promoters- concept and strength of promoter, stages of transcription: initiation, elongation, backtrack RNA and termination: rho dependent and independent. Glimpse of alternative sigma factors,inhibitors of transcription.

Unit V

Genetic code: Deciphering genetic code, T4*rII* mutants and their use in elucidation of genetic code, characteristics of genetic code, Nirenberg and Matthaei *experiment*, wobble hypothesis, genetic code reassignment. Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides in prokaryotes and eukaryotes, inhibitors of translation.

Text Books

1. Lodish, H., Berk, A., Zipursky, S.L., Matsudara, P., Baltimore, D. and Darnell, J. 2016. Molecular Cell Biology, 8th Ed. W. H. Freeman and Company,New York.
2. Malacinski, G.M. 2015. Freifelder's essentials of Molecular biology, 4th edition. Jones & Barlett learning, NewDelhi.

References

1. Vijai Singh and Pawan K. Dhar. 2020. Genome Engineering via CRISPR-Cas9 System, Elsevier.
2. Krebs,J.E.,Goldstein,E.S.,Kilpatrick,S.T.2011.Lewin'sGenes10th Ed.,JonesandBartlett.UK.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Robersts, K. and Walter, P. 2008. Molecular Biology of the Cell, 6thEd. Garland Publishing,Inc., USA.
4. Watson, J.D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. and Weiner, A. M. 2004. Molecular Biology of the Gene, 4thEd. Pearson Education Inc., NewYork.
5. Griffiths, A.J.F., Lewontin, R.C., Gelbart, W.M. and Miller, J.H. 2002. Modern Genetic Analysis. 2ndEd. W.H. Freeman and Company, NewYork.

Web Resources

1. Replication models - https://www.youtube.com/watch?v=ZDqsojQ8A5k–
2. Meselson and Stahl experiment https://www.youtube.com/watch?v= JeoegQaF8ig&t=75s
3. Transcription -https://www.youtube.com/watch?v=DKgJPhvCDU8

Course Designer

Dr. C.M. Archana
Assistant Professor

Lecture Schedule

Units	Topic	Lecture hrs
Unit I		
1.1	Structural organization of chromosomes- prokaryotes (circular and linear) and eukaryotes; DNA as genetic material (Griffith and Hershey - Chase experiment)	4
1.2	Physical and chemical properties of DNA- Chargaff rule, Watson-Crick model, DNA conformation- A, B, Z	3
1.3	Topology of DNA, denaturation and renaturation, hypo and hyperchromicity, C-value paradox	3
1.4	Organelle DNA – Chloroplast and Mitochondria. Introduction and function of DNases.	2
Unit II		
2.1	RNA: Genetic material – Gierer and Schramm; Fraenkel-Conrat and Singerexperiment; structures of RNA (mRNA (monocistronic and polycistronic), rRNA, tRNA)	3
2.2	Split genes, concept of introns and exons, RNA splicing, spliceosome machinery, concept of alternative splicing, poly adenylation and capping, processing of rRNA.	4
2.3	RNA interference - si RNA and miRNA and their significance, Structure and function of tmRNA, introduction and function of RNases, introduction to CRISPR.	3
Unit III		
3.1	Modes of replication: conservative, semiconservative (Meselson and Stahl experiment) and dispersive method.	3
3.2	Enzymes and proteins involved in DNA replication; DNA polymerases, ligase, primase, topoisomerase, telomerase- replication of linear ends.	3
3.3	Stages of replication- types and enzymology of DNA polymerase, Okazaki fragments, origin of replication, initiation, elongation, and	4

	termination	
3.4	Types of replication- unidirectional, bidirectional and Plasmid (theta and rolling) replication. Inhibitors of replication.	3
Unit IV		
4.1	Transcription in prokaryotes and eukaryotes – RNA polymerases and general transcription factors	3
4.2	Transcription signals, promoters – concept and strength of promoter, stages of transcription – initiation, elongation, backtrack RNA	4
4.3	Termination: rho dependent and independent	3
4.4	Glimpse of alternative sigma factors, inhibitors of transcription.	3
Unit V		
5.1	Genetic code: Deciphering genetic code, T4*rII* mutants and their use in the elucidation of genetic code, characteristics of genetic code	4
5.2	Nirenberg and Matthaei *experiment*, wobble hypothesis, genetic code reassignment. Charging of tRNA, aminoacyl tRNA synthetases	4
5.3	Mechanisms of Initiation, elongation and termination of polypeptides in prokaryotes and eukaryotes, inhibitors of translation.	4

Thiagarajar College (Autonomous):Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B.Sc., Microbiology on or after June 2020)
Programme Code-UMB

CourseCode	Course Title	Category	L	T	P	Credit
UMB20CL31	Lab in Molecular Biology	Core lab 3	--	--	2	1

L - Lecture T - Tutorial P - Practicals

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

Preamble

Impart hands on training in the molecular biology aspects of extraction, separation and estimation of proteins and nucleic acids.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Perform the isolation of DNA from bacterial culture.	80	90
CO2	Estimate the nucleic acids in a biological sample	80	90
CO3	Demonstrate the protein and nucleic acids separation through blotting techniques	85	95
CO4	Analyze the nucleic acids through electrophoresis techniques	80	90
CO5	Experiment with transferring exogenous genetic material into a bacterial cell through transformation	80	90

Mapping of Cos with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	--	S	M	S	--	S
CO2	--	M	M	S	--	S
CO3	--	L	L	M	--	S
CO4	--	S	M	S	--	S
CO5	--	L	M	M	--	M

Strong(S), Medium(M), Low(L)

Mapping of Cos with PSOs

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

Blooms Taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Lab in Molecular Biology

1. Extraction of DNA from *E. coli*.
2. Extraction of plasmid DNA from bacterial culture.
3. Estimation of DNA by DPA method.
4. Estimation of RNA by Orcinol method.
5. Determination of melting curve of DNA.
6. Restriction enzyme digestion.
7. Preparation of competent cell.
8. Bacterial Transformation and blue white screening for recombinant clones.
9. Agarose gel electrophoresis.
10. SDS-PAGE.
11. Blotting Techniques (Southern, Western) – Demonstration.
12. PCR – Demonstration.

References:

1. Sambrook, I., Fritsch, E.F. and Maniatis, T. 2012. 4thEd., Molecular Cloning 1, 2, 3 - A Laboratory Manual, Cold Spring Laboratory Press, USA.
2. Palanivelu. P. 2009. Analytical Biochemistry and Separation Techniques. Twentyfirst Century Publications, Madurai.
3. Rajamanickam, C.2001. Experimental protocols in basic molecular biology, Osho Scientific Publications,Madurai.
4. Brown, T.A. 1998. Molecular Biology Lab; Gene Analysis, Academic Press,London.
5. Ausubel, F.M., Roger, B., Kingston, R.E., Moore, D. A., Seidman J.G., Smith, J. A. and Kelvin, S. 1992. 3rdEd., Short Protocols in Molecular Biology, John Wiley & Sons Inc., NewYork.

Web Resources

1. DNA isolation - https://www.youtube.com/watch?v=tcPgdR9_t64&t=418s
2. Southern blotting - https://www.youtube.com/watch?v=ts96P-mRF9U
3. Transformation - https://www.youtube.com/watch?v=8admZaGsFHo

Course Designer:

Dr. C.M. Archana
Assistant Professor

Thiagarajar College (Autonomous): Madurai – 625 009

Department of Zoology and Microbiology

(For those joined B. Sc., Microbiology on or after June 2020)

Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20C32	Microbial Physiology and Metabolism	Core 6	4	--	--	4

L - Lecture T - Tutorial P - Practical

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

Preamble

Provides a conceptual understanding in knowing the microbial processes and energy production to carry out various metabolic activities. Emphasis on the various transport mechanisms in cells.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Outline the basic transport mechanisms in microorganisms	70	80
CO2	Define the thermodynamic laws and the basics of energy production	70	75
CO3	Explain the methods for ATP generation by photosynthetic reactions	60	70
CO4	Illustrate the concepts in energy production by aerobic heterotrophs	60	65
CO5	Apply and develop the generation of fuel using chemoorganotrophic bacteria	70	65

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**L**	**S**	**M**	**S**	**-**	**M**
CO2	**S**	**S**	**M**	**S**	**-**	**S**
CO3	**L**	**M**	**L**	**M**	**-**	**L**
CO4	**-**	**M**	**L**	**M**	**-**	**L**
CO5	**L**	**M**	**M**	**S**	**M**	**S**

Strong(S), Medium(M), Low(L)

Mapping of Cos with PSOs

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

Blooms Taxonomy	CA		End of Semester
	First	Second	
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**

Microbial Physiology and Metabolism

Unit I

Introduction to biomembranes,lipid bilayer.Membrane dynamics: Flip-flop, lateral diffusion, trans bilayer translocations.Biochemical activities of membrane: Osmosis, Diffusion, Facilitated diffusion and active transport, ABC transporter, aquaporins, ionophores. Cotransport: Uniport, symport and antiport. Group translocation across membrane,siderophore mediated -iron transport,Donnan equilibrium, Nernst equation.

Unit II

Bioenergetics: Laws of thermodynamics, enthalpy, entropy and free energy. Oxidation–reduction potential, Coupling of chemical reactions: Glycolysis, TCA cycle, Respiratory chain (ETC), Uncouplers and inhibitors. Oxidative phosphorylation, Chemiosmotic theory of Mitchell - efficiency of coupling. Physiology of sporulation in *Bacillus* and *Myxobacteria*.

Unit III

Photosynthetic microorganisms, pigments and their metabolisms, Photosynthetic Equation, oxygenic and anoxygenic types of photosynthesis, Light reaction in aerobic oxygenic phototrophic bacteria (Cyanobacteria), Light reaction in anaerobic anoxygenic phototrophic bacteria (Green and Purple bacteria), CO_2 fixation, Calvin cycle.

Unit IV

Fueling reaction in aerobic heterotrophs: Pentose Phosphate Pathway (HMP shunt), Phosphoketolase pathway, Entner-Doudoroff pathway, glyoxylate cycle. Fueling reactions 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, Stress response: Osmotic stress, oxygen, CO_2, pH, Temperature.

Text Books

1. Madigan, M. T., Kelley, B. S., Daniel, B. H., Matthew, S. W. and David, S. A. 2019.Brock Biology of Microorganisms, 15th Ed., Pearson Publications, New York.
2. Nelson, L. D. and Cox, M. M. 2017. Lehninger Principles of Biochemistry, 7th Ed., W. H. Freeman, New York.

References

1. Jacquelyn, B. G. and Black L. J. 2015. Microbiology – Principles and Explorations, 9th Ed., Library of Congress Cataloguing-in Publication Data, USA.
2. Sathyanarayana, U. and Chakrapani, U. 2013. Biochemistry, 4th Ed., Elsevier Publications, Co-published with Books and Allied, Haryana, India.
3. Moat, A.G. and Foster, J.W. 2009. Microbial Physiology, 4th Ed. John Wiley & Sons, New York.

4. Jyotsna Rathi, 2009. Microbial Physiology, Genetics and Ecology, Manglam Publications, New Delhi.
5. Byung H. K. and Geoffrey, M. G. 2008. Bacterial Physiology and Metabolism, Cambridge University Press, Singapore.

Web Resources:

1. Mechanisms of ATP generation https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Kaiser)/Unit_7%3A_Microbial_Genetics_and_Microbial_Metabolism/17%3A_Bacterial_Growth_and_Energy_Production/17.5%3A_Phosphorylation_Mechanisms_for_Generating_ATP
2. Sporulation and its mechanism - https://www.onlinebiologynotes.com/bacterial-spore-structure-types-sporulation-germination/

Course Designer

Dr. S. Subramani
Assistant Professor

Lecture Schedule

Unit	Topic	Lecture Hrs
Unit I		
1.1	Introduction to Biomembranes,lipid Bilayer	02
1.2	Membrane dynamics: Flip-flop, lateral diffusion, trans bilayer translocations.	02
1.3	Biochemical activities of membrane:Osmosis, diffusion,facilitated diffusion	01
1.4	active transport, ABC transporter, aquaporins, ionophores.	02
1.5	Cotransport:uniport, symport and antiport-Group translocation across membrane	01
1.6	Siderophore mediated -iron transport	01
1.7	Donnan equilibrium, Nernst equation	02
Unit II		
2.1	Bioenergetics: Laws of thermodynamics, enthalpy, entropy and free energy, Oxidation–reduction potential	02
2.2	Coupling of chemical reactions:Glycolysis, TCA cycle, Uncouplers and inhibitors,	03
2.3	Respiratory chain (ETC)	02
2.4	Oxidative phosphorylation – Chemiosmotic theory of Mitchell	02
2.5	efficiency of coupling	01
2.6	Physiology of sporulation in *Bacillus* and *Myxobacteria*.	01
Unit III		
3.1	Photosynthetic microorganisms, pigments and their metabolisms	02
3.2	Photosynthetic equation, Oxygenic and anoxygenic types of photosynthesis	02
3.3	Light reaction in aerobic oxygenic phototrophic bacteria (Cyanobacteria)	03
3.4	Light reaction in anaerobic anoxygenic phototrophic bacteria (Green and Purple bacteria)	03
3.5	CO_2 fixation, Calvin cycle	01
Unit IV		

4.1	Fueling reaction in aerobic heterotrophs – Pentose Phosphate Pathway (HMP shunt)	02
4.2	Phosphoketolase pathway, Entner-Doudoroff pathway	02
4.3	The glyoxylate cycle	01
4.4	Fueling reactions in anaerobic heterotrophs, anaerobic respiration	03
Unit V		
5.1	Fueling reaction in chemo – organotrophs: Acetogenesis and methanogenesis	04
5.2	Fueling reaction in chemolithotrophs: Hydrogen bacteria, sulphur bacteria, nitrifying bacteria	04
5.3	Methylotrophs and Methanotrophs	04
5.4	Gluconeogenesis and Glycogenesis	04
5.5	Stress response – Osmotic stress, oxygen, CO_2, pH, Temperature	03

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B. Sc., Microbiology on or after June 2020)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20GE31	Agricultural Microbiology	Generic Elective	4	--	--	4

L - Lecture T - Tutorial P - Practicals

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

Preamble

Summarises plant-microbe interactions and the comprehensive role of microorganism in plant growth. Emphasis on beneficial and pathogenic potential of microbes in plant growth and environment along with its control measures.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Explain the properties of soil and their associated microbes.	70	75
CO2	Interpret biological nitrogen fixation of microbes to facilitate plant growth	70	80
CO3	Explain the production of biofertilizers and biotech feed by bacteria and fungi	60	70
CO4	Classify the plant diseases mediated by bacteria, virus, fungi & nematode and analyze their control measures	65	70
CO5	Compare the significance of biopesticides and chemical pesticides against plant pathogens	80	80

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	--	M	S	--	--
CO2	M	--	M	M	--	--
CO3	--	M	L	M	M	S
CO4	M	M	L	M	--	M
CO5	M	S	M	M	M	S

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	30%	30%	30%
Understand	40%	40%	40%
Apply	30%	30%	30%

Agricultural Microbiology

UnitI

Soil as Microbial Habitat, Soil profile and physico-chemical properties, Soil formation, Diversity and distribution of microorganisms in soil, Factors influencing growth of soil microbes - root exudates, rhizosphere effect, phyllosphere.

Unit II

Nitrogen fixation-symbiotic nitrogen fixers (*Rhizobium*, *Azolla*, *Anabena*), Associative nitrogen fixer (*Azospirillum*), free-living nitrogen fixers (*Azotobacter*, *Blue Green Algae*), *Rhizobium*-root nodule formation, plant growth promoting *Rhizobacteria*, host specificity, physiology of N_2 fixation (*nod* and *nif* genes), *Mycorrhizal* association: occurrence and distribution, phosphate solubilisation.

Unit III

Biofertilizer production- *Rhizobium*, *Azospirillum*, *Anabena*, *Azolla*, *Azotobacter*,*Nostoc*, preparation of carrier-based inoculants and crop response, Phosphate solubilizing-*Phosphobacterium*, *Mycorrhizal* biofertilizer- collection of VAM spores and production of VAM spores in stock plants, biotech feed, silage, biomanure, biogas, biofuels – advantages and processing parameters, Genetically modified crops: Bt crops, golden rice Advantages, social and environmental concerns.

Unit IV

Plant pathogens- Symptoms, transmission and mechanism of plant diseases of Bacteria-potato scab, citrus canker, blight; fungi-smuts, rusts, leaf spots, virus-Tobacco mosaic, Bunchy top-banana, tomato spotted wilt, *Mycoplasma* and *Nematode* diseases. Plant disease: control measures and IPM.

Unit V

Control measures of plant pathogens-Chemical pesticides: types, advantages and limitations; biopesticides-bacterial-*Bacillus thuringiensis*, fungal-*Beaveria bassiana*, viral-NPV, CPV, GV, Phytochemicals -neem extract, Panchagavya.

Text Books:

1. Subba Rao N.S. 2016. Advances in Agricultural Microbiology, Oxford and IBH publishing, New Delhi and Butterworth Scientific, London.
2. Rangaswami, G. and Bagyaraj, D. J.2004. AgriculturalMicrobiology. India: PHILearning Pvt.Ltd. New Delhi, India.

References:

1. Mahendra K. Rai. 2005. Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York, USA.

2. Coyne MS. 2001. Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning. New York, USA.
3. Altman A. 1998. Agriculture Biotechnology, 1st Ed., Marcel decker Inc. New York, USA.
4. Agrios, G.N. 1997. Plant pathology, 4thEd., Replica Press Pvt. Ltd., New Delhi.
5. Campbell RE. 1983. Microbial Ecology. Blackwell Scientific Publication, Oxford, England.

Web Resources:

1. Soil profile- https://www.youtube.com/watch?v=nEShY_S_KGc
2. Soil dynamics- https://www.youtube.com/watch?v=mg7XSjcnZQM
3. Soil microbiology- https://www.youtube.com/watch?v=PssluRwbOc4
4. Bio fertilizers - https://www.youtube.com/watch?v=KS95D3njzSo
5. Carrier based inoculants - https://www.youtube.com/watch?v=SlrfWALczXc
6. Agriculture research institute - https://www.icar.org.in/
7. Phytopathological forum - https://www.apsnet.org/Pages/default.aspx

Course Designers:

Dr.E. Kaarunya,
Assistant Professor.

Lecture Schedule

Unit	Topic	Lecture hrs.
Unit I		
1.1	Microbial habitat in soil	2
1.2	Soil physico-chemical properties, soil ecology	2
1.2	Diversity of microbes, factors influencing growth of soil microbes	3
1.4	root exudates, rhizosphere effect, phyllosphere	3
Unit II		
2.1	Nitrogen fixation-symbiotic nitrogen fixers (Rhizobium, Azolla, Anabena)	4
2.2	Associative nitrogen fixer (Azospirillum)	2
2.3	free-living nitrogen fixers (Azotobacter, Blue Green Algae),	3
2.4	Rhizobium-root nodule formation	2
2.5	host specificity, physiology of N2 fixation (nod and nif genes)	2
2.6	Mycorrhizal association: occurrence and distribution, phosphate solubilisation	2
Unit III		
3.1	Biofertilizer production- Mass cultivation of Rhizobium, Azospirillum, Anabena-Azolla, Azotobacter, Nostoc	4
3.2	preparation of carrier-based inoculants and crop response	2
3.3	Phosphate solubilizing- Phosphobacterium	2
3.4	Mycorrhizal biofertilizer- collection of VAM spores and production of VAM spores in stock plants	3
Unit IV		
4.1	Symptoms, transmission and mechanism of Bacteria-potato scab, citrus canker	3
4.2	Symptoms, transmission and mechanism of blight; fungi-smuts, rusts, leaf spots	3
4.3	Symptoms, transmission and mechanism of virus-Tobacco mosaic, Bunchy top banana, tomato spotted wilt	3

4.4	Symptoms, transmission and mechanism of Mycoplasma and Nematode diseases.	4
Unit V		
5.1	Chemical pesticides: types, advantages and limitations	2
5.2	Control measures of plant pathogens using biopesticides-bacterial-*Bacillus thuringiensis*	2
5.3	Control measures of plant pathogens using biopesticides fungal-*Beaveria bassiana*	2
5.4	Control measures of plant pathogens using viral-NPV,CPV,GV	3
5.5	Control measures of plant pathogens using Phytochemicals-neem extract, panchagavya.	2

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B.Sc. (other than Microbiology)/B.A/B.Com/BBA on or after June 2020)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20NE31	Health Awareness	NME1	2	-	-	2

L - Lecture T - Tutorial P - Practical

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

Preamble

Develop awareness and persuade the students to maintain their health by hygiene and nutrition.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Outline the dimensions and characteristics of health determinants	70	75
CO2	Define epidemiology of disease and public health care	70	65
CO3	Explain classification and functions of food nutrition and illustrate the harmful effects of poor nutrition	75	70
CO4	Infer the health effects, prevention and control measures of pollutants in environment	75	65
CO5	Provide awarenesson importance of mental health, hygiene & immunization	75	70

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**M**	**S**	**--**	**M**	**L**	**--**
CO2	**S**	**S**	**M**	**M**	**S**	**L**
CO3	**S**	**S**	**S**	**S**	**S**	**--**
CO4	**S**	**S**	**S**	**S**	**S**	**L**
CO5	**S**	**S**	**S**	**S**	**S**	**S**

Strong(S), Medium(M), Low(L)

B.A. P.O.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**			**M**	**M**	**M**
CO2	**S**	**M**		**M**	**M**	**M**
CO3	**S**	**M**		**M**	**S**	**M**
CO4	**S**	**M**		**S**	**S**	**M**
CO5	**S**	**S**		**S**	**M**	**M**

B.B.A. P.O.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	M	L	L		L
CO2	S	M	M	L		L
CO3	S	M	L	L		L
CO4	S	L	L	L		M
CO5	S	S	M	S		M

B.Com. P.O.

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

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Health Awareness

Unit I

Dimensions and Determinants of health, Indicators of health – Characteristics of indicators, Types of indicators, Disease agents – Classification: water, air, vector borne, zoonotic disease (Ebola, Sars, Sars-Cov2).

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 – sources, sanitation, hygiene- purification: household level, criteria for water quality standards, Air – Health effects of air pollution, prevention and control, Noise – sources, effects of noise exposure and control measures, Radiation- public health effects: EMF, x-rays, nuclear plants, mobile phones and preventive measures.

Types of mental illness – Major and minor illnesses - Social pathological causes, Maternal and

child health care- Immunization – Vaccines, Vaccine development strategies- covid19 vaccines and Immunization Schedule.

Text Books:

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

Reference books:

1. Khan, M.F. 2008.Textbook of Health Awareness 1stEd.,CBS Publishers & Distributors, India
2. Timmreck, T. C. 1997. Health services encyclopedic dictionary: a compendium of health care and public health terminology. 3rd Ed. Jones and Bartlett Publishers. Sudbury, MA, USA

Web Resources:

1. World Health Report. 2000. https://www.who.int/whr/2000/en/. Health systems; Improving Performance.

Course Designer:

Dr. E.Kaarunya,
Assistant Professor.

Lecture Schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Dimensions and Determinants of health	2
1.2	Indicators of health – Characteristics of indicators, Types of indicators	3
1.3	Disease agents – Classification of disease agents- water, air, vector borne, zoonotic disease	4
1.4	Nutrition – Classification and functions of food,	2
1.5	Source and requirement of Carbohydrates, Proteins, Fats, Vitamins and Minerals in diet	2
1.6	Malnutrition – Protein energy Malnutrition (PEM),	2
1.7	Balanced diet – Composition of balanced diet	2
Unit II		
2.1	Water – sources and uses, pollution, purification - household level, criteria for water quality standards	3
2.2	Air – Health effects of air pollution, prevention and control	2
2.3	Noise – sources, effects of noise exposure and control measures	2
2.4	Types of mental illness: Major and minor illnesses- Social pathological causes	3
2.5	Maternal and child health care- Immunization – Vaccines and Immunization Schedule.	3

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology
(For those joined B. Sc., Microbiology on or after June 2020)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20C41	Microbial Genetics	Core 7	4	-	-	4

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course outlines prokaryotic gene expression with emphasis on natural gene transfer methods.Enlighten the importance of mutationsin fuelling the evolution of life forms on earth and their repair mechanisms.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Explain the significance of mutations in the evolution of life forms and the role of mutagenic agents.	60	65
CO2	Interpret the role of various repair mechanisms to maintain the integrity of the genome.	65	60
CO3	Illustrate natural gene transfer methods and their importance in the survival of microbes.	65	60
CO4	Explain the basic concepts and regulation of gene expression.	65	70
CO5	Summarize the types and role of transposable elements in prokaryotes and their mode of replication.	60	60

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**L**	**S**	**S**	**S**	**M**	**S**
CO2	**L**	**M**	**S**	**S**	**--**	**M**
CO3	**L**	**S**	**M**	**M**	**--**	**S**
CO4	**--**	**--**	**L**	**M**	**--**	**L**
CO5	**L**	**L**	**L**	**M**	**--**	**L**

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

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

Blooms Taxonomy

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

Microbial Genetics

Unit I

Mutation: Origin of spontaneous mutations – Luria and Delbruck's classic experiments – Fluctuation test – Newcombe experiment – Types of mutations: Silent – reverse – missense – nonsense – frameshift – conditional lethal – dominant and recessive nature of mutations – intragenic and extragenic suppressor mutations – nonsense suppressor mutations – deletion – duplication – inversion. Mutagens and their mode of action: Physical (UV, X-rays), Chemical (NTG, 5BU) and Biological agents (*mutH*, *mutS*).

Unit II

Molecular basis of suppression: missense – nonsense – frameshift mutations – intragenic and extragenic.DNA repair: Direct repair – photoreactivation and dealkylation, excision repair –base excision and nucleotide excision, mismatch repair, recombination repair and SOS repair.

Unit III

Genetic recombination in bacteria: Transformation -Discovery, mechanism of natural competence, process of transformation, competence development and competence factors, joint transformation and its significance. Transduction – generalized and specialized,co-transduction and its uses and conjugation- Discovery, mechanism, Hfr and F` strains, Interrupted and uninterrupted mating technique. Recombination: Homologous – Holiday model; nonhomologous – transposition, site specific (integration and excision of prophages).

Unit IV

Regulation of prokaryotic gene expression: Bacterial inducible and repressor system - *lac* operon, *trp* operon, *ara* operon; attenuation and antitermination; Repressors of phage lambda – maintenance of lysogenic state and switching from lysogenic lytic infection, biology of phage M13 and φ174; Plasmid – types (F, R, *Ti*& Col), stringent and relaxed plasmids; amplification and copy number, plasmid incompatibility, plasmid curing.

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, 4thEd. Jones & Barlett learning, New Delhi.
2. Larry, R. S., Peters, J. E., Henkin, T. M. and Champness, W. 2013. Molecular Genetics of Bacteria, 4th Ed. ASM Press, USA.

References:

1. Griffiths, A.J.F., Doebley, J. F., Peichel, C.L. and Wassarman, D.A. 2020. An introduction to Genetic Analysis, 12th Ed. W.H. Freeman and Company, New York.
2. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2017. Lewin's Genes 12th Ed. Jones and Bartlett, USA.
3. Watson, J.D., Hopkins N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. 2017. Molecular Biology of the Gene, 7thEd. Pearson Education Inc., New York.
4. Lodish, H., Berk, A., Zipursky, S.L., Matsudara, P., Baltimore, D. and Darnell, J. 2016. Molecular Cell Biology, 8thEd. W.H.Freeman and Company, New York.
5. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. 2015. Molecular Biology of the Cell, 6thEd. Garland Publishing, Inc., USA.

Web Resources:

1. Lac Operon -- https://www.youtube.com/watch?v=oBwtxdI1zvk
2. Gene expression -- https://www.youtube.com/watch?v=OEWOZS_JTgk
3. Tryptophan Repressor -- https://www.youtube.com/watch?v=EC0Zo9urhNQ
4. SOS response -- https://www.youtube.com/watch?v=wIQcmwgg1ik

Course Designer:

Dr. B. Singaravelan
Assistant Professor

Lecture Schedule

Unit	Topic	Lecture hrs.
Unit I		
1.1	Mutation: Origin of spontaneous mutations – Luria and Delbruck's classic experiments – Fluctuation test – Newcombe experiment	3
1.2	Types of mutations: Silent – reverse – missense – nonsense – frameshift – conditional lethal – dominant and recessive nature of mutations – intragenic and extragenic suppressor mutations – nonsense suppressor mutations – deletion – duplication – inversion.	4
1.3	Mutagens and their mode of action: Physical (UV, X-rays), Chemical (NTG, 5BU) and Biological agents (*mutH, mutS*).	4
Unit II		
2.1	Molecular basis of suppression: missense – nonsense – frameshift mutations – intragenic and extragenic.	3
2.2	DNA repair: Direct repair – photoreactivation and dealkylation, excision repair	3
2.3	base excision and nucleotide excision, mismatch repair, recombination repair and SOS repair.	3
Unit III		
3.1	Genetic recombination in bacteria: Transformation -Discovery, mechanism of natural competence, process of transformation, competence development and competence factors, joint transformation and its significance.	4
3.2	Transduction – generalized and specialized, cotansduction and its uses	3
3.3	Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted and uninterrupted mating technique.	3

3.4	Recombination: Homologous – Holiday model; nonhomologous – transposition, site specific (integration and excision of prophages).	4
Unit IV		
4.1	Regulation of prokaryotic gene expression: Bacterial inducible and repressor system - *lac* operon, *trp* operon, *ara* operon; attenuation and antitermination	6
4.2	Repressors of phage lambda – maintenance of lysogenic state and switching from lysogenic lytic infection.	3
4.3	Biology of phage M13 and φ174	2
4.4	Plasmid – types (F, R, ***Ti***& Col), stringent and relaxed plasmids;	2
4.5	amplification and copy number, plasmid incompatibility, plasmid curing.	2
Unit V		
5.1	Transposable elements in prokaryotes: IS elements and transposons – composite and non-composite transposons	4
5.2	Transposable elements in plasmids and	2
5.3	Phage mu	2
5.4	Mechanism of transposition – replicative and conservative transpositions	3

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B. Sc., Microbiology on or after June 2020)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20CL41	Lab in Microbial Genetics	Core Lab 4	-	-	2	1

L - Lecture T - Tutorial P - Practicals

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 microbial genetics.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Isolate mutant colonies with different methods.	70	80
CO2	Enumerate the amount of phage present in the samples.	75	80
CO3	Evaluate various methods to control microbes.	60	80
CO4	Determine the gene expression by spectrophotometric assay.	70	80
CO5	Isolate extrachromosomal genetic material and transfer into another cell.	75	70

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	--	L	M	L	--	S
CO2	--	L	M	L	--	L
CO3	S	S	S	S	S	S
CO4	--	L	M	M	--	M
CO5	--	--	M	M	--	M

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

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

Blooms Taxonomy

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

Lab in Microbial Genetics

1. Isolation of petite mutants
2. Plaque assay
3. Isolation of mutant colonies by Direct selection method.
4. Isolation of mutant colonies by Gradient plate method.
5. Isolation of mutant colonies by Replica plate method.
6. Determination of Minimum Inhibitory concentration
7. UV survival curve
8. UV irradiation and photoreactivation
9. Isolation of auxotrophic mutants
10. Isolation of Lac- and Lac+ colonies
11. AMES test
12. β-galactosidase assay
13. Isolation of Plasmid DNA
14. Transformation using $CaCl_2$ method–Demonstration
15. Transduction – Demonstration
16. Conjugation – Demonstration

References:

1. Cappuccino and Welsh, 2018, Microbiology – A Laboratory Manual, 11th Ed. Pearson Education Ltd., Global Edition. UK.
2. Sambrook, I., Fritsch, E.F. and Maniatis, T. 2012. 4thEd., Molecular Cloning 1, 2, 3 - A Laboratory Manual, Cold Spring Laboratory Press, USA.
3. Rajamanickam, C.2001 Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
4. 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, USA.
5. Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.

Web Resources:

1. UV effects on bacteria -- https://www.youtube.com/watch?v=z4qrnMlhbpE
2. Ames test -- https://www.youtube.com/watch?v=nb8k8ZtWIgE
3. Beta-galactosidase assay -- https://www.youtube.com/watch?v=b1UuF86dFZE

Course Designer:

Dr. B. Singaravelan
Assistant Professor

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B. Sc., Microbiology on or after June 2020)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20C42	Medical Bacteriology and Virology	Core 8	4	--	--	4

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course focuses on the mechanism of infection by bacterial and viral pathogens.Emphasis on the etiology of disease, pathogenic factors and therapeutic approaches.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Interpret the host pathogen interactions and list the virulence factors.	75	65
CO2	Summarize the basis of infections caused by bacteria.	65	60
CO3	Explain the basics of animal viral replication and enumeration.	70	70
CO4	Outline the etiology of important human viral diseases.	60	65
CO5	Explain the concepts of antimicrobial chemotherapy.	65	60

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**S**	**--**	**M**
CO2	**M**	**S**	**S**	**S**	**M**	**L**
CO3	**M**	**L**	**L**	**M**	**--**	**--**
CO4	**S**	**S**	**S**	**S**	**M**	**L**
CO5	**S**	**S**	**S**	**S**	**M**	**S**

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

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

Blooms Taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Medical Bacteriology and Virology

Unit I

Koch's Postulates, Stages of an infectious diseases, Host-pathogen interactions, Modes of transmission of infectious agents, Pathogenicity. Virulence Factors:adhesins, aggresins, impedins, invasins, evasion. Toxins:endotoxins and exotoxins.Antigenic variation:antigenic drift and antigenic shift, *vir* genes and pathogenicity islands.

Unit II

Characteristic features, clinical significance, pathology, pathogenesis, lab diagnosis, prophylaxis and treatment of diseases caused by Gram Positive bacteria: *Staphylococcus*, *Streptococcus*, *Bacillus* and *Mycobacteria* (*M. tuberculosis* and *M. leprae*). Gram Negative bacteria: *Neisseria*, *E. coli*, *Salmonella* and *Pseudomonas.*

Unit III

Stages in animal virus replication – attachment, entry, uncoating, replication, assembly and release, cultivation, purification and assay of animal viruses.DNA virus – adenovirus, oncogenic virus- poxvirus.

Unit IV

Clinical manifestations, lab diagnosis, prophylaxis and treatment of diseases caused by Hepatitis B Virus, Rhabdovirus, HIV, Ebola, Zika and SARS-COV2.

Unit V

Classification of antibacterial antibiotics with examples, Mechanism of action of antibacterial agents: Penicillin, Streptomycin. Drug resistance (NDM, ESBL) and Multi Drug Therapy. Classification of antiviral agents, Modes of action of Amantadine, Zidovudine, Vaccines and interferons, Methods of testing drug sensitivity.

Text Books:

1. Murray Patrick R., Rosenthal Ken S and Michael Pfaller A.2020. Medical Microbiology, 9th Ed., Elsevier Publications, Inc., New York.
2. Dimmock, N. J., Easton A. J and Leppard K. N. 2007. Introduction to Modern Virology, 7th Ed., Wiley Blackwell Publishers, England.

References:

1. Stefan Riedel, Stephen Morse, Timothy Mietzner, and Steve Miller. 2019. Jawetz, Melnick & Adelberg's Medical Microbiology, 28th Ed., McGraw Hill, New York.
2. Reba Kanungo. 2017. Ananthanarayanan and Paniker's Textbook of Microbiology, 10th Revised Ed., The Orient Blackswan Publishers, Hyderabad.
3. Wang-Shick Ryu. 2017. Molecular Virology of Human Pathogenic Viruses, Elsevier Publications, UK.

4. Carter John and Venetia Saunders, 2013, Virology: Principles and Applications, 2nd Ed., Wiley and Sons Ltd., UK.
5. Collier Leslie and John Oxford, 2006, Human Virology – A Text for students of Medicine, Dentistry and Microbiology, 3rd Ed., Oxford University Press, New York.

Web Resources:

1. Virulence Factors - https://open.oregonstate.education/microbiology/chapter/15-3virulence-factors-of-bacterial-and-viral-pathogens/
2. Culture of Viruseshttps://courses.lumenlearning.com/microbiology/chapter/isolation-culture-and-identification-of-viruses/

Course Designers:

Dr. S. Subramani.
Assistant Professor

Lecture Schedule

Unit	Topic	Lecture Hrs.
Unit I		
1.1	Koch's Postulates, Stages of an infectious disease	02
1.2	Host-pathogen Interaction, Modes of transmission of infectious agents	04
1.3	Pathogenicity. Virulence Factors: Adhesins, aggresins, Impedins, Invasins, Evasion. Toxins: Endotoxins and exotoxins, antigenic variation: Antigenic drift and antigenic shift, *vir* genes and pathogenicity islands.	04
Unit II		
2.1	Characteristic features, Clinical significance, pathology, pathogenesis, lab diagnosis, prophylaxis and treatment of diseases caused by Gram Positive: *Staphylococcus*, *Streptococcus* and *Bacillus*.	04
2.2	*Mycobacteria* (*M. tuberculosis* and *M. leprae*)	03
2.3	Gram Negative: *Neisseria*, *E. coli*	02
2.4	*Salmonella*	02
2.5	*Pseudomonas*	02
Unit III		
3.1	Stages in animal virus replication – Attachment, Entry, Uncoating, Replication, Assembly and release	03
3.2	Cultivation, Purification and assay of Viruses	03
3.3	DNA virus - adenovirus	03
3.4	Oncogenic virus - poxvirus	03
Unit IV		
4.1	Clinical manifestations, lab diagnosis, prophylaxis and treatment of diseases caused by Hepatitis B Virus, Ebola	03
4.2	Rhabdovirus	02
4.3	HIV	02
4.4	Zika	02
4.5	SARS-COV2	02
Unit V		
5.1	Classification of antibacterial antibiotics with examples	02
5.2	Mechanism of action of antibacterial agents: Penicillin, Streptomycin.	02
5.3	Drug Resistance (NDM, ESBL) and Multi Drug therapy	03

5.4	Classificationof antiviral agents	02
5.5	Modes of action of Amantadine and Zidovudine, vaccines and interferons	03
5.6	Methods of testing drug sensitivity	02

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B. Sc., Microbiology on or after June 2020)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20GE41	Environmental Microbiology	Generic Elective	4	-	-	4

L - Lecture T - Tutorial P - Practicals

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

Preamble

Elaboratesthe consortium of microbes in different environmental niches and their interactions. The course enlightens the biogeochemical cycling and the treatment of different types of waste materials.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Illustrate the consortium of microbes present in the different ecosystem and in extreme habitats.	70	70
CO2	Explain the basic concepts of microbial ecology and their interactions.	75	70
CO3	Summarize various biogeochemical cycles and degradation of pesticides.	60	60
CO4	Solve environmental problems – liquid and solid waste treatment.	65	75
CO5	Summarize the extended use of microbes in environmental microbiology	70	65

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**L**	**M**	**M**	**L**	**--**	**M**
CO2	**M**	**M**	**L**	**M**	**--**	**M**
CO3	**--**	**M**	**L**	**L**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**M**	**S**	**S**	**S**	**S**	**S**

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

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

Blooms Taxonomy

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

Environmental Microbiology

Unit I

Microorganisms and their habitats: Structure and function of ecosystems. Terrestrial: agricultural and desert – Soil profile and microflora; aquatic: fresh water and marine - microflora, atmosphere: Aeromicroflora and dispersal of microbes and animal: Microbiomics (microbes in/on human body) and cattle. 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, amensalism, predation, Parasitism. Population Ecology: Characteristics of population, population growth curves ((r and k selection) and population regulations.

Unit III

Biogeochemical Cycling: Carbon cycle: Microbial degradation of cellulose, hemicelluloses and lignin Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction Other elemental cycle: Sulphur and Iron. Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter.

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 digestor (CD) and Packed Column Reactor (PCR); Tannery effluent Treatment

Unit V

Microorganisms responsible for bioluminescence in marine environment; symbiotic luminescent bacteria. Mechanism of quorum sensing in *Vibrio fischeri,* Microbial indicators. Definition and scope of Bioaccumulation, Biomagnification, biotransformation, biosurfactants, Biofouling, biocorrosion, biofilms, bionanoparticles, biodegradation and bioremediation. Use of genetically engineered microorganisms in environmental microbiology.

Text Books:

1. Prescott, L.M., Harley, J.P. and Klein, D.A. 2008. Microbiology 7th edition, McGraw Hill, New York.
2. Peer, I.L., Gerba, C. P., Gentry, T.J., and Maier, R. M. 2008. Environmental Microbiology, 2nd Edition, Academic Press. US.

References:

1. Chatterji, A.K. 2005.Introductionto Environmental Biotechnology, India
2. Varnam, A. H. and Evans, M. G.2000. Environmental Microbiology, Manson Publishing Ltd. UK.
3. Mitchel, R. 2009. Environmental Microbiology, 2nd Ed., Wiley-Blackwell, US.
4. Hurst, C. J., Crawford, R. L., Garland, J. L., Lipson, D. A. and Mills, A. L. 2007. Manual of Environmental Microbiology, ASM Press, USA.
5. Atlas R.M., and Bartha R. 1993.Microbial Ecology, Benjamin Cummings Publishing Co, Redwood City, CA.

Web Resources:

1. Microbial Ecology -- https://www.youtube.com/watch?v=frrCE40hj5I
2. Molecular methods in Microbial Ecology -- https://www.youtube.com/watch?v=RVPyACLtfmk
3. Waste water treatment -- https://www.youtube.com/watch?v=s8IVjQg7yno
4. Tiny treasure – Nanogold -- https://www.youtube.com/watch?v=QorK2X7GsVU

Course Designers:

Dr. B. Singaravelan
Assistant Professor

Lecture Schedule

Unit	Topic	Lecture hrs.
Unit I		
1.1	Microorganisms and their habitats: Structure and function of ecosystems. Terrestrial: agricultural and desert – Soil profile and microflora	3
1.2	aquatic: fresh water and marine - microflora	2
1.3	atmosphere: Aeromicroflora and dispersal of microbes and animal: Microbiomics (microbes in/on human body) and cattle.	4
1.4	Microbial diversity in extreme environments: Oligotrophs, thermophiles, psychrophiles, barophiles, organic solvent and radiation tolerant, metallophiles.	3
Unit II		
2.1	Microbial ecology: Basic concepts, Types, microbial habitats and factors affecting microbial Populations	4
2.2	Microbial interactions: competition, commensalism, mutualism, synergism, amensalism, predation, Parasitism.	4
2.3	Population Ecology: Characteristics of population, population growth curves ((r and k selection) and population regulations.	4
Unit III		
3.1	Biogeochemical Cycling: Carbon cycle: Microbial degradation of cellulose, hemicelluloses and lignin	4
3.2	Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction	4
3.3	Other elemental cycle: Sulphur and Iron. Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter.	4
Unit IV		
4.1	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.	3
4.2	Liquid waste – sources, stages of treatment: Primary, secondary, and	3

	tertiary.	
4.3	Methods of treatment: Aerobic: -Activated sludge process (ASP), Biological filters (or) Fixed Film System (FFS)	3
4.4	Anaerobic Contact digestor (CD) and Packed Column Reactor (PCR); Tannery effluent Treatment	3
Unit V		
5.1	Microorganisms responsible for bioluminescence in marine environment; symbiotic luminescent bacteria.	4
5.2	Mechanism of quorum sensing in *Vibrio fischeri*, Microbial indicators.	4
5.3	Definition and scope of Bioaccumulation, Biomagnification, biotransformation, biosurfactants, Biofouling, biocorrosion, biofilms, bionanoparticles, biodegradation and bioremediation.	2
5.4	Use of genetically engineered microorganisms in environmental microbiology.	2

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B.Sc., Microbiology on or after June 2020)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20GL41	Lab in Agricultural Microbiology and Environmental Microbiology	Generic Elective Lab	--	--	4	2

L - Lecture T - Tutorial P - Practical

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

Preamble

The course enables isolation and enumeration of microbial population from different soil environmentsand their significance in plant growth promotion.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Isolate and enumerate the microbial population from rhizosphere	80	90
CO2	Isolate microbial pathogens from infected plants	80	85
CO3	Demonstrate the importance and quantify plant growth hormones	90	90
CO4	Enumerate the coliforms from different water sources.	80	90
CO5	Isolate airborne microorganisms from indoor and outdoor regions	80	95

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	L	--	S	--	S
CO2	-	L	--	S	--	M
CO3	M	L	--	M	--	M
CO4	L	L	--	M	--	S
CO5	L	L	--	M	--	S

Strong(S), Medium(M), Low(L)

Mapping of COs with PSOs

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

Blooms Taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Lab in Agricultural Microbiology

1. Determination of pH from different soil samples.
2. Enumeration of bacterial populations from rhizosphere and Non-rhizosphere soil samples.
3. Direct cell count method of soil microflora using hemocytometer
4. Isolation of *Azotobacter* using soil plating method
5. Isolation of *Azospirillum*
6. Isolation of cyanobacteria from soil
7. Isolation of Rhizobium species from root nodule of legumes (staining procedure)
8. Isolation and staining of *Arbuscular Mycorrhizal* spores from soil
9. Isolation of fungal pathogens from plants-leaf, stem and fruits
10. Isolation of bacterial pathogens from plants
11. Isolation of Phosphate solubilizing bacteria
12. Estimation of nitrate reductase enzyme.
13. Estimation of cellulase activity
14. Estimation of chlorophyll pigment - Demonstration
15. Isolation of Starch degrading bacteria from soil.
16. Isolation of protein degrading bacteria from environmental sources.
17. Isolation of lipid degrading bacteria from environmental sources.
18. Isolation of pectinolytic fungi.
19. Estimation of dissolved oxygen in water sample.
20. Estimation of biological oxygen demand in water sample.
21. Estimation of free CO_2 in water sample.
22. Enumeration of MPN in water sample.
23. Demonstration of metal tolerance in bacteria.
24. Sampling of airborne microorganisms.

Reference books:

1. Reddy, S.M. and Ram Reddy, S.R. 2000. Microbiology - A Laboratory Manual, BSC Publishers &Distributors, India.
2. Thangaraj, M. and Santhana Krishnan, P. 1998. Practical Manual on Microbial inoculants, Centre of advanced studies in agricultural University, TNAU,Coimbatore.
3. Aneja K.R. 1993. Experiments in Microbiology: Plant Pathology and Tissue Culture, Wishwa Prakashan, NewDelhi.
4. Cappuccino James and Welsh Chad. 2019. Microbiology - A Laboratory Manual, Pearson Publications, New York.
5. Hurst J. Christon. 2007. Manual of Environmental Microbiology, 3rd Ed., ASM Press, Washington DC.
6. Pepper I. L. and Gerba C. P. 2004. Environmental Microbiology – A Laboratory Manual, 2nd Ed. Elsevier academic Press, USA.

Web Resources:

1. *Mycorrhizal*staining - https://www.youtube.com/watch?v=d98bwg26IsY
2. Isolation of phosphate solubilising https://www.youtube.com/watch?v=KR4nvTH3yVM
3. Extraction and estimation of chlorophyll in plants - https://www.youtube.com/watch?v=JLAR2v11bZQ
4. Water quality analysis -- https://www.jove.com/v/10025/water-quality-analysis-via-indicator-organisms
5. BOD -- https://www.youtube.com/watch?v=aMyhmUB4eb8
6. Environmental Sampling -- https://www.cdc.gov/infectioncontrol/guidelines/environmental/background/sampling.html

Course Designer:

Dr. E. Kaarunya, Assistant Professor.
Dr. S. Subramani Assistant Professor

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Zoology and Microbiology
(For those joined B.Sc. (other than Microbiology)/B.A/B.Com/BBA on or after June 2020)
Programme Code-UMB

Course Code	Course Title	Category	L	T	P	Credit
UMB20NE41	Clinical Lab Technology	NME	2	-	-	2

L - Lecture T - Tutorial P - Practical

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

Preamble

Familiarize with the collection, transport and analysis of clinical specimens for diagnosis. Providescomprehensive knowledge on the different techniques related to clinical laboratory.

Course Outcomes

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

#	Course Outcome	Expected Proficiency %	Expected Attainment %
CO1	Outline the code of conduct and SOP of clinical laboratory	75	70
CO2	Explain the biosafety levels, laboratory safety measures and precautions.	70	75
CO3	Summarize the collection, transport of blood and urine samples	70	65
CO4	Illustrate the theoretical knowledge of antigen and antibody interactions.	70	65
CO5	Explain the significance of biochemical tests, inheritance of blood & Rh factor	70	65

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**M**	**M**	**S**
CO2	**M**	**S**	**M**	**M**	**M**	**S**
CO3	**M**	**M**	**M**	**M**	**--**	**L**
CO4	**L**	**M**	**L**	**L**	**M**	**S**
CO5	**L**	**M**	**L**	L	M	**S**

Strong(S), Medium(M), Low(L)

B.A. P.O.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**M**	**M**	**M**	**S**
CO2	**M**	**S**	**M**	**M**	**M**	**S**
CO3	**M**	**M**	**M**	**M**	**--**	**L**
CO4	**L**	**M**	**L**	**L**	**M**	**S**

CO5	**L**	**M**	**L**	L	M	**S**

B.B.A. P.O.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**M**		**L**	**M**		**L**
CO2	**M**	**M**	**M**	**M**		**M**
CO3	**M**	**M**	**M**	**M**		**L**
CO4	**M**	**M**	**M**	**M**		**L**
CO5	**M**	**M**	**M**	**M**		**L**

B.Com. P.O.

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

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Clinical Lab Technology

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

Blood: 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, Rh factor. Determination of blood glucose, Urea, Cholesterol and Bilirubin.

Urine: Collection, transport and Storage of Urine sample; Chemical examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies. Pregnancy Test.

Text Books:

1. Mukherjee, L.K. 2010. Medical Laboratory Technology, 3 vol. 2nd Ed.,Hill Publishing Ltd., NewDelhi.
2. Sood, R, 2010. Medical Laboratory Technology, Methods and interpretations, 7th Ed., Jaypee, NewDelhi.

Reference books:

1. Ochei, J and Kolkatkar, A. 2009. Medical Laboratory Science, Theory and Practice. Tata Mc Graw Hill Publishing Company Ltd., New Delhi,India.
2. Alex, C., Sonnenwirth, 1998. Gradwohl‟s Clinical Laboratory Methods and Diagnosis, Vol. 1&2, 8th Ed., B.I. Publications Ltd., NewDelhi.
3. David, S. Jacobs, Wayne R. Demott, Paul R. Finley, 1994. Laboratory Test Hand Book, 3rd Ed., Key word index, Laxi-Compinc,Hudson.
4. Woohan, I.D.P., Heather Freeman, 1990. Micro Analysis in Medical Biochemistry, 6th Ed., Churchil Livingstone Publishing Ltd.,USA.

Web Resources:

1. Personal hygiene for Laboratory Technologists - https://www.youtube.com/watch?v=acRXhnCi3dc -
2. First Aid in laboratory and Precautions- https://www.youtube.com/watch?v=Gn2pxZoxCaQ-
3. Blood glucose determination- https://www.youtube.com/watch?v=SwzN0rqIFcA&t=39s

Course Designer:

Dr. C.M. Archana
Assistant Professor

Lecture Schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Laboratory designing, Code of conduct for Clinical Laboratory, SOP	3
1.2	Personal hygiene for Laboratory Technologists.	3
1.3	National and International GLP and GMP- Biosafety levels.	4
1.4	Accidents-types and safety measures.	3
1.5	First Aid in laboratory and Precautions.	2
Unit II		
2.1	Blood: Collection and processing of blood sample.	3
2.2	Determination of TC, DC, ESR, Hb, Bleeding time & clotting time. ABO Blood group system and determination of blood group, Rh factor.	3
2.3	Determination of blood glucose, Urea, Cholesterol and Bilirubin.	3
2.4	Urine: Collection, transport and Storage of Urine sample;	3
2.5	Chemical examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies. Pregnancy Test.	3

B.Sc., Microbiology:

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

Core

Code	Title of the paper	PSO1	PSO2	PSO3	PSO4	PSO5
UMB20C31	Microbial Physiology and Metabolism	15	12	6	13	11
UMB20C32	Molecular Biology	15	12	13	12	12
UMB20CL32	Lab in Molecular Biology	15	12	13	14	13
UMB20C41	Medical Bacteriology and Virology	15	9	12	11	12
UMB20C42	Microbial Genetics	15	13	11	14	13
UMB20CL42	Lab in Microbial Genetics	15	12	11	14	12

Core elective

Code	Title of the paper	PSO1	PSO2	PSO3	PSO4	PSO5
UMB20G31Z	Agricultural Microbiology	14	10	3	14	11
UMB20GL31Z	Lab in Agricultural Microbiology	15	13	2	15	12
UMB20G41Z	Environmental Microbiology	15	12	2	14	12
UMB20GL41Z	Lab in Environmental Microbiology	15	12	6	15	11

Non Major Elective

Code	Title of the paper	PSO1	PSO2	PSO3	PSO4	PSO5
UMB20NE31	Health Awareness	9	-	7	6	5
UMB20NE41	Clinical Lab Technology	13	2	11	11	14

M.Sc. Microbiology

Programme Code - PMB

(SF)

Programme Outcome - PO (Aligned with Graduate Attributes) - Master of Science(M. Sc.,)

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 differentdisciplines.

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 scholarlydebate;

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

Recognize 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 employablegraduates

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 forstudents
- 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	Adopt for careers in the food/agriculture/ pharmaceutical industry, agriculture, and applied research
PEO2	To compete in competitive exams like NET, SET and civil services
PEO3	Analyze and interpret scientific data collected with microbiological laboratory techniques and safety procedures
PEO4	To utilize the scientific literature effectively for the successful completion of research projects related to microbiology
PEO5	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

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

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DEPARTMENT OF ZOOLOGY & MICROBIOLOGY
COURSE STRUCTURE- M.Sc., Microbiology (w.e.f. 2021 batch onwards)
Programme Code: PMB
Semester – I & II

Course	Code	Title of the Paper	Contact Hrs/W	Credits	Total Hrs	Max Mark CA	Max Marks SE	Total
Core 1	PMB21 C11	General Microbiology	5	4	75	25	75	100
Core 2	PMB21 C12	Microbial Biochemistry and Physiology	4	4	75	25	75	100
Core 3	PMB21 C13	Environmental Microbiology	4	4	75	25	75	100
Core Elective1	PMB21 CE11	Elective 1 (Options Given)	5	5	75	25	75	100
Lab 1	PMB21 CL11	Lab in General Microbiology	4	2	75	40	60	100
Lab 2	PMB21 CL12	Lab in Microbial Biochemistry and Physiology	4	2	75	40	60	100
Lab 3	PMB21 CL13	Lab in Environmental Microbiology	4	2	75	40	60	100
	Total		**30**	**23**				

Semester – II

Course	Code	Title of the Paper	Contact Hrs/W	Credits	Total Hrs	Max Mark CA	Max Marks SE	Total
Core 4	PMB21C21	Immunobiology	5	4	75	25	75	100
Core 5	PMB21 C22	Molecular Biology and Microbial Genetics	6	5	75	25	75	100
Core 6	PMB21 C23	Applied Microbiological Techniques	6	5	75	25	75	100
Core Elective 2	PMB21 CE21	Elective 2 (Options Given)	5	5	75	25	75	100
Lab 4	PMB21CL21	Lab in Immunobiology	4	2	75	40	60	100
Lab 5	PMB21 CL22	Lab in Molecular Biology and Microbial Genetics	4	2	75	40	60	100
	Total		**30**	**23**				

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COURSE STRUCTURE- M.Sc., Microbiology (w.e.f. 2020 batch onwards)
Programme Code: PMB
Semester – III & IV

Course	Code	Title of the Paper	Contact Hrs/W	Credits	Total Hrs	Max Mark CA	Max Marks SE	Total
Core 7	PMB20 C31	Medical Microbiology	5	4	75	25	75	100
Core 8	PMB20 C32	Clinical Lab Technology	4	4	75	25	75	100
Core 9	PMB20 C33	rDNA Technology	4	4	75	25	75	100
Core Elective 3	PMB20 CE31	Elective 3 (Options Given)	5	5	75	25	75	100
Lab 5	PMB20 CL31	Lab in Medical Microbiology	4	2	75	40	60	100
Lab 6	PMB20 CL32	Lab in Clinical Lab Technology	4	2	75	40	60	100
Lab 7	PMB20 CL33	Lab in rDNA Technology	4	2	75	40	60	100
	Total		30	23				

Semester –IV

Course	Code	Title of the Paper	Contact Hrs/W	Credits	Total Hrs	Max Mark CA	Max Marks SE	Total
Core 10	PMB20 C41	Fermentation Technology	5	4	75	25	75	100
Core 11	PMB20 C42	Food and Agriculture Microbiology	5	5	75	25	75	100
Core 12	PMB20 C43	Research Methodology	6	5	75	25	75	100
Core Elective 4	PMB20 PJ41	Elective Project	6	3	75	25	75	100
Lab 8	PMB20 CL41	Lab in Fermentation Technology	4	2	75	40	60	100
Lab 9	PMB20 CL42	Lab in Food, Agriculture and Environmental Microbiology	4	2	75	40	60	100
	Total		30	21				

1. Consolidation of Contact Hours and Credits: PG Microbiology

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

2. Curriculum Credits

Core - 78
Elective - 18

Total **90**

PMB20/21CE(A) Cell Biology
PMB20/21CE(B) Forensic Science
PMB20/21CE(C) IPR and Bioethics
PMB20/21CE (D) Biology for competitive exams (CSIR, NET, SET)
PMB20/21CE(E) Herbal Medicine
PMB20/21CE(F) Nanobiotechnology
PMB20/21CE(G) Microbial Genomics
PMB20/21CE(H) Computational Biology

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(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21C11	General Microbiology	Core-1	4	1	-	4

L - Lecture T - Tutorial P – Practical

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

Preamble

Provide comprehensive knowledge on the history and development of microbiology. Elaborate on the classification, identification and application of microbes.

Prerequisite

Basics of chemistry and biology.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Enlights the elemental concepts, history and development of microbiology	**70**	**60**
CO2	Explain the significance of sterilization protocols for the control, of microorganisms	**70**	**60**
CO3	Summarize the structural organization, morphology and reproduction of microbes	**70**	**60**
CO4	Analyze the structure and life cycle of viruses	**60**	**70**
CO5	Illustrate the distribution, nutrition, reproduction of various algae and fungi	**60**	**70**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	L	-	L	M	L
CO2	S	S	S	-	M	M	-
CO3	S	M	S	L	L	L	M
CO4	S	S	M	M	M	M	M
CO5	S	M	S	L	M	M	S

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	S	L
CO2	S	S	S	-	L
CO3	S	S	M	-	M
CO4	S	S	L	-	S
CO5	S	S	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	**60**	**60**	**150**

Title of the Paper: General Microbiology

Unit I

History and scope of microbiology. Microbial taxonomy- Nomenclature rules and identification-Haeckel's three kingdom classification, Whittaker's five kingdom approach - Woese domain system. Bergey's Manual of Systematic Bacteriology (9th edition). Classification of Bacteria by Physiological, Metabolic, Serological and Molecular methods. Numerical Taxonomy-16S rRNA based classification. Bacterial identification methods. Ribotyping, Ribosomal Database Project

Unit II

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. Indicator microorganism for sterilization methods. Evaluation of antimicrobial chemical agents – MIC and MBC assays.

Unit III

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 IV

Classification of viruses (ICTV method). Structure and life cycle of viruses- bacterial virus (T_4, Lambda), Animal virus (Pox, Adeno), Plant virus (TMV and CMV), Insect virus

(Baculovirus), Flu virus, Mycophages and Cyanophages. Protozoa- classification, characterization and reproduction.

Unit V

Outline classification of fungi (Alexopoulos method) and algae (Fristch System). Distribution, importance, structure, nutrition and reproduction of fungi- *Rhizopus*, *Saccharomyces*, *Agaricus* and *Fusarium*. Algae - *Chlamydomonas*, *Sargassum*, *Gellidium*. Lichens - Structures and types.

Reference Books:

- Black JG, Black LJ (2017). Microbiology: Principles and Explorations. Tenth Edition, John Wiley & Sons. Australia
- Pelczar MJ, Chan ECS and Kreig NR (2006). Microbiology. Fifth edition, Tata McGraw-Hill INC. New York.
- Prescott LM, Harley JP and Klein DA (2005). Microbiology. McGraw Hill International edition, New York.
- Madigan MT Martinko JM and Parker J Brock TD (1997). Biology of Microorganisms. Eighth edition. Prentice Hall International Inc, London.
- Holt J.S., Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Determinative Bacteriology. Ninth Edition, Williams and Wilkins, Baltimore.

ICT Tutorials:

- Taxonomy of Bacteria- https://youtu.be/8IJRzcPC9wg
- 16s rRNA Sequencing- https://youtu.be/3UHiveJ1jzM
- Life cycle of virus- https://youtu.be/Qulwy6ow-Wc

Course Designers:

1. Dr. A. Kanakalakshmi –Assistant professor
2. Dr. K. Renugadevi–Assistant professor

Lecture Schedule

#	Topic	No. of Lecture hrs.
Unit- I		
1.1	History and scope of microbiology	2
1.2	Microbial Taxonomy-Numerical Taxonomy	2
1.3	Bergey's Manual of Systematic Bacteriology	5
1.4	Classification of Bacteria by Physiological, Metabolic, Serological and Molecular methods	4
1.5	Bacterial identification methods	1
1.6	Ribotyping and Ribosomal Database project	1
Unit- II		
2.1	Control of microorganisms	3
2.2	Physical agents - conditions influencing antimicrobial action, temperature, desiccation, osmotic pressure, radiation, filtration	4
2.3	Chemical agents -characteristics of an ideal antimicrobial agents, phenolic compound, alcohol, halogens, heavy metals, dyes, synthetic detergents, quaternary ammonium compounds, aldehydes, gaseous agents	4
2.4	Indicator microorganism for sterilization	1
2.5	Evaluation of antimicrobial chemical agents.	3
Unit- III		

3.1	Morphology and structure of bacteria - size, shape and arrangement of bacterial cell.	3
3.2	External structure and chemical composition of - flagella, pili, capsules, sheaths, prostheca	4
3.3	cell wall -Gram positive and Gram negative	3
3.4	Internal structure- cell membrane, cell inclusions - carbon storage polymers, polyphosphate, sulfur, minerals, magnetosomes, gas vesicles and carbonate.	5
Unit- IV		
4.1	Outline classification of viruses (ICTV Method)	1
4.2	Structure and life cycle of viruses	1
4.3	bacterial virus -T_4	1
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	1
4.9	Insect virus –Baculovirus	1
4.10	Flu virus	1
4.11	Mycophages and Cyanophages	1
4.12	Protozoa- classification, characterization and reproduction	1
Unit- V		
5.1	Outline classification of fungi (Alexopoulos method)	1
5.2	Outline classification of algae (Fristch System)	1
5.3	Distribution, importance, structure, nutrition and reproduction of fungi- *Rhizopus*,	1
5.4	Distribution, importance, structure, nutrition and reproduction of fungi- *Saccharomyces*,	1
5.5	Distribution, importance, structure, nutrition and reproduction of fungi- *Agaricus*	2
5.6	Distribution, importance, structure, nutrition and reproduction of fungi- *Fusarium*	2
5.7	Distribution, importance, structure, nutrition and reproduction of Algae *–Chlamydomonas*	1
5.8	Distribution, importance, structure, nutrition and reproduction of Algae *–Chrysamoeba*	1
5.9	Distribution, importance, structure, nutrition and reproduction of Algae *–Sargassum*	2
5.10	Distribution, importance, structure, nutrition and reproduction of Algae *–Gellidium*	2
5.11	Lichens- Structures and types	1
	Total	**75**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21CL11	Lab in General Microbiology	Core lab-1	-	-	4	2

L - Lecture T - Tutorial P – Practical

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

Preamble
Provide hands on training in isolation, cultivation and characterization of microorganisms.

Prerequisite
Basics of chemistry and biology.

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate the proper usage of the scientific protocols	**80**	**80**
CO2	Explain the basic microbial techniques for isolation of microbes	**80**	**80**
CO3	List the experimental protocols for the identification of microorganisms	**70**	**80**
CO4	Distinguish the use of chemical and physical methods for the control of microbes	**80**	**80**
CO5	Compare the macroscopic and microscopic characteristics of fungi and algae	**70**	**80**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	S	L	-
CO2	S	S	S	L	M	-	L
CO3	S	S	S	M	M	L	L
CO4	S	S	S	L	M	L	-
CO5	S	S	S	-	M	M	M

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: 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. Study of microbial taxonomy by using bacterial morphology and biochemical tests.
14. Identification of fungi by lactophenol cotton blue staining method.
15. Fungi slide culture technique.
16. Measurement of fungal growth rate – colony diameter method.
17. Collection and identification of algae.

Reference Books:

- Cappuccino, J.H. and Sherman,N. (2012). Microbiology – A Lab Manual, Seventh Edition, Dorling Kidersley (India) Pvt., Ltd., NewDelhi.
- Aneja, K.R. (1993). Experiments in Microbiology: Plant Pathology and Tissue Culture, Wishwa Prakashan, New Delhi.
- Gunasekaran, P. 2008. Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
- Harry W. Seeley, J.R., Paul, J. Van Demark and John J.Lee. 1997. Microbes in Action – A Laboratory Manual of Microbiology. W. H. Freeman and Company, New York
- Kanika Sharma, 2009. Manual of Microbiology – Tools and Techniques. 2nd Edition, Ane Books Pvt. Ltd., New Delhi.

ICT Tutorials:

- Streak Plate Method- https://youtu.be/oPl4ETb3vMg
- Serial dilutions and Pour plate technique- https://youtu.be/nViO9Y4Yxfk
- Hanging drop Method- https://youtu.be/ujzSmsmg7ok

Course Designer:

1. **Dr. A. Kanakalakshmi- Assistant Professor**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credits
PMB21C12	Microbial Biochemistry and Physiology	Core – 2	4	-	-	4

L - Lecture T - Tutorial P – Practical

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

Preamble

The course provides an overview on the classification, structure and function of bio-molecules. Elaborates the physiology of microorganisms and their significance.

Prerequisites

Basics of chemistry and biology

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the chemistry, structure, function and metabolism of carbohydrates	**70**	**60**
CO2	Summarize the structure, function and metabolism of lipids and proteins	**70**	**60**
CO3	Interpret the importance, structure function of enzymes and to highlight the significance of nucleic acid metabolism	**60**	**70**
CO4	Identify the structure, function and metabolism of microbial pigments and photosynthetic pathways	**70**	**60**
CO5	Distinguish the elemental concepts of bio energetic and physiological aspects of microbial stress responses.	**70**	**60**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**S**	**L**	**-**	**-**	**L**
CO2	**M**	**M**	**S**	**L**	**-**	**-**	**L**
CO3	**M**	**S**	**S**	**L**	**-**	**-**	**S**
CO4	**L**	**L**	**S**	**-**	**L**	**S**	**M**
CO5	**S**	**L**	**S**	**-**	**M**	**M**	**S**

S: Strong M: Medium L: Low

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	S	M	-	L
CO2	L	S	M	-	L
CO3	S	S	M	L	S
CO4	M	S	L	-	M
CO5	S	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	**60**	**60**	**150**

Title of the paper: Microbial Biochemistry & Physiology

Unit I

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

Unit II

Lipids**:** Classification and properties. Phospholipid and cholesterol synthesis in bacteria. Metabolism - α, β and ω oxidation of fatty acids and lipid peroxidation. Amino Acid: Classification based on structure, polarity, biological importance 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

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. Nucleic acids: Synthesis and degradation of purines and pyrimidines. Vitaminsas cofactors and its importance

Unit IV

MicrobialPhotosynthesis: - 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, Reverse TCAcycle, electron transport chain.

Unit V

Bioenergetics: Principles and laws of thermodynamics.chemiosmotic theory of Mitchell - efficiency of coupling. 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

Reference Books:

- Nelson, D.L. and Cox, M.M. (2002). Lehingers's Principles of Biochemistry, Third Edition, Mac Millan worth Publishers, New Delhi.
- Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2009). Twelfth Edition, Brock Biology of Microorganisms, Mac Millan Press, England.
- Moat, A.G. and Foster, W. (1988). Microbial Physiology, Second Edition, John Wiley and Sons, New York.
- Srivastava, M.L. 2008. Microbial Biochemistry, Narosa Publishing House, New Delhi.

ICT Tutorials:

- Fruiting body formation - https://www.youtube.com/watch?v=O1jPzhz1Qyc
- Bioenergitics &Thermodynamics -https://www.youtube.com/watch?v=PDgidel_Feo
- Bacterial Photosynthesis model - https://www.youtube.com/watch?v=J5Nz4cQJ2u8

Course Designers:

1. **Dr. M. Karthikeyan- Assistant Professor**
2. **Dr. J. Vinoth- Assistant Professor**

Lecture Schedule

#	Topic	No. of Lecture hrs.
Unit- I		
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 &EntnerDoudroff pathway.	2
Unit- II		
2.1	Lipids Classification and Properties	2
2.2	Phospholipid and Cholesterol synthesis in bacteria	2
2.3	Lipid Metabolism- α, β, ω oxidation of fatty acids	2
2.4	Lipid peroxidation	1
2.5	Amino Acid: Classification based on structure, polarity	1
2.6	Biological importance and reactivity,	1
2.7	physical properties and chemical reactions	2
2.8	Amino acid biosynthesis	1
2.9	Protein**:** Classification, Physical and chemical properties	1

2.10	Protein structure – Primary, Secondary & Tertiary	2
Unit- III		
3.1	Enzyme Classification	2
3.2	Mechanism of enzyme action	2
3.3	Enzyme kinetics –Michaelis Menten equation	1
3.4	Enzyme kinetics – Lineweaver Burk plot	1
3.5	Factors influencing enzyme activity	1
3.6	Enzyme inhibition- active site, allosteric site	1
3.7	Isozyme, ribozyme and abzyme.	1
3.8	Nucleic acids Structure	1
3.9	Synthesis and degradation of purines	2
3.10	Synthesis and degradation of pyrimidines	2
3.11	Vitamins as cofactors and its importance	1
Unit- IV		
4.1	Bacterial Photosynthesis: Historical background	1
4.2	Types of microbial photosynthesis - oxygenic and anoxygenic.	2
4.3	Structure of photosynthetic pigments	2
4.4	Photosynthetic bacteria - green sulphur and purple.	2
4.5	Mechanism of photosynthesis - non-cyclic and cyclic electron transport and photophosphorylation.	2
4.6	Calvin & Reverse citric acid cycle	2
4.7	Hydroxypropionate cycle	1
4.8	Reverse TCA cycle	1
4.9	Electron transport chain	2
Unit- V		
5.1	Bioenergetics: Principles and laws of thermodynamics	1
5.2	Chemiosmotic theory of Mitchell - efficiency of coupling.	2
5.3	Endospore formation	1
5.4	Characteristics of endospore forming bacteria	1
5.5	Life cycle of Bacillus- stages of sporulation.	2
5.6	Physiological and genetic aspects of sporulation, metabolic changes during germination	2
5.7	Life cycle of myxobacteria	1
5.8	Physiological and genetic aspects of sporulation - genes involved in signaling, aggregation	3
5.9	Chemotaxis and signal transduction system	2
	Total	**75**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21CL12	Lab in Microbial Biochemistry and Physiology	Core Lab -2	-	-	4	2

L - Lecture T - Tutorial P – Practical

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

Preamble

The course provides hands on training on analytical biochemical techniques for the separation, purification and characterization of biological molecules.

Prerequisites

Basics of analytical chemistry and biology.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the procedures involved in the preparation of buffers and solutions	**70**	**60**
CO2	Illustrate the conceptual knowledge of analysis of biomolecules	**70**	**60**
CO3	Categorize the protocols for the separation of biomolecules	**70**	**60**
CO4	Interpret the procedures involved in the purification of biomolecules	**70**	**60**
CO5	Distinguish the physiological features of microorganisms	**70**	**60**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	S	S	M	L	-	L
CO2	S	M	S	L	-	-	L
CO3	S	L	S	L	-	-	M
CO4	S	L	S	L	-	-	M
CO5	M	M	S	-	L	M	M

S: Strong M: Medium L: Low

Mapping of COs with PSOs

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

S: Strong M: Medium L: Low

Title of the Paper: Lab in Microbial Biochemistry and Physiology

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

Reference Books:

- David T. Plummer (2008). An introduction to practical Biochemistry, Third Edition, Tata Mc Graw Hill publishing Com. Ltd., New Delhi.
- Jayaraman, J. (1985). Laboratory Manual in Biochemistry, New Age International (Pvt.) Ltd. Publishers, New Delhi.
- Palanivel, P. (2000). Laboratory Manual for Analytical Biochemistry & Separation Techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
- Wilson, K. and Walker, J. (2008). Practical Biochemistry, Cambridge State University Press, UK

ICT Tutorials

- FT-IR Demonstration - https://www.youtube.com/watch?v=eALOKgRr3eI
- Ultra-sonicator Demonstration - https://www.youtube.com/watch?v=5rqv1uS2lIg

Course Designers:

1. **Dr. M. Karthikeyan- Assistant Professor**

THIAGARAJAR COLLEGE, MADURAI:: 9
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DEPARTMENT OF ZOOLOGY & MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21C13	Environmental Microbiology	Core- 3	4	-	-	4

L - Lecture T - Tutorial P – Practical

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

Preamble
Impart knowledge on the impact of microorganisms in different environmental regimes. Elaborate the elemental aspects of microbial interactions for the maintenance of sustainable environment.

Prerequisite
Knowledge on Environmental science and Microbiology

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	List the role and impact of microbes in different environment	70	60
CO2	Demonstrate theoretical knowledge on microbial ecology and microbial interactions	60	70
CO3	Interpret elemental knowledge on waste treatment techniques.	70	60
CO4	Distinguish the application and importance of environmental strategies.	60	70
CO5	Summarize the role of microbes in the development of alternative fuels	60	70

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**L**	**M**	**L**	**-**	**S**	**-**
CO2	**S**	**M**	**S**	**M**	**L**	**M**	**S**
CO3	**S**	**S**	**S**	**M**	**M**	**S**	**M**
CO4	**S**	**M**	**S**	**-**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**M**	**S**	**S**	**S**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	-	L
CO2	S	S	L	-	S
CO3	S	S	M	L	S
CO4	S	S	M	M	S
CO5	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)	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	**60**	**60**	**130**

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. Litho–Ecosphere – composition of rocks, soil, soil texture and humic acid characteristics and deep subsurface microbiology.

Unit II:

Microbial interactions within the community – positive & negative interactions: symbiosis, amensalism, commensalisms, predation, parasitism and competition. Population within biofilms. Extremophiles- acidophilic, alkalophilic and thermophilic bacteria. Biogeochemical cycling – nitrogen cycle (ammonification, nitrification, nitrate reduction and denitrification), carbon, hydrogen, oxygen, sulfur, phosphorus, iron. Winogradsky column.

Unit III:

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- Effect of eutrophication on the quality of water- Factors influencing the eutrophication.

Unit IV:

Pollutants and entry of pollutants in to environment. Microbial remediation- phenolics, metals, sewage nutrients (phosphate and nitrate), xenobiotics. Role of microbial enzymes in bioremediation Microbial leaching of ores. Microbial deterioration - paper, leather, wood, paint and textiles. Biodegradation of Complex Polymers (Cellulose and Lignin), Biodegradation of lignin and pesticides. Applications of GIS and RS techniques in Environmental monitoring.

Unit V:

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

Reference Books:

- Lee S and Shah YT (2013) Biofuels and Bioenergy: Processes and Technologies, CRC Press, Boca Raton, FL, USA.
- Saha, TK. (2010). Ecology and Environmental Biology, Books and Allied Pvt. Ltd. Kolkata.
- Atlas RA. & Bartha,R. (2000).Microbial Ecology, Fundamentals and Application, Benjamin Cummings, New York.
- Ravindranath NH. and Hall DO (1995); Biomass, Energy, and Environment: A Developing Country Perspective from India, Oxford University Press, New York.
- Allsopp, D and Seal J. (1986), Introduction to Biodeterioration, Edward Arnold (Publishers), London.

ICT Tutorials:

- Winogradsky column- https://youtu.be/wslx_GaNfWQ
- Waste water Treatment- https://youtu.be/KU5KefXTe4g
- Microbial Fuel Cell- https://youtu.be/bECIaInLmRw

Course Designers:

1. **Dr. A. Kanakalakshmi- Assistant Professor**
2. **Dr. K. Renugadevi- Assistant Professor**

Lecture Schedule

#	Topic	No of lecture hrs.
Unit- I		
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.	3
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.	3
1.5	Litho–Ecosphere – Deep subsurface microbiology, determining soil texture and humic acid characteristics.	3
Unit- II		
2.1	Microbial interactions within the community – positive & negative interactions:	3
2.2	Symbiosis, Amensalism	1
2.3	Commensalisms, Predation	1
2.4	Parasitism, Competition	1
2.5	Population within biofilms	1
2.6	Biogeochemical cycling – nitrogen cycle (ammonification, nitrification, nitrate reduction and denitrification)	2

2.7	Biogeochemical cycling –carbon, hydrogen	2
2.8	Biogeochemical cycling –oxygen, sulfur	2
2.9	Biogeochemical cycling- phosphorus, iron	2
2.10	Winogradsky column.	1
Unit- III		
3.1	Waste treatment- types of wastes	1
3.2	characteristics of solid and liquid wastes	2
3.3	Treatment of solid wastes - composting and vermiform composting	2
3.4	Treatment of liquid wastes - primary, secondary	3
3.5	Trickling filter, activated sludge	2
3.6	Oxidation pond, oxidation ditch	2
3.7	Tertiary treatment	2
3.8	Eutrophication.	1
Unit- IV		
4.1	Pollutants and entry of pollutants in to environment	1
4.2	Microbial remediation –phenolics, metals	1
4.3	Role of microbial enzymes in bioremediation	1
4.4	Microbial remediation – sewage nutrients (phosphate and nitrate), xenobiotics	1
4.5	Microbial leaching of ores, paper	2
4.6	Microbial deterioration - leather, wood	1
4.7	Microbial deterioration – paint, textile	2
4.8	Applications of GIS and RS techniques	2
4.9	Biodegradation of Complex Polymers	2
4.10	Metagenomics and its applications in bioremediation	1
4.11	Biodegradation of lignin and pesticides	1
Unit- V		
5.1	Biomass as a source of energy and its classifications	1
5.2	Trans esterification and combustion of biomass	1
5.3	Biofuels and its types	1
5.4	Ethanol & Methanol production using bagasse	2
5.5	Biodiesel from *Jatropha curcas*	1
5.6	Advantages and limitations of biodiesel	1
5.7	Microbial oil production from oleaginous microorganisms	2
5.8	Microbial biogas production: methane& hydrogen	2
5.9	Process design and Applications	1
5.10	Microbial Fuel Cell, Process design and Applications	1
5.11	National Biofuel Policy	1
	Total	**75**

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(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21CL13	Lab in Environmental Microbiology	Core Lab -3	-	-	4	2

L - Lecture T - Tutorial P – Practical

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

Preamble

The course provides hands on training on the isolation and characterization of microbes involved in remediation of environment. Demonstrates the techniques involved in pollution abetment.

Prerequisites

Basics of analytical chemistry and microbiology.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the procedures involved in the determination of water quality	**70**	**80**
CO2	Illustrate the conceptual knowledge of bioremediation	**70**	**80**
CO3	Categorize the protocols for the identification of metabolites involved in biodegradation process	**70**	**80**
CO4	Interpret the procedures for assessment of environmental parameters	**70**	**80**
CO5	Distinguish the physiological features of microorganisms in pollutant degradation	**70**	**80**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**L**	**S**	**-**	**L**	**S**	**S**	**M**
CO2	**M**	**L**	**S**	**-**	**S**	**S**	**M**
CO3	**L**	**M**	**S**	**-**	**L**	**S**	**L**
CO4	**L**	**M**	**-**	**-**	**S**	**S**	**M**
CO5	**M**	**L**	**S**	**-**	**S**	**S**	**M**

S: Strong M: Medium L: Low

Mapping of COs with PSOs

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

S: Strong M: Medium L: Low

Title of the Paper: Lab in Environmental Microbiology

1. Potability analysis of drinking water (MPN test).
2. Biodegradation of oil pollutants
3. Isolation and purification of biosurfactants
4. Assessment emulsification index and cell surface hydrophobicity
5. Biodegradation of dyes
6. Biodegradation of heavy metals
7. Isolation and characterization of methanogens
8. Isolation and characterization of oleaginous microbes
9. Isolation and characterization of exoelectrogens
10. Construction of microbial fuel cell for electricity production
11. Isolation and characterization of Bio hydrogen producing microbes
12. Estimation of BOD
13. Estimation of COD
14. Estimation of TDS and DO in water samples
15. Development of Winogradsky column
16. Industrial visit to Aavin /CFTRI / TNAU.

Reference Books:

- Atlas, RM. (2000). Microbiology Fundamentals and Application, Macmillan Publish
- Company, New York.
- Cappuccino, JH. and Sherman, N. (2012). Microbiology – A Lab Manual, seventh Edition, Dorling Kidersley (India)Pvt., Ltd., New Delhi.
- Gunasekaran, P. (2008). Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi.
- Seeley HW, Paul JR, Van Demark J and Lee JJ. (1997). Microbes in Action – A Laboratory Manual of Microbiology. W.H. Freeman and Company, New York

ICT Tutorials

- Microbial Fuel Cell Set up - https://www.youtube.com/watch?v=-NIzK91ISdo\
- Biohydrogen production - https://www.youtube.com/watch?v=Eve2ddj9PCY

Course Designers:

1. **Dr. M. Karthikeyan- Assistant Professor**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21C21	Immunobiology	Core - 4	4	1	-	4

L - Lecture T - Tutorial P – Practical

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

Preamble

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. This course will be an overview of a variety of topics that together describe the development and function of the immune system

Prerequisite

Basics knowledge on immune system and infection biology

Course Outcomes

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

#	Course Outcomes	Expected Proficiency (%)	Expected Attainment (%)
CO1	Appraise the importance of immunology, types of immune system, lymphoid organs and development of the immune cells	**70**	**60**
CO2	Spell the types of antigens and immunoglobulins and its production	**70**	**60**
CO3	Interpret the Immune effector mechanisms and its tolerance	**70**	**60**
CO4	Distinguish the defense mechanisms of infections and disorders	**60**	**70**
CO5	Outline the immunodiagnostic methods and transplantation immunology	**70**	**60**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**M**	**S**	**L**	**-**	**M**
CO2	**S**	**S**	**S**	**M**	**M**	**M**	**M**
CO3	**S**	**S**	**S**	**M**	**M**	**-**	**L**
CO4	**S**	**S**	**S**	**M**	**S**	**S**	**L**
CO5	**S**	**S**	**S**	**L**	**S**	**M**	**S**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**-**	**S**	**-**	**L**
CO2	**S**	**S**	**L**	**M**	**S**
CO3	**S**	**M**	**L**	**-**	**L**
CO4	**S**	**M**	**M**	**L**	**L**
CO5	**S**	**L**	**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)	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	**60**	**60**	**130**

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. Kinetics of antibody response. 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. Hypersensitiivity – anaphylaxis, cytotoxic, immune complex deposition and cell mediated. Auto immunity - idiotype network and autoimmune diseases. Mechanism of immune regulation – tolerance.

Unit IV

Immunity to infectious diseases – bacterial (Tuberculosis), viral (AIDS), protozoan and parasitic diseases (Malaria and Leishmaniasis). Immune deficiency disorders – T cells, B cells, phagocytic, natural killer cell associated diseases and AIDS. Failures of host defense mechanisms to infectious diseases 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 tumor immunology: Tumor antigens,

immune responses to tumor and immunotherapy of malignancy. Immuno diagnosis based on antigen and antibody interaction - precipitation, agglutination, EIA, RIA, ELISPOT assay, immunofluorescence techniques, flow cytometry and Immunohistochemistry.

Reference Books:

- Arora, M.P. (2010). Immunology, Ane Books Pvt. Ltd., New Delhi.
- Goldsby, R.A., T.J. Kindt, and B.A. Osborne, Kuby. (2002). Immunology. Fourth edition.W.H. Freeman and Company, New York.
- Roitt, I., J. Brostaffand D.Male, (2001). Immunology, Sixth Edition, Mosby, London.
- Eli Benjamini, G. Sunshine and Lespcowitz, (2000). Immunology – a short course, Fourth Edition, Wiley – Liss, New York.
- Abbas, A.K., A.H. Lichtmann and Y.S. PSOber. 2000, Cellular and Molecular Immunology, fourth edition, W.B. Saunders company, London.

ICT Tutorials

- Antigen Recognition - https://www.youtube.com/watch?v=VAHdJMZDKjA
- Isotype, allotype and idiotype-https://www.youtube.com/watch?v=fa3nQGxaDO8
- Vaccine - https://www.youtube.com/watch?v=lZ0qhiMHg4U

Course Designers:

1. **Dr. J. Vinoth- Assistant Professor**
2. **Dr. A. Kanakalakshmi- Assistant Professor**

Lecture Schedule

#	Topic	No. of Lecture Hours
Unit- I		
1.1	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
Unit- II		
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	2
2.4	Kinetics of antibody response	1
2.5	Immunotechnology – Hybridoma and monoclonal antibodies	2
2.6	Antibody Engineering – Production of chimeric and hybrid monoclonal antibodies	2

Unit- III		
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
Unit- IV		
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	2
4.5	Failures of host defense mechanisms to infectious diseases	1
4.6	Vaccines – Identification and analysis of vaccines	2
4.7	Inactivated , Subunit & synthetic vaccines	1
4.8	DNA, RNA and Live attenuated vaccines	1
Unit- V		
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
	Total	**75**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21CL21	Lab in Immunobiology	Core 1ab – 4	-	-	4	2

L - Lecture T - Tutorial P – Practical

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

Preamble
Provide hands on training on immunological techniques for the assessment of immune disorders and demonstration of immunization protocols.

Prerequisite
Basic theoretical knowledge on immunology and biology.

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the elemental concepts of immunology	**65**	**80**
CO2	Demonstrate the protocols involved in the preparation of antigen and antibodies	**70**	**80**
CO3	Distinguish the salient features of antigen antibody reaction and it's in diagnostics	**60**	**80**
CO4	Make use of biotechnological tools for the separation and purification of serum proteins	**60**	**80**
CO5	Evaluate the methods involved in the isolation and enumeration of immune cells	**70**	**80**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	M	L	L	-
CO2	S	S	S	M	M	L	L
CO3	S	S	S	L	S	-	M
CO4	S	M	S	-	M	L	L
CO5	S	S	S	L	S	M	L

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	L	-	M
CO2	S	M	M	L	S
CO3	S	S	M	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. Electrophoretic separation of serum proteins.
6. Immuno electrophoretic technique (Rocket, counter -current)
7. Agar gel Ouchterlony double immuno diffusion.
8. Mancini single radial immuno diffusion.
9. Haemagglutination titration assay.
10. Direct agglutination to determine ABO blood grouping.
11. Visualization and study of Lymphoid Organs from mice and Chicken (Model).
12. Determination of differential leukocyte count.
13. Isolation and enumeration of lymphocytes from human blood.
14. Determination of lymphocyte viability by trypan blue exclusion test.
15. Identification and enumeration of human T – lymphocyte using E – rosette technique.

Reference Books:

- Rastogi S.C. (1996). Immunodiagnostics Principles and Practice, New Age International (P) Ltd., New Delhi.
- Talwar, G.P. and Gupta, S.K. (1992). A Hand Book of Practical and Clinical Immunology, Vol. 1 -2, CBS Publishers & Distributors, Delhi.
- Myers, R.L. (1989). Immunology: A Laboratory Manual, Wm. C. Brown Publishers, Dubuque, Lowa.
- Talwar, G.P. (1983). A Hand Book of Practical Immunology, Vikas Publishing House Pvt. Ltd., New Delhi.

ICT tools:

- Methods of antigen administration: https://www.youtube.com/watch?v=sJptG3_uiVg
- Lymphoid organs: https://www.youtube.com/watch?v=C3WmRCVFCK0
- Enumeration of Human T-lymphocyte- https://www.youtube.com/watch?v=Cl4sTwKFe9k

Course Designers:

1. **Dr. J. Vinoth – Assistant Professor**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credits
PMB21C22	Molecular Biology & Microbial Genetics	Core – 5	5	1	-	5

L - Lecture T - Tutorial P – Practical

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

Preamble

Introduce the core principles of molecular biology and microbial genetics to nourish on the mechanism of basic molecular aspects of DNA mutation, repair, recombination and gene expression strategies.

Prerequisites

Basic concepts of molecular biology and microbial genetics

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Illustrate the structure, types and functions of genetic material	**60**	**70**
CO2	Focus on the elemental concepts of prokaryotic and eukaryotic transcription and post modification systems	**60**	**70**
CO3	Classify the concepts of genetic code, mechanism of translational and post processing in prokaryotes and eukaryotes	**60**	**70**
CO4	Explain the mechanism of molecular and biochemical basis of DNA mutation and damage with repairing process	**60**	**70**
CO5	Compare the methods of gene transfer mechanism and its significance in gene mapping procedures	**70**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	L	M	-	L	-
CO2	S	S	L	M	-	L	M
CO3	S	S	L	M	L	M	M
CO4	S	M	M	L	L	S	S
CO5	S	S	S	M	M	S	S

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	-	-
CO2	S	S	M	-	L
CO3	S	S	S	L	L
CO4	S	S	S	L	M
CO5	S	S	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)	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	**60**	**60**	**130**

Title of the Paper: Molecular Biology and Microbial Genetics

Unit I

Discovery and Molecular basis of DNA as genetic material. Structure and forms of DNA. Properties of DNA - denaturation, renaturation, melting curve, hyperchromicity. Structure and types of RNA - tRNA, mRNA & rRNA. Epigenetics, Histone proteins. 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 II

Transcription process in Prokaryotes and Eukaryotes: Initiation - promotors, upstream & downstream sequences, sigma and transcription factors. Elongation - RNA polymerase, sub units. Termination - Rho dependent and Rho independent, nus A, antitermination. RNA processing (post transcriptional modifications) – tRNA, rRNA, mRNA, RNA degradation, inhibitors of transcription. Reverse transcription.

Unit III

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

Unit IV

Mechanism of DNA damage & repair: Molecular and Biochemical basis of mutation: mutation rates. Mutagenesis & mutagenic agents. Isolation of mutants. Selection of bacterial variation. Origin of mutation-Transcriptional regulation in prokaryotes-inducible and repressible system, positive regulation and negative regulation-lac, trp, Ara operons. Detection of mutagen - Ames test. 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 V

Mechanism of genetic exchange: Types of plasmids (F Plasmid: Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes. Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu–virus); Bacterial Genetics (Mutant phenotype, DNA mediated Transformation; Conjugation (Cointegrate formation and Hfr Cells, Time–of–Entry Mapping, F' Plasmid); Transduction (Generalized transduction, Specialized Transduction) - gene mapping.

Reference Books:

- Sandhya Mitra. 2017. Genetic Engineering: Principles and Practice. Second Edition, McGraw Hill Education (India) Private Limited, New Delhi, India.
- Primrose, S.B, Twyman, R.M. 2009. Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell Publishing, UK.
- Stanley R. Maloy, John E.C. and Freifelder, D. 2008. Microbial Genetics, Eighteenth Edition. Narosa Publishing House, New Delhi, India.
- Freifelder, D. 2000. Molecular Biology, Second Edition, Narosa Publishing house. New Delhi, India.
- Malacinski, G.M. and Freifelder, D. 1998. Essentials of Molecular Biology, Third Edition, Jones and Bartleft publishers, Boston.
- Kornberg, A., and Baker, T. A. 1992. DNA Replication, 2nd Edition. W. H. Freeman and Company, New York.

ICT Tutorials:

- Meselson & Stahl experiment- https://www.youtube.com/watch?v=yDQg7uXShUs
- Transcription in prokaryotes- https://www.youtube.com/watch?v=nJK-l7ByQAs
- Differences in translation between prokaryotes and eukaryotes: https://www.youtube.com/watch?v=WNZf4ip_R9s

Course Designers:

1. **Dr. K. Renugadevi – Assistant Professor**
2. **Dr. M. Karthikeyan - Assistant Professor**

Lecture Schedule

#	Topic	No of lecture hrs.
Unit- I		
1.1	Discovery and Molecular basis of DNA as genetic material. Structure and forms of DNA. Replication of DNA - semi conservative mode, Meselson - Stahl experiment.	3
1.2	Properties of DNA - denaturation, renaturation, melting curve, hyperchromicity.	3
1.3	Structure and types of RNA - tRNA, mRNA & rRNA. Epigenetics, Histone proteins.	3
1.4	Enzymology of DNA replication - DNA polymerase I, II &III, topoisomerase I & II, helicase, primase, gyrase.	4
1.5	Molecular basis of DNA replication - replication fork, origin, Okazaki fragments. Types of replication - circular and theta.	3
Unit- II		
2.1	Transcription process in Prokaryotes and Eukaryotes: Initiation - promotors, upstream & downstream sequences, sigma and	3

	transcription factors.	
2.2	Elongation - RNA polymerase, sub units. Termination - Rho dependent and Rho independent, nus A, antitermination.	3
2.3	RNA processing (post transcriptional modifications) – tRNA, rRNA, mRNA,	3
2.4	RNA degradation, inhibitors of transcription. Reverse transcription.	3
Unit- III		
3.1	Genetic code: Elucidation of triplet code, code characteristics, codon dictionary. Reading frames, sense and nonsense code.	3
3.2	Degeneracy - wobble hypothesis, universality of genetic code and exceptions.	2
3.3	Process of translation in prokaryotes and eukaryotes: Initiation - initiation factors, initiator tRNA, amino acid activation, Shine Dalgarno sequences, initiation site.	4
3.4	Elongation - elongation factors and translocation. Termination - termination factors.	3
3.5	Post translational modifications - post translational transport, signal hypothesis.	3
Unit- IV		
4.1	Mechanism of DNA damage & repair: Origin of mutation. Molecular and Biochemical basis of mutation: mutation rates. isolation of mutants.	4
4.2	DNA damages, hit theory, UV radiation. DNA repair: post irradiation effects on survival levels	3
4.3	Biochemical repair mechanism - photo reactivation, liquid holding theory - excision, recombination and SOS repair.	3
4.4	Selection of bacterial variation: Direct - fluctuation test, indirect - replica plating.	3
4.5	Mutagenesis & mutagenic agents. Detection of mutagen - Ames test.	3
Unit- V		
5.1	Mechanism of genetic exchange: Types of plasmids (F Plasmid: a Conjugate plasmid', Mobilization of Non-conjugative plasmid, R plasmid, Col plasmid Copy number and incompatibility), Episomes.	5
5.2	Transposable elements (Insertion sequence and transposons, Integrons and Antibiotic-Resistance cassettes, Multiple Antibiotic Resistant bacteria, Mu–virus);	4
5.3	Bacterial Genetics (Mutant phenotype, DNA mediated Transformation;	3
5.4	Conjugation (Cointegrate Formation and Hfr Cells, Time–of–Entry Mapping, F' Plasmid);	2
5.5	Transduction (Generalized transduction, Specialized Transduction)-gene mapping.	2
	Total	**75**

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DEPARTMENT OF ZOOLOGY & MICROBIOLOGY
(For those joined M.Sc., Microbiology on or after June 2021)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21CL22	Lab in Molecular Biology & Microbial Genetics	Core lab-5	-	-	4	2

L - Lecture T – Tutorial P – Practical

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

Preamble

Focused the hands-on training of basic techniques in molecular biology and microbial genetics by enlightening with basic principles behind on the different concepts and functions of biological mechanism

Prerequisite

Critical knowledge on the gene regulation and expression mechanism

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Elaborate the mechanism of isolation and estimation procedures in molecular biology	**70**	**80**
CO2	Demonstration of protocols for the basic electrophoretic separation techniques	**60**	**80**
CO3	Outline the most significant molecular and cell-based methods used to extend their knowledge of biology in cell survival mechanism	**70**	**80**
CO4	Simplify and explain the various methods used for genetic recombination and stability maintenance	**60**	**70**
CO5	Appraise the importance and analysis of genetic material	**60**	**80**

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	L	L	L	-
CO2	S	S	S	M	M	-	M
CO3	S	M	S	S	S	L	M
CO4	S	M	S	M	S	M	L
CO5	S	S	S	S	S	M	-

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Title of the paper: Lab in Molecular Biology and Microbial Genetics

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

Reference Books

- Rajamanickam, C. 2001, Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
- Sambrook, I., Fritsch, E.F. and Maniatis, T. 2001. Third Edition, Molecular Cloning 1, 2, 3 - A Laboratory Manual, Cold Spring Laboratory Press, USA.
- Brown, T.A. 1998. Molecular Biology Lab Fax 11 Gene Analysis, Academic Press, London.
- 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.
- 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.
- Malov, S.R. 1990. Experimental Techniques in Bacterial Genetics, Jones and Bartlett Publishers, Boston.

ICT Tutorials:

- Isolation and estimation of RNA- https://www.youtube.com/watch?v=l5xlb8kkkt4
- Detection of proteins by SDS-PAGE-https://www.youtube.com/watch?v=ve4nysv-gfu
- Detection of mutagen - AMES test- https://www.youtube.com/watch?v=8fycieqsrq0

Course Designer

1. Dr. K. Renugadevi – Assistant Professor

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB21C23	**Applied Microbiological Techniques**	Core-6	5	1	-	5

L - Lecture T – Tutorial P – Practical

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

Preamble

The course corroborates the fundamental concepts of analytical microbiology techniques. Elaborates the core principles involved in microbial quality control strategies in industrial sector.

Prerequisite

Basic knowledge on microbiology and chemistry

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define and classify the pharmaceutical microbiology techniques and its significance	**70**	**60**
CO2	Apply the fundamental principles for the testing of pharmaceutical products	**60**	**70**
CO3	Outline the importance and techniques for the treatment of ophthalmic diseases	**60**	**70**
CO4	Analyze the techniques involved in the processing of mineral water	**70**	**60**
CO5	Appraise the procedures for the standardization and processing of food products.	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**M**	**S**	**-**	**L**	**-**	**M**
CO2	**M**	**L**	**M**	**-**	**L**	**-**	**M**
CO3	**L**	**M**	**S**	**-**	**M**	**-**	**M**
CO4	**M**	**L**	**S**	**-**	**M**	**S**	**L**
CO5	**L**	**M**	**S**	**M**	**S**	**M**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**M**	**M**	**-**	**L**
CO2	**L**	**M**	**-**	**-**	**S**
CO3	**L**	**M**	**-**	**-**	**S**
CO4	**L**	**M**	**S**	**-**	**L**
CO5	**S**	**L**	**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)	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	**60**	**60**	**130**

Title of the Paper: Applied Microbiological Techniques

Unit I

Introduction to pharmaceutical microbiology- Laboratory management and design. Microbiological environmental monitoring- Air and surface sampling methods. Assessment of microbiological water quality systems, microorganisms detected from pharmaceutical manufacturing environments, counting, sampling and product related testing regimes. Auditing of microbiological laboratory

Unit II

Bioburden determination- non sterile products and microbial limit testing and assessment. Sterility testing – antimicrobial effectiveness testing. Sterility assurance – biological indicators, sterilization validation process. Endotoxin test methods - gel clot assay, turbido-meteric assay and chromogenic methods. Biological assays - vitamin assay, antibiotic assay and mycoplasma testing. Endotoxin activity – risk assessment in manufacture of parenterals – pyrogen test – depyrogenation methods

Unit III

Ophthalmic products: Sterility - direct inoculation method, membrane filtration method; clarity-visual inspection, leaker; organoleptic inspection-containers, discolouration, emulsion breakdown, crystal growth, evidence of microbial growth; test for metal particles in drops and ointments, insoluble particulate matter test for ophthalmic solutions

Unit IV

Mineral water industry: Categories of bottled water, Stages of mineral water production. Cleaning and disinfection process of bottled water industry. Bottle manufacture and filling equipments. Methods of mineral water quality assessment. Auditing of bottled water operations. Microbiology of natural mineral water, Microbiology of treated bottled water, Determination of microbial load in water: Faecal indicator organisms – *Coliforms* and *Enterococci*–MPN test, membrane filtration technique

Unit V

Food quality Management: Quality control and quality assurance - principles of quality management; statistical quality management; HACCP, ISO – 9000 series, ISO- 14000 series,

occupational health and safety, trade quality systems; food auditing, traceability; certification of food quality management systems; qualitative food safety matrix.

Reference Books

- Ranganna, S. 2017. Handbook of Analysis and Quality Control for Fruit and Vegetable Products, II Edn. McGraw Hill Education, USA.
- Sandle, T. 2015. Pharmaceutical Microbiology: Essentials for Quality Assurance and Quality Control, Woodhead Publishing. UK
- Herschdoerfer, S. 2012 Quality Control in the Food Industry 1st Edition, Academic Press. USA.
- Fresenius, W., Schneider, W. and Quentin, K.E. 2011. Water analysis: A practical guide to physic-chemical, chemical and microbiological water examination and quality assurance. Springer-Verlag, Germany
- Baird, R.M., Hodges, N.A. and Denver, S.P. 2000. Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices, I Edn. CRC Press. USA

ICT Tutorials:

- Assesment of microbiological water quality-https://www.youtube.com/watch?v=NPvf856TKMQ
- Bioburden determination- https://www.youtube.com/watch?v=ZXDmQqSRX60
- Endotoxin activity- https://www.youtube.com/watch?v=Uv5cBH-avb4

Course Designers:

1. Dr. M. Karthikeyan- Assistant Professor
2. Dr. K. Renukadevi- Assistant Professor

Lecture Schedule

#	Topic	No of lecture hrs.
Unit-I		
1.1	Introduction to pharmaceutical microbiology- Laboratory management and design.	4
1.2	Microbiological environmental monitoring- Air and surface sampling methods.	4
1.3	Assessment of microbiological water quality system, microorganisms detected from pharmaceutical manufacturing environments,	3
1.4	counting, sampling and product related testing regimes. Auditing of microbiological laboratory	4
Unit-II		
2.1	Bioburden determination- non sterile products and microbial limit testing and assessment.	3
2.2	Sterility testing – antimicrobial effectiveness testing. Sterility assurance – biological indicators, sterilization validation process.	3
2.3	Endotoxin test methods - gel clot assay, turbidometeric assay and chromogenic methods.	3
2.4	Biological assays - vitamin assay, antibiotic assay and mycoplasma testing.	3
2.5	Endotoxin activity – risk assessment in manufacture of parenterals – pyrogen test – depyrogenation methods	3
Unit-III		

3.1	Ophthalmic products: Sterility - direct inoculation method, membrane filtration method	3
3.2	clarity-visual inspection, leaker; organoleptic inspection-containers, discolouration, emulsion breakdown, crystal growth, evidence of microbial growth;	3
3.3	Bacterial endotoxin test- gel-clot technique, turbidimetric technique.	3
3.4	Microbiological examination (total aerobic microbial count (TAMC) and total combined yeasts and molds count (TYMC)	3
Unit-IV		
4.1	Mineral water industry: Categories of bottled water, Stages of mineral water production.	3
4.2	Cleaning and disinfection process of bottled water industry. Bottle manufacture and filling equipments.	3
4.3	Methods of mineral water quality assessment. Auditing of bottled water operations.	3
4.4	Microbiology of natural mineral water, Microbiology of treated bottled water	3
4.5	Determination of microbial load in water: Faecal indicator organisms – coliform and *Enterococci*– MPN test, membrane filtration technique	3
Unit-V		
5.1	Food quality Management: Quality control and quality assurance - principles of quality management.	3
5.2	statistical quality management, ISO – 9000 series, ISO- 14000 series, occupational health and safety,	4
5.3	trade quality systems; food auditing, traceability; certification of food quality management systems; qualitative food safety matrix	3
5.4	Laws and Regulations to Prevent Adulteration and Cross Contamination,	4
5.5	Microbial Contamination, Hygienic Practice	2
	Total	75

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20C31	**Medical Microbiology**	Core-7	4	1	-	4

L - Lecture T – Tutorial P – Practical

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

Preamble

Medical microbiology imparts in-depth understanding on the route cause of various microbial diseases and its diagnostics procedures. The mode of actions of different antibiotics used in its treatment.

Prerequisite

Basic understanding of medically important pathogens.

Course Outcomes

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

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Outline the general characteristics, laboratory diagnosis and control measures of bacteria	70	70
CO2	Appraise the diagnosis, prevention, treatment and epidemiology of infectious diseases including the impact of bacterial infectious agents on the human body	70	70
CO3	Explain the general characteristics, pathogenesis and laboratory diagnosis of fungi, parasites	65	70
CO4	Apprise the different microbiological methods for viral diagnosis	65	70
CO5	Classify various antibiotics based on their mode of actions	60	70

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**M**	**L**	**M**	**S**	**L**
CO2	**S**	**M**	**M**	**-**	**M**	**S**	**M**
CO3	**S**	**S**	**M**	**-**	**L**	**S**	**S**
CO4	**S**	**M**	**M**	**L**	**M**	**S**	**S**
CO5	**S**	**M**	**M**	**-**	**S**	**S**	**L**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	L
CO2	S	S	M	M	L
CO3	S	S	M	M	L
CO4	S	S	S	M	L
CO5	S	M	L	-	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)	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	**60**	**60**	**130**

Title of the paper: Medical Microbiology

Unit I

History and overview of medical Microbiology. Pathogenesis of microbial infections. General characters, virulence factors, antigenic structures, mode of transmission, pathogenesis, diagnosis, epidemiology and control measures of: Gram positive aerobic bacteria– *Staphylococci, Streptococci*, *Corynebacteria*, *Bacillus. A*naerobic bacteria: *Clostridium.* Acid fast bacteria – *M. tuberculosis, M. leprae,* Sexually transmitted diseases – *Treponema pallidum,* Spirochaetes – *Leptospira*

Unit II

General characters, antigenic structures, pathogenesis, diagnosis, mode of transmission, epidemiology control measures of: Gram negative non-spore forming bacilli: Aerobic (*Bordetella, Haemophilus), Yersinia*, Enterobacteriaceae *(Vibrio, E. coli, Klebsiella pneumoniae, Shigella, Salmonella)* Aerobic cocobacilli- *Neisseria gonorrhoeae,* Cell wall less bacteria: *Mycoplasma pneumoniae, Ureaplasma urealyticum*

Unit III

General characters, pathogenesis, diagnosis, control measures of superficial mycosis- *Tinea versicolor*. Systemic Mycoses – *Histoplasma capsulatum, Blastomyces dermatitidis, Cryptococcus neoformans*, Opportunistic mycoses: Candidiasis. Fungal Allergies, Mycotoxins. Morphology, life cycle, pathogenesis, laboratory diagnosis and treatment of Amobea- *Entamoeba histolytica*, Flagellates- *Trichomonas vaginalis*, Apicomplexa-*Plasmodium flaciparum, Toxoplasma gondii*, Ciliate-*Balantidium coli*, *Ascaris lumbricoides, Ancylostoma duodenale, Taneia*

Unit IV

Principles and Pathogenesis of viral Disease. Morphology, pathogenesis, diagnosis and treatment of: *Ebola virus, Poxviruses, Epstein Barr Virus, Herpes simplex virus, Hepatitis B virus. Flavi virus* (dengue), Retrovirus -HIV. Viral zoonosis - *Japanese encephalitis, Rabies, Corona virus*, Oncogenic virus.

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 re-emerging infections (MRSA, NDMS), Beta lactamase and types, Antifungal resistance (CDR and ERG), Superbugs, National programs in prevention of infectious diseases.

Reference Books:

- David Greenwood, Richard Slack, John Pertherer and Mike Barer, 2009. Medical Microbiology - A Guide to Microbial infections, pathogenesis, immunity, lab diagnosis and control, 17th Edition, Elsevier Publications.
- Ananthanarayanan and C.K. Jeyaram Paniker, 2009. Text Book of Microbiology, Eighth Edition, Orient Longman, Chennai.
- George F. Brooks, Karen C.Carroll, Janet S.Butel, Stephen A. Morse. 2007. Jawetz, Melnick & Adelberg's Medical microbiology. 24th Ed. McGraw-Hill Professional New Delhi.
- Murray P.R., Pfaller M.A., Tenover F.C., and Yolken R.H. 2007. Clinical Microbiology, ASM Press.
- Collee, J.G., A.G.Fraser, B. P. Marmion and A.Simmons, 2007. Mackie and McCartney, Practical Medical Microbiology, Fourteenth Edition, Churchill Lingstone.

ICT Tutorial:

- Antibiotics - https://www.youtube.com/watch?v=Cj9UADDIidI
- ELISA-https://www.youtube.com/watch?v=CWkrQrq0yxQ
- Mantox test- https://www.youtube.com/watch?v=9O0yDUktaLk

Course Designers:

1. **Dr. J. Vinoth- Assistant Professor**
2. **Dr. K. Renugadevi- Assistant Professor**

Lecture Schedule

#	Topics	No. of Lecture Hours
Unit 1		
1.1	History and overview of medical Microbiology	1
1.2	Pathogenesis of microbial infections	2
1.3	*Staphylococci*	1
1.3	*Streptococci*	1
1.4	*Corynebacteria*	2
1.5	*Bacillus*	1
1.6	*Clostridium*	2
1.7	*Mycobacterium tuberculosis*	1
1.8	*M. leprae*	1
1.9	*Treponema pallidum*	1
1.10	*Leptospira*	1
Unit II		
2.1	*Bordetella,*	1
2.2	*Haemophilus*	1
2.3	*Yersinia*	1
2.4	*Vibrio*	1
2.5	*E. coli*	1
2.6	*Klebsiella pneumoniae*	1
2.7	*Shigella*	1
2.8	*Salmonella*	1
2.9	*Neisseria gonorrhoeae,*	1
2.10	*Mycoplasma pneumoniae*	1
2.11	*Ureaplasma urealyticum*	1

Unit III		
3.1	*Tinea versicolor*	1
3.2	*Histoplasma capsulatum*	1
3.3	*Blastomyces dermatitidis*	1
3.4	*Cryptococcus neoformans*	1
3.5	Candidiasis	1
3.6	Fungal Allergies and Mycotoxins	2
3.7	*Entamoeba histolytica*	1
3.8	*Trichomonas vaginalis*	1
3.9	*Plasmodium falciparum*	1
3.10	*Toxoplasma gondii*	1
3.11	*Balantidium coli*	1
3.12	*Ascaris lumbricoides*	1
3.13	*Ancylostoma duodenale*	1
3.14	*Taneia*	1
Unit IV		
4.1	Principles and Pathogenesis of viral Disease	2
4.2	*Ebola virus*	1
4.3	*Poxviruses*	1
4.4	*Epstein Barr Virus*	1
4.5	*Herpes simplex virus*	1
4.6	*Hepatitis B virus*	1
4.7	*Flavi virus* (dengue)	1
4.8	Retrovirus – HIV	2
4.9	*Japanese encephalitis*	1
4.10	*Rabies*	1
4.11	*Corona virus*	1
4.12	Oncogenic virus	1
Unit V		
5.1	Classification of antibiotics based on mode of action	3
5.2	Antibacterial antibiotics (Penicillin and Streptomycin)	2
5.3	Antiviral drugs (Amantidine and Zidovudine)	2
5.4	Antifungal (Amphotericin and Nystatin)	2
5.5	Antiparasitic drugs (Quinine and Metranidazole)	2
5.6	Anticancer drugs (Methotrexate and L asparaginase)	2
5.7	Emerging and re-emerging infections (MRSA, NDMS)	2
5.8	Beta lactamase and types	2
5.9	Antifungal resistance (CDR and ERG)	2
5.10	Superbugs, National programs in prevention of infectious diseases	2
	Total	**75**

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(For those joined M.Sc., Microbiology on or after June 2020)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20CL31	**Lab in Medical Microbiology**	Core Lab - 5	-	-	4	2

L - Lecture T – Tutorial P – Practical

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

Preamble

Provide hands on exposure to processing of clinical specimens and laboratory diagnosis of microorganisms using different techniques

Prerequisite

Develop diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases

Course Outcomes

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

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Identify microorganisms of relevance to health care and the pharmaceutical industry and their sources	60	80
CO2	Perform microbiological laboratory procedures according to appropriate safety standards	70	80
CO3	Evaluate microbial content testing and sterility testing	65	80
CO4	Compare and contrast different microbial diseases, including the properties of different types of pathogens, and the mechanisms of pathogenesis	70	80
CO5	llustrate the therapeutic treatments for microbial infections, and distinguish when a vaccine, antibiotic, or other therapy is likely to be the most appropriate response	70	80

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**S**	**L**	**M**	**L**	**-**
CO2	**S**	**M**	**M**	**L**	**M**	**L**	**-**
CO3	**S**	**M**	**M**	**-**	**M**	**-**	**-**
CO4	**S**	**S**	**M**	**L**	**S**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**S**	**L**	**L**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Title of the paper: Lab in Medical Microbiology

1. Staining techniques- Simple, Negative, Gram's, capsule, Spores
2. Staining of Acid fast Bacilli by Ziehl Nelson staining (Virtual).
3. Isolation and identification of pyogenic microorganisms.
4. Identification of *Staphylococci* and *Streptococci sp.* by hemolysis (α, β and γ haemolysis)
5. Differentiation of *Streptococci sp.* by Bile solubility test.
6. Differentiation of *Staphylococci sp.* by coagulase test
7. Isolation and identification of microorganisms from urine sample
8. Biochemical tests for identification of unknown bacteria (IMViC, Urease, TSI, Catalase & oxidase test)
9. Isolation and identification of Dermatophytic fungus (*Microsporum, Epidermophyton, Trichophyton)*
10. Lactophenol cotton blue staining and KOH mount for fungi *(Aspergillus, Mucor, Rhizopus, Penicillium).*
11. Germ tube test for identification of *Candida albicans*
12. Preparation of dried filter paper discs for susceptibility assay.
13. Antimicrobial activity by Kirby – Bauer disc diffusion technique.
14. Determination of MIC & MBC
15. Antimicrobial susceptibility test against filamentous and non- filamentous fungi.
16. Detection of β lactamase producing organisms
17. Detection of Azole resistance in *Candida albicans*

Reference Books:

- Betty A.F., Daniel F.S., Alice S. Bailey & Scott's Diagnostic Microbiology (2006), 12th Edition Diagnostic Microbiology, Mosby London.
- Lippincott Williams and Wilkins. Philadelphia, Baltimore 2006. Koneman's Color Atlas and Text book of Diagnostic Microbiology.
- Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.
- Wadhar B.H. and Boosreddy, G.L. 1995. Manual of Diagnostic Microbiology, Himalaya Publishing House, New Delhi.

ICT tools:

- Antibiotic resistance- Beta lactamase:https://www.youtube.com/watch?v=byLV2bESY4k
- Azole resistance *Candida albicans*: https://www.youtube.com/watch?v=6GT11CiOykM
- Determination of MIC and MBC: https://www.youtube.com/watch?v=jCShFlXPcmg

Course Designer:

1. Dr. J. Vinoth – Assistant Professor

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20C32	Clinical Lab Technology	Core-8	4	-	-	4

L - Lecture T – Tutorial P – Practical

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

Preamble

The course provides an overview of diagnostic procedures required for performing clinical laboratory techiques. The course work demonstrates technical skills, quality control parameters and other health related settings required for clinical lab technician.

Prerequisite

Basic knowledge on microbiology and biochemistry

Course Outcomes

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

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Spell the basic lab safety methods and different clinical lab techniques	60	70
CO2	Summarize theoretical knowledge on blood sample analysis and grouping	65	60
CO3	Emphasize the scientific knowledge on urine sample processing and analysis	70	60
CO4	Interpret the importance of microscopic, macroscopic and culture sensitivity analyses of stool samples	65	60
CO5	Make use of scientific knowledge on specimen collection and examination of sputum and semen sample analyses	65	60

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**S**	**-**	**L**	**-**	**L**
CO2	**L**	**M**	**S**	**L**	**L**	**-**	**M**
CO	**S**	**M**	**S**	**L**	**L**	**-**	**M**
CO4	**L**	**M**	**S**	**L**	**L**	**-**	**M**
CO5	**L**	**M**	**S**	**L**	**L**	**-**	**M**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Blooms taxonomy

Blooms Taxanomy			
	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	**60**	**60**	**130**

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. Staining techniques for blood samples. ABO Blood group system- Slide and tube method, RH system. Antihuman globulin test (Direct and Indirect methods), Coombs test. Determination of TC, DC, Platelets, ESR, Hb, BT & CT, Prothrombin time, Thromboplastin time, Blood disorder diseases. Blood transfusion and Compatibility testing. Determination of blood glucose, Urea, Cholesterol, Creatinine and Bilirubin. Rheumatoid arthritis, 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, specific gravity, amino acids. Microscopic Examination of Urine – Cast Crystals and Cells. Automation urine analysis, Special urine test, Pregnancy Test (slide test and ELISA). Urine culture and sensitivity.

Unit IV

Collection and transport cerebrospinal fluid sample. Lumbar Puncture (Spinal Tap), CSF Pressure, Color and appearance, Microscopic examination of cells. Synovial fluid test, Peritoneal fluid test. 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, Chemical examination of semen. Skin test- Tuberculin test, Schick test

Reference Books

- Sood, R, 2010. Medical Laboratory Technology – Methods and interpretations – Seventh edition, Jaypee, New Delhi.
- Mukherjee, L.K. 2010. Medical Laboratory Technology – 3 volumes – second edition – Hill Publishing Ltd., New Delhi.
- Ochei, J and Kolkatkar, A. 2009. Medical Laboratory Science – Theory and Practice. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi, India.
- Alex, C., Sonnenwirth, 1998. Gradwohl's Clinical Laboratory Methods and Diagnosis, Vol. 1&2, eighth edition, B.I. Publications Ltd., New Delhi.
- David, S. Jacobs, Wayne R. Demott, Paul R. Finley, 1994. Laboratory Test Hand Book, third edition, Key word index, Laxi-Compinc, Hudson.

ICT Tools

- VDRL Test - https://www.youtube.com/watch?v=cFRk6CoupDs
- Urine analysis - https://www.youtube.com/watch?v=d8w5SICzzxc
- Analysis of Blood cells - https://www.youtube.com/watch?v=yKWQ_oLSXI8

Course Designers

1. Dr. M. Karthikeyan- Assistant Professor

2. Dr. J. Vinoth- Assistant Professor

Lecture Schedule

#	Topic	No of lecture hrs.
Unit-I		
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
1.11	Biomedical waste management	1
Unit-II		
2.1	Collection and processing of blood sample	1
2.2	Staining techniques for blood samples	2
2.3	ABO Blood group system- Slide and tube method, RH system	1
2.4	Antihuman globulin test (Direct and Indirect methods), Coombs test	2
2.5	Blood transfusion and Compatibility testing	2
2.6	Determination of TC, DC, Platelets, ESR, Hb	3
2.7	BT & CT, Prothrombin time, Thromboplastin time	3
2.8	Blood disorder disease	1
2.9	Determination of blood glucose	1
2.10	Determination of urea	1
2.11	Determination of blood Cholesterol	1
2.12	Determination of Bilirubin & Creatinine	1
2.13	Rheumatoid arthritis, VDRL & Widal test	2

2.14	VDRL	1
2.15	Blood culture and sensitivity	2
Unit-III		
3.1	Collection, transport and Storage of Urine sample	1
3.2	Physical properties of Urine.	2
3.3	Examination of urine	2
3.4	Microscopic Examination of Urine – Cast Crystals and Cells.	2
3.5	Pregnancy Test	1
3.6	Urine culture and sensitivity.	2
Unit-IV		
4.1	Collection and transport cerebrospinal fluid sample	1
4.2	Lumbar Puncture (Spinal Tap), CSF Pressure, Color and appearance	2
4.3	Microscopic examination of CSF cells	2
4.4	Synovial fluid test, Peritoneal fluid test	1
4.5	Collection and transport of stool sample.	1
4.6	Macroscopic and Microscopic examination of stool.	2
4.7	Chemical examination of stool.	1
4.8	Stool Culture and sensitivity	2
4.9	Occult blood and its clinical significance	2
Unit-V		
5.1	Collection and transport of sputum specimen.	2
5.2	Macroscopic and Microscopic examination of sputum-AFB staining.	3
5.3	Sputum culture and sensitivity.	2
5.4	Collection of semen	1
5.5	Semen analysis – motility, total count and abnormality	2
5.6	Chemical examination of semen.	1
5.7	Skin test- Tuberculin test, Schick test	1
	Total	**75**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20CL32	Lab in Clinical Lab Technology	Core Lab - 6	-	-	4	2

L - Lecture T – Tutorial P – Practical

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

Preamble
Provides hands on training to the students on the collection, transport and analyses of clinical specimens.

Prerequisite
Knowledge on the mechanism and diagnosis of diseases in clinical specimens

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

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Apply different clinical laboratory techniques for collection and analysis of body fluids	60	80
CO2	Exhibit technical skills in clinical sample analyze according to pre-established laboratory standards	70	80
CO3	List and adhere to safety rules and regulations prescribed for sample acquisition, handling and test to be adopted for analyses.	65	80
CO4	Choose to work or establish a clinical laboratory	70	80
CO5	Explain methods for microbial culture, evaluate microbial content testing and sterility testing	70	80

Mapping of COS with POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	**S**	**S**	**M**	**-**	**M**	**M**	**L**
CO2	**S**	**S**	**M**	**L**	**M**	**M**	**-**
CO3	**S**	**M**	**M**	**-**	**L**	**M**	**-**
CO4	**S**	**L**	**M**	**L**	**M**	**L**	**L**
CO5	**S**	**S**	**M**	**L**	**L**	**L**	**-**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Title of the paper: Lab in Clinical Lab Technology

1. Collection and processing of clinical specimen for microbiological examination.
2. Coombs test
3. Determination of ESR
4. Estimation of Haemoglobin
5. Estimation of Blood Sugar
6. Estimation of blood Urea
7. Estimation of serum Cholesterol
8. Estimation of serum bilirubin
9. Urine analysis
10. Urine sample analysis to detect sugar, protein, Albumin, Ketone bodies, bile salts and bile pigments
11. Sero-diagnosis of bacterial infection using WIDAL & RPR, RA Test
12. Staining techniques for Amoeba / Intestinal protozoa / Malarial parasites – Leishman's stain, Giemsa stain.
13. Semen analysis – Motility and Total count.
14. Chemical analysis of semen
15. Virtual lab on Tuberculin test and Schick test

Reference Books:

- Collee, J.G., A.G.Fraser, B.P.Marmion and A.Simmons 2007. Mackie and McCartney Practical medical Microbiology. Elsiever, New York.
- Ranjan Kumar De, 2007. Diagnostic Microbiology, (For DMLT Students) Jaypee Brothers publishing, New Delhi.
- Betty A.F., Daniel F.S., Alice S. Bailey & Scott's Diagnostic Microbiology (2006), 12th Edition Diagnostic Microbiology, Mosby London.
- Lippincott Williams and Wilkins. Philadelphia, Baltimore 2006. Koneman's Color Atlas and Text book of Diagnostic Microbiology.
- Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. (1996) Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.

ICT Tools:

- Schick test: https://www.youtube.com/watch?v=ToXXdTIB5cs
- **S**emen analysis: https://www.youtube.com/watch?v=gIDMLjZgj8g
- Rheumatoid arthritis: https://www.youtube.com/watch?v=Yc-9dfem3lM

Course Designer:

1. Dr. J. Vinoth – Assistant Professor

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20C33	rDNA Technology	Core-9	4	-	-	4

L - Lecture T – Tutorial P – Practical

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

Preamble
Provide the principles of elemental concepts, various methods of gene manipulation and its implementation in multiple sectors of modern biotechnology

Prerequisite
Be aware of the principles behind the methods of rDNA technology

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

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Explain to the history, principles behind the restriction and modification methods	60	70
CO2	Recall and make use of various cloning methodologies, genomic library construction and blotting techniques	70	60
CO3	List an in-depth knowledge of PCR and sequencing methods	60	70
CO4	Interpret and defend the cloning techniques of various bacteria and yeast	65	70
CO5	Explain the importance of transposition, plant genetic engineering and gene silencing	60	70

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	S	M	S
CO2	S	M	S	M	M	-	M
CO3	S	S	S	M	S	L	M
CO4	S	S	S	M	M	L	-
CO5	S	M	M	M	S	S	L

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Blooms taxonomy

Blooms Taxanomy			
	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	**60**	**60**	**130**

Title of the paper – rDNA Technology

Unit I

History and scope of rDNA technology. Restriction enzymes – nomenclature, classification and applications. DNA modifying enzymes– nucleases – T4/T7 DNA polymerases, Ligases, Reverse Transcriptase, Terminal Transferases, T4 Polynucleotide kinases & Alkaline phosphatase. Cloning vectors – Plasmids, Cosmids, Phasmids, Phagemids, Plasmid vectors – pBR322 and pUC18, Expression vectors-YAC, BAC vectors, M13 vectors, Hybrid vectors, Adenoviral and Adenovirus associated viral vectors.

Unit II

Cloning methodologies – sticky and blunt end cloning, homopolymeric tailing and use of adapters & linkers. Cloning from mRNA – synthesis of cDNA, cloning cDNA in plasmid and phage vectors, cDNA libraries. Cloning from genomic DNA – genomic library. Shot gun cloning, Physical and restriction mapping. Site directed mutagenesis, Screening of recombinant – phenotypic expression of characters – antibiotic resistance, lacZ complementation (Blue-white selection), fluorescent markers (e.g. GFP). Blotting techniques – Western, Northern, Southern.

Unit III

PCR – basic process, types and applications in gene amplification, primer designing, optimization, variation in the PCR-reverse transcriptase and Real-Time PCR. Automated DNA sequencing, high throughput pyrosequencing, DNA sequencing – Sanger – Coulsen's method, Maxam Gilbert's method. DNA foot printing. Next generation sequencing concepts.

Unit IV

Industrial application of rDNA technology. Synthesis and purification of proteins from cloned genes- Native and fusion proteins. Production of enzymes and therapeutic products for use in human health care - insulin, growth hormones, interferon, somatostatin and Hepatitis B vaccine. 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

Gene silencing and antisense technology: Types and mechanism of gene silencing. Gene silencing in crop plants-tomato and rice. Si RNA and disease control. Vector less DNA delivery-

Ti & Ri plasmid, vector-based DNA delivery– microprojectile bombardment, microinjection, electroporation and pollen tubes. rDNA technology in clinical diagnosis of inherited disorders and infectious diseases, Multiplex PCR. Gene therapy for cystic fibrosis.

Reference Books

- Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, Seventh Edition, Blackwell publishing, UK.
- Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
- Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2009. Lewin's Gene X Jones & Bartlelt Publishers, Boston.
- Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
- Brown, T.A. 2006. Gene Cloning, Fifth Edition, Chapman and Hall Publication, USA.
- Glick, B.K. and Pasternak, J.J. 2002. Molecular Biotechnology Principles and Applications of Recombinant DNA, ASM Press, Washington.

ICT Tutorials

- Cloning vectors-Plasmids: https://www.youtube.com/watch?v=Bz02Qlsu4XI
- Blue white screening: https://www.youtube.com/watch?v=4fnS2xKjIbg
- Gene silencing and antisense technology: https://www.youtube.com/watch?v=dNWpM7a23Cw

Course Designers

1. Dr. K. Renugadevi– Assistant Professor

2. Dr. A. Kanakalakshmi– Assistant Professor

Lecture Schedule

#	Topic	No of lecture hrs.
Unit-I		
1.1	DNA modifying enzymes and their uses in rDNA technology. Restriction enzymes – nomenclature, classification and applications.	2
1.2	DNA modifying enzymes– nucleases – T4/T7 DNA polymerases, Ligases, Reverse Transcriptase, Terminal Transferases, T4 Polynucleotide kinases & Alkaline phosphatase.	3
1.3	Cloning vectors – Plasmids, Cosmids, Phasmids, Phagemids	2
1.4	Plasmid vectors –pBR322 and pUC18, Expression vectors-YAC, BAC vectors,	2
1.5	M13 vectors, Hybrid vectors, Adenoviral and Adenovirus associated viral vectors.	2
Unit-II		
2.1	Cloning methodologies – sticky and blunt end cloning, homopolymeric tailing and use of adapters & linkers.	2
2.2	Cloning from mRNA – synthesis of cDNA, cloning cDNA in plasmid and phage vectors, cDNA libraries.	4
2.3	Cloning from genomic DNA – genomic library. Shot gun cloning.	3
2.4	Site directed mutagenesis, Screening of recombinant – phenotypic expression of characters – antibiotic resistance, lacZ complementation (Blue-white selection),	3
2.5	fluorescent markers (e.g. GFP). Blotting techniques – Western, Northern, Southern.	3
2.6	Physical mapping of cloned genes – restriction mapping.	3
Unit-III		

3.1	PCR – basic process, types and applications in gene amplification, primer designing, optimization,	2
3.2	variation in the PCR (RAPD, RFLP, RACE, RT-PCR and Real-Time PCR).	2
3.3	Automated DNA sequencing, high throughput pyrosequencing, DNA sequencing	2
3.4	Sanger – Coulsen's method, Maxam Gilbert's method.	1
3.5	Site-directed mutagenesis and protein engineering. DNA foot printing.	2
3.6	Next generation sequencing - Lynx Therapeutics' Massively Parallel Signature Sequencing (MPSS).	3
Unit-IV		
4.1	Industrial application of rDNA technology. Synthesis and purification of proteins from cloned genes- Native and fusion proteins.	2
4.2	Production of enzymes and therapeutic products for use in human health care - insulin, growth hormones, interferon,	2
4.3	somatostatin and Hepatitis B vaccine.	2
4.4	Human antibody production by r-DNA technology. Recombinant vaccine development - HBs Ag in yeast.	2
4.5	Cloning for commercial production of antibiotics (Penicillin).	2
4.6	Chymosin (Rennin) in *E. coli* and yeast.	2
Unit-V		
5.1	rDNA technology in crop improvement. Gene silencing and antisense technology: Types and mechanism of gene silencing.	2
5.2	Gene silencing in crop plants-tomato and rice. Si RNA and disease control.	2
5.3	Plant genetic engineering: Ti & Ri plasmid, DNA delivery to plant cells – microprojectile bombardment, microinjection, electroporation and pollen tubes.	2
5.4	Medical and forensic applications of rDNA technology- DNA Profiling, Multiplex PCR, Diagnosis of inherited disorders and infectious diseases.	2
5.5	Treatment using rDNA technology- gene therapy for cystic fibrosis.	2
	Total	**75**

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20CL33	Lab in rDNA Technology	Core Lab - 7	-	-	4	2

L - Lecture T – Tutorial P – Practical

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

Preamble

Provide hands on training about the various procedures of gene manipulation techniques and its significance

Prerequisite

Basic knowledge on the principle behind the methods of rDNA technology

Course Outcomes

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

#	Course Outcome	Expected proficiency (%)	Expected Attainment (%)
CO1	Perform the nucleic acid isolation and separation procedures	60	80
CO2	Analyze the restriction endonuclease activity and its significance	70	80
CO3	Demonstrate the procedures of gene cloning and PCR analysis	65	80
CO4	Execute the cloning technologies to elucidate genetic issues	70	80
CO5	Elucidate the computational tools in comparative studies of genes and its target approach	70	80

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**L**	**M**	**L**	**-**
CO2	**S**	**M**	**S**	**-**	**M**	**M**	**M**
CO3	**S**	**M**	**S**	**M**	**S**	**M**	**M**
CO4	**S**	**S**	**S**	**M**	**S**	**M**	**L**
CO5	**S**	**S**	**S**	**L**	**M**	**M**	**S**

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Title of the paper: Lab in rDNA technology

1. Isolation and purification of DNA from plant samples and agarose gel electrophoresis.
2. Isolation and purification of DNA from animal samples and agarose gel electrophoresis.
3. Isolation of Plasmid by alkaline detergent method - A miniprep procedure
4. Primer designing by *in-silico* method
5. PCR amplification of DNA
6. Determination of fragment order of plasmid by single and double restriction digestion.
7. Demonstration of T4 DNA Ligation.
8. Cloning of DNA fragment in pBR322 / pBluescript – insertion inactivation/blue white selection.
9. Acrylamide gel electrophoresis and silver staining procedure.
10. Western Blotting analysis
11. Protoplast isolation and fusion
12. *In-silico* analysis:
    A. Database-homology searches using different types of BLAST analysis
    B. Multiple sequence alignment using CLUSTAL W and Multalin tools.
    C. Identification of restriction site using NEB cutter tool.
    D. Identification of protein cleavage site using PEP cutter tool.

Reference Books:

- Betty A.F., Daniel F.S., Alice S. 2006. Bailey & Scotts Diagnostic Microbiology, 12th Edition Diagnostic Microbiology, Mosby London.
- Lippincott Williams and Wilkins. 2006. Koneman's Color Atlas and Text book of Diagnostic Microbiology. 6th Edn. Philadelphia, Baltimore.
- Brown, T.A. 1998. Molecular Biology Lab Fax II Gene analysis, Second Edition, Academic Press, UK.
- Collee, J.C., Duguid, J.P., Fraser, A.C. and Marimon, B.P. 1996. Mackie and McCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone, London.

ICT Tutorials

- Demonstration of T4 DNA Ligation: https://www.youtube.com/watch?v=51brWA7j-OU
- Cloning of DNA fragment-https://www.youtube.com/watch?v=26SoY5obNxs
- Western Blotting analysis-https://www.youtube.com/watch?v=-Zchea9xGT0

Course Designer:

1. Dr. K. Renugadevi – Assistant Professor

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20C41	**Fermentation Technology**	Core-10	4	1	-	4

L - Lecture T – Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
Second	Fourth	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.

Prerequisite

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

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Infer the basic principles of bioprocess technology like strain development and preservation techniques	**70**	**60**
CO2	Summarize and apply the different methods of fermentation and various designs of fermenters	**70**	**60**
CO3	Explain the several media based on optimization technique and secure a wide view on fermentation kinetics	**70**	**60**
CO4	Simplify a diverse knowledge on the production of different fermentation products	**60**	**70**
CO5	Explains the fermentation economics and social issues in industrial microbiology	**70**	**60**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	M	-	L
CO2	S	S	M	L	S	-	M
CO3	S	M	S	M	M	L	L
CO4	S	S	S	M	L	M	-
CO5	S	M	M	-	M	M	L

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	-
CO2	S	L	L	M	S
CO3	S	L	M	M	-
CO4	S	S	M	M	L
CO5	M	L	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)	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	**60**	**60**	**130**

Title of the paper: Fermentation 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. Inoculum development- Bacterial, fungal spores, fungal mycelium. Sterilization- fermenter, feed- filter sterilization (media & air).

Unit II

Design of fermenters- Body construction- aeration and agitation- Valves and steam traps. Instrumentation and control- Methods of measuring process variables (Temperature, Measurement and control of pH, Flow and Pressure), safety valves, Control system (Manual & automatic). Computer applications in fermentation technology. Types of fermentation. Methods of fermentation-batch, continuous and fed batch system. Types -batch, CSTF, air lift, tower, bubble column, fluidized bed fermenter.

Unit III

Media-chemical composition, raw materials – Carbon source, Nitrogen source, minerals, oil and fat, Antifoam agents and industrial wastes. Media optimization (batch and continuous). Fermentation kinetics-Batch and continuous. Downstream processing –cell disruption-physical and chemical methods. Separation- filtration, centrifugation, liquid-liquid extraction, chromatography, precipitation, drying and crystallization. Immobilization of cells and enzymes-methods and application.

Unit IV

Microbial assay: vitamin (B_2, B_{12}), Amino acid (lysine, Glutamic acid), Antibiotics (Streptomycin, Erythromycin). Fermentation products-Anaerobic fermentation (Beer, wine, Palm wine, alcohol). Aerobic fermentation (Vinegar, citric acid, Lactic acid), Amino acid (lysine, glutamic acid, Valine), Antibiotics (Penicillin, Streptomycin, Tetracyclin), Antitumour Antibiotics, Enzymes (Amylase, Protease), Vitamins (B_{12}, Riboflavin), Hormones (Gibberellic acid, Indole acetic acid). Ergot Alkaloids. Vaccine production (Viral vaccine and bacterial toxoids)

Unit V

Fermentation economics- Market potential, Process cost, recovery cost, water usage and recycling, Treatment of effluent from the fermenter industry, market potential and Cost benefit

ratio. Societal issues in industrial microbiology- Impact- Influence in society- Public perception to policy development- impact to policy development. Societal issues in industrial microbiology.

Reference Books:

- Casida, J.F. 2010. Industrial Microbiology, New Age International India Pvt. Ltd., New Delhi.
- Peppler, H.., and Pearman, D. 2008. Microbial Technology, second edition, Vol. I, Academic Press, New York.
- Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
- Crueger, W. and Crueger, A. 2000. Biotechnology: A Test Book of Industrial Microbiology, Second Edition, Panima Publishing corporation, New Delhi.
- Stanbury, P.F, Whitaker, A. and Hall, S.J.1999. Principles of Fermentation Technology, Second Edition, Aditya Book (P) Ltd., New Delhi.
- Patel, A.H., 1996, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi.

ICT Tutorials

- Design of fermenters- https://youtu.be/-ddTYPSa2Ao
- Fermentation Kinetics- https://youtu.be/J6kpFAGYH6s
- Ergot Alkaloids- https://youtu.be/_YSv2NUmdXc

Course Designer:

1. Dr. A. Kanakalakshmi- Assistant Professor
2. Dr. J. Vinoth- Assistant Professor

Lecture Schedule

#	Topic	No of lecture hrs.
1.1	General concepts of industrial microbiology	1
1.2	Isolation of productive strains-screening technique - primary and secondary	2
1.3	Strain development – mutation, protoplast fusion and recombinant DNA techniques.	3
1.4	Preservation techniques	2
1.5	Inoculum development- Bacterial	2
1.6	Inoculum development fungal spores, fungal mycelium	2
1.7	Sterilization- fermenter, feed filter sterilization (media & air)	2
2.1	Design of fermenters- Body construction	3
2.2	Aeration and agitation- Valves and steam traps	2
2.3	Instrumentation and control	3
2.4	Methods of measuring process variables (Temperature, Measurement and control of pH, Flow and Pressure)	1
2.5	safety valves, Control system (Manual & automatic	2
2.6	Computer applications in fermentation technology	2
2.7	Methods of fermentation-batch, continuous and fed batch system	3
2.8	Types -batch, CSTF, air lift, tower, bubble column, fluidized bed fermenter.	3
3.1	Introduction to Media-chemical composition	1
3.2	Raw materials – Carbohydrate, Nitrogen source, minerals, oil	4

	and fat, Antifoam agents and industrial wastes.	
3.3	Media optimization (batch and continuous)	2
3.4	Fermentation kinetics-Batch and continuous	3
3.5	Downstream processing –cell disruption-physical and chemical methods	3
3.6	Separation- precipitation, filtration, centrifugation, liquid-liquid extraction, chromatography, drying and crystallization	4
3.7	Immobilization of cells and enzymes-methods and application.	3
4.1	Microbial assay of vitamin ($B_{2,}$ B_{12})	2
4.2	Amino acid (lysine, Glutamic acid)	2
4.3	Antibiotics (Streptomycin, Erythromycin)	2
4.4	Fermentation of microbial products-Anaerobic fermentation (Beer, wine, Palm wine, alcohol)	4
4.5	Aerobic fermentation (Vinegar, citric acid, Lactic acid)	3
4.6	Amino acid (lysine, glutamic acid, Valine)	2
4.7	Antibiotics (Penicillin, Streptomycin, Tetracyclin), Antitumour Antibiotics	4
4.8	Enzymes (Amylase, Protease), Vitamins (B_{12}, Riboflavin)	2
4.9	Hormones (Gibberellic acid, Indole acetic acid)	2
4.10	Ergot Alkaloids. Vaccine production (Viral vaccine and bacterial toxoids)	1
5.1	Market Potential, Process cost, recovery cost, water usage and recycling, Effluent treatment, market potential and Cost benefit ratio.	1
5.2	Societal Issues in Industrial Microbiology	1
5.3	Impact- Influence in society- Public perception to policy development- impact to policy development	1
5.4	Societal issues in industrial microbiology. Labelling of GM food products	1
	Total	75

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20CL41	**Lab in Fermentation Technology**	Core Lab-8	-	-	4	2

L - Lecture T – Tutorial P – Practical

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

Preamble

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

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	Expected Proficiency (%)	Expected Attainment (%)
CO1	Discuss/demonstrate the important aspects in bioprocess technology for commercialization purpose of biotechnology products	**70**	**80**
CO2	Analyze the mass transfer and material balance calculation in different types of application in bioprocess	**60**	**80**
CO3	Infer the kinetics parameter values in different types of fermentation process	**70**	**80**
CO4	Apply fundamental calculation in bioprocessing	**70**	**80**
CO5	Illustrate the schematic diagram of upstream and downstream processing for product recovery and purification	**70**	**80**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	M	M	L
CO2	S	S	M	S	M	L	M
CO3	S	M	S	M	L	M	L
CO4	S	S	M	S	L	M	L
CO5	S	M	S	S	L	L	L

S: Strong M: Medium L: Low

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 Fermentation 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:

- Kulanthaivel,S and S. Janarthanan 2012. Practical Manual on Fermentation Technology. I.K. International Publishing house. New Delhi.
- Peppler,H,J and Periman,D. 2008.Microbial Technology Fermentation Technology, (Two Volumes)Second Edition, Elsevier, Academic Press. U.K.
- Demain, A.L, and Davis, J.E. 1999. Manual of Industrial Microbiology and Biotechnology, second edition, American Society for Microbiology, Washington.
- Mc. Neil, B. and Harvery, L.M. 1990. Fermentation: A Practical Approach (Units I-III), IRL Pvt ltd, New York.

ICT Tutorials

- Cell disruption using Sonicator- https://youtu.be/f_G1N8BH0CY
- Lyophilization- https://youtu.be/-INsuz3H1M0

Course Designers:

1. Dr. A. Kanakalakshmi- Assistant Professor

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credits
PMB20C42	Food & Agriculture Microbiology	Core - 11	5	-	-	5

L - Lecture T – Theory P – Practical

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

Preamble

The course illustrates the process of food spoilage and preservation methods. Elaborates the application of microbes in plant growth promotion and disease management. The main focus of the course is to explain the role of microbes in food and agricultural sectors.

Prerequisite

Basics of chemistry and biology

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define and classify the process involved in preparation of fermented food products and its applications	**70**	**60**
CO2	Apply the fundamental principles of food preservation techniques	**70**	**60**
CO3	Outline the importance and mechanism of microbial pathogenicity and transmission of plant pathogens	**60**	**70**
CO4	Analyze the techniques involved in the processing biofertilizers and its applications	**70**	**60**
CO5	Appraise and distinguish the elemental concepts in formulation of biopesticides and nanoferilzers	**70**	**60**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	-	S	-	S	L	M
CO2	M	L	S	-	-	-	M
CO3	M	L	S	-	L	S	M
CO4	M	L	S	-	S	S	M
CO5	M	L	S	-	S	S	M

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	S	-	M
CO2	M	L	S	-	L
CO3	S	L	S	-	M
CO4	M	L	S	-	S
CO5	M	L	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)	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	**60**	**60**	**130**

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 pathogenecity, 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 seasamum phyllody.

Unit IV

Biofertilizers: General account of taxonomy, physiology, mass cultivation, carier 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. Plant growth promoting bacteria (PGPB), Endophytic bacteria and its significance

Unit V

Biopesticides: Bacterial pesticides: *Bacillus thuringiensis, Pseudomonas.* Viral Pesticides: Nuclear Polyhedrosis virus. Fungal pesticides: Entomopathogenic fungi - *Beaveria bassiana.* Bioherbicides - Integrated weed management. Nanotechnology in Agricultre – Nanopesticides and Nanofertilizers

Reference Books:

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

ICT Tutorials

- Biofertilizer production - https://www.youtube.com/watch?v=P9vfXkiHmqQ
- Food processing Start up in India - https://www.youtube.com/watch?v=IZ4ZVPwoSoA
- Nanopesticides - https://www.youtube.com/watch?v=Lams7PqbnCE

Course Designers:

1.Dr. M. Karthikeyan– Assistant Professor

2. Dr. J. Vinoth– Assistant Professor

Lecture Schedule

#	Topic	No of lecture hrs.
Unit- I		
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
Unit- II		
2.1	Food preservation – principle, Methods - physical – asepsis, high temperature, low temperature, drying, radiation, canning, controlled atmosphere;	7
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
Unit- III		
3.1	Transmission of plant pathogens, mechanism of microbial pathogenecity, factors affecting disease incidence. Bacteria – *Xanthomonas malvacearum* (Cotton blight),	2
3.2	Transmission of plant pathogens, mechanism of microbial pathogenecity, factors affecting disease incidence. Bacteria – *Xanthomonas citri* (Citrus canker).	2
3.3	Fungi – *Ustilago maydis* (Smut rust of Corn)	2

3.4	Fungi -*Cercospora arachidicola* (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
Unit- IV		
4.1	**Biofertilizers:** General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: Nitrogenous Bacteria - (*Rhizobium)*	2
4.2	**Biofertilizers:** General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: Nitrogenous Bacteria-(*Frankia)*	2
4.3	**Biofertilizers:** General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: Nitrogenous Bacteria –(*Azotobacter),*	2
4.4	**Biofertilizers:** General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: *Cyanobacteria (Nostoc & Anabaena).*	2
4.5	**Biofertilizers:** General account of taxonomy, physiology, mass cultivation, carier based inoculants and application of Biofertilizers: -*AM.* Mechanism of phosphate solubilization and phosphate mobilization.	3
4.6	Storage, shelf life, quality control and marketing of Biofertilizers. Biomanures	2
4.7	Plant growth promoting bacteria (PGPB)	1
4.8	Endophtic bacteria and its significance	1
Unit- V		
5.1	**Biopesticides:** Bacterial pesticides: *Bacillus thuringiensis.*	3
5.2	**Biopesticides:** Bacterial pesticides: *Pseudomonas.*	3
5.3	**Biopesticides:** Viral Pesticides: Nuclear Polyhedrosis virus	3
5.4	**Biopesticides:** Fungal pesticides: Entomopathogenic fungi – *Beaveria bassiana.*	2
5.5	**Bioherbicides –** Integrated weed management.	2
5.6	Nanotechnology in Agricultre	1
5.7	Nanopesticides and Nanofertilizers	1
	Total	75

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credits
PMB20CL42	Lab in Food and Agriculture Microbiology	Core Lab-9	-	-	4	2

L - Lecture T – Theory P – Practical

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

Preamble

The course provides hand on training on the isolation, identification of microbes involved in crop protection and food spoilage microbes. Elaborates the techniques involved in production of biofertilizers and pesticides

Prerequisite

Basic microbiology and chemistry

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Explain and demonstrate the role of intrinsic and extrinsic factors on growth and survival of microorganisms in food	**70**	**80**
CO2	Demonstrate the mechanism of food spoilage and preventive strategies of food preservation.	**70**	**80**
CO3	List the experimental protocols for the isolation, identification and application of plant growth promoting bacteria in agriculture	**70**	**80**
CO4	Illustrate the effects of plant pathogens in agriculture	**70**	**80**
CO5	Demonstrate the role of plant growth promoting microbes in crop protection	**70**	**80**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	S	-	L	M	M
CO2	L	M	S	-	M	M	L
CO3	M	L	S	-	S	S	M
CO4	M	L	S	-	S	S	M
CO5	M	L	S	-	S	S	M

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

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 *Xanthomonasmalvacearum*from angular leaf spot of cotton
13. Isolation of pathogenic fungi from plant
14. Isolation of cyanobacteria from soil
15. Isolation of Arbuscular Mycorhizal spores from soil.
16. Staining of VAM.
17. Isolation & enumeration of *Azospirillum* – an associative symbiotic nitrogen fixing bacteria.
18. Isolation & enumeration of *Azotobacter&Beijerinekia* – non symbiotic nitrogen fixing bacteria.
19. Isolation of Phosphate solubilizing Microorganisms from soil.

Reference Books:

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

ICT Tutorials:

- Biofertilizer production - https://www.youtube.com/watch?v=P9vfXkiHmqQ
- Food processing Start up in India - https://www.youtube.com/watch?v=IZ4ZVPwoSoA
- Nanopesticides - https://www.youtube.com/watch?v=Lams7PqbnCE

Course Designer:

1. Dr. M. Karthikeyan- Assistant Professor

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(For those joined M.Sc., Microbiology on or after June 2020)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20C43	Research Methodology	Core-12	5	1	-	**5**

L - Lecture T - Tutorial P – Practicals

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

Preamble

Acquire knowledge on the procedure and the techniques adopted while conducting the research.

Prerequisite

Basic knowledge on research

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Elaborates the basic framework of research process	**70**	**60**
CO2	Illustrates the various research design and techniques	**60**	**70**
CO3	Provides various sources of information for literature review and data collection	**70**	**60**
CO4	Elaborates the Understanding of ethical dimensions of conducting applied research	**60**	**70**
CO5	Appreciate the components of scholarly writing and evaluate its quality.	**60**	**70**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	M	L	M
CO2	S	M	S	-	S	-	L
CO3	S	S	M	S	S	-	M
CO4	S	M	M	S	M	L	M
CO5	S	S	M	S	S	S	-

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	S
CO2	S	M	S	S	-
CO3	S	S	-	M	S
CO4	S	S	S	S	S
CO5	S	M	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	**60**	**60**	**150**

Title of the Paper: Research Methodology

Unit I

Research- meaning, objectives- significance, 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. Review of literature-meaning-objectives- functions- importance of literature review in defining the problem, source- primary and secondary sources. Criteria of good research.

Unit II

Problem Identification & Formulation. Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables Hypothesis - null and alternate hypothesis - hypothesis testing; Exploratory and descriptive research design - concept, types and uses.

Unit III

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, insects, plant, animals from natural and lab bred population; Biological models.

Unit IV

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; standard error and standard deviation. Correlation,

Regression, ANOVA – one and two way, DMRT, Tukey test.

Unit V

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 and review articles –copyright violation – choosing the right journal; refereed journals, open access journals, citation, impact factor, SCI, H index, i10 index, referencing software (Zotero/Mendeley), software for paper formatting like LaTex/MS Office, Software for detection of Plagiarism.

Reference Books:

- Fink, A., (2009). Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
- Anthony, M., Graziano, A.M. and Raulin, M.L., (2009). Research Methods: A Process of Inquiry, Allyn and Bacon.
- C.R.Kothari, IInd edition(2004) Research methodology: Methods and Techniques. New Age International (p) ltd publishers, New Delhi.
- Jerrod H.Zar (1999) Biostatistical ananlysis by Prentice hall international Inc Press, London.
- Day, R.A., (1992).How to Write and Publish a Scientific Paper, Cambridge University Press
- Coley, S.M. and Scheinberg, C. A., (1990) "Proposal Writing", Sage Publications.

ICT Tutorials

- How to write thesis- https://youtu.be/XDgXzdl9bCw
- LaTex Tutorial- https://youtu.be/VhmkLrOjLsw

Course Designers:

1. **Dr. Rm. Murugappan- Associate Professor**
2. **Dr. A. Kanakalakshmi- Assistant Professor**

Lecture Schedule

#	Topic	No of lecture hrs.
Unit-I		
1.1	Research- meaning, objectives- significance, types of research	2
1.2	Descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical	2
1.3	Literature review - various sources of information; identification, defining and devising of research problem	2
1.4	Review of literature-meaning-objectives- functions	2
1.5	importance of literature review in defining the problem, source-primary and secondary sources	2
1.6	Criteria of good research	2
Unit- II		
2.1	Problem Identification & Formulation.	2
2.2	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept	2
2.3	Descriptive Research Designs – concept, types and uses.	3
2.4	Experimental Design: Concept of Independent & Dependent variables Hypothesis	2
2.5	Null and alternate hypothesis - hypothesis testing; Exploratory and descriptive research design - concept, types and uses	2

Unit- III		
3.1	Sampling methods - sample, sampling frame, sampling error, sample size, non-response, simple random sample	2
3.2	Systematic sample, stratified random sample and multi-stage sampling	2
3.3	Determining size of the sample	2
3.4	Practical considerations in sampling and sample size	2
3.5	Sample collection, transport, handling	2
3.6	preservation of microorganisms, insects, plant, animals from natural and lab bred population; Biological models.	2
Unit- IV		
4.1	Observation and collection of data	2
4.2	Methods of data collection	2
4.3	Data Processing and analysis strategies	2
4.4	Univariate analysis (frequency tables,)	2
4.5	Bar charts, pie charts, percentages	2
4.6	Measures of central tendency and dispersion	2
4.7	Bivariate analysis – cross tabulations and chi square	2
4.8	Standard error and standard deviation	2
4.9	Correlation, Regression	2
4.10	ANOVA – one and two way	2
4.11	DMRT, Tukey test; R software	2
Unit- V		
5.1	Thesis writing – Introduction, Review of literature, Methodology, Results	2
5.2	Discussion, Bibliography, Foot notes and proof correction	2
5.3	Oral presentation – planning and preparation – use of visual aids – importance of effective communication	2
5.4	Publication of research and review articles –copyright violation – choosing the right journal	2
5.5	Refereed journals, open access journals, citation	2
5.6	Impact factor, SCI, H index, i10 index	2
5.7	Referencing software (Zotero/Mendeley)	2
5.8	Software for paper formatting like LaTex/MS Office	2
5.9	Software for detection of Plagiarism.	2
	Total	75

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20CE(F)	Nanobiotechnology	Elective	5	-	-	5

L - Lecture T - Tutorial P – Practical

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

Preamble
Provide comprehensive theoretical knowledge on nanobiotechnology to perceive various nanomaterial synthesis and characterization.

Prerequisite
Basics of chemistry and biology.

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

#	Course outcome	Expected Proficiency %	Expected Attainment %
CO1	Spell the basic concept on nanobiotechnology and the importance nanoscience	**60**	**70**
CO2	Describes the DNA nanostructures and the applications of biosensors and 3D bioprinting	**60**	**70**
CO3	Explains the synthesis and characterization of nanoparticles	**50**	**70**
CO4	Expound the fabrication of nanomaterials and various biomedical applications	**50**	**70**
CO5	Enlists the toxicological issues and the guidelines	**50**	**70**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	L	-	-	-
CO2	S	S	S	M	L	M	L
CO3	S	M	S	M	M	M	M
CO4	S	S	S	M	S	S	M
CO5	S	S	S	M	S	M	M

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	-	-
CO2	S	M	L	-	L
CO3	S	S	M	M	M
CO4	S	S	S	M	S
CO5	S	S	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	**60**	**60**	**150**

Title of the Paper: Nanobiotechnology

Unit: I

Nanobiotechnology- definition, concepts, importance of nanoscience and historical background. Classification of nanostructures –Nanomaterials, Nanocomposites-Micelles-Polymer Micelles, Vesicles, Liposomes, Dendrimers, Nanocapsules, Nanopores, Nanoconjucates.

Unit: II

Synthesis of Nanoparticles and Nanostructures- Synthesis methods- physical (ball milling, Thin film deposition), Chemical (reduction method using sodium borohydride, sodium citrate), Biological (protein, microorganisms, plants). Mechanism of nanoparticle formation- Strategies for shape and size control. Characterization of nanoparticles - spectroscopic methods (UV-visible, FTIR, Raman spectroscopy, NMR), Differential Scanning Calorimetry (DSC)- Microscopic (AFM, Scanning and Transmission Electron microscopy), Structural (XRD), EDAX.

Unit: III

Biomedical applications of nanoparticles: drug carriers-liposomes, nanoshells, micelles, dendrimers and hydrogels; functionalization of nanomaterials and Targeted drug delivery. Imaging technique; quantum dots and magnetic nanoparticles, Implants: orthopaedic and vascular. Application in cancer treatments.

Unit: IV

DNA, RNA and protein-based nanostructures. Nanobiosensors- Cantilever- Optical biosensors- DNA enabled biosensors. 3D bioprinting- types- bioinks for 3D bioprinting – Application of 3D bioprinting.

Unit: V

Nanotoxicology-National Personal Protective Technology Laboratory (NIOSH) Guidelines and toxicity issues. Immune response to nanoparticles, Safety concerns about using nanotechnology.

Reference Books:

- Claudio Nicolini, (2009) Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pvt. Ltd. UK.
- Melgardt M.deVilliers, Pornanong Aramwit, Glen S.Kwon, (2009)

Nanotechnology in Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press. USA

- Niemeyer, CM and Mirkin, CA (2004) Nanobiotechnology, Concepts, Applications and perspectives, WILEY-VCH, Verlag Gmb H&Co,. New Jersey.
- David Goodsell, S. (2004) Bionanotechnology, Lessons from Nature, Wiley-Liss, Inc,. New York

Course Designers:

1. Dr. A. Kanakalakshmi- Assistant Professor

2. Dr. K. Renugadevi- Assistant Professor

Lecture Schedule

	Topic	No of lecture hrs.
1.1	Nanobiotechnology- definition, concepts, importance of nanoscience and historical background.	3
1.2	Classification of nanostructures – Top down and bottom-up approaches	2
1.3	Micelles-Polymer Micelles, Vesicles, Liposomes	2
1.4	Dendrimers, Nanocapsules, Nanowires, nanotubes, nanocomposites	2
1.5	Concepts in nanobiomachines for information processing and communications.	2
2.1	DNA Nanostructures	7
2.2	DNA protein nanostructures-Methods	5
2.3	Three-dimensional DNA Nanostructures	3
2.4	Self-assembled DNA nanotubes	2
2.5	DNA as Biomolecular template- DNA programmed assembly of Biomolecules and Materials	2
2.6	Nanobiosensors- Cantilever- Optical biosensors- DNA enabled biosensors.	2
2.7	3D bioprinting- Classification- bioinks for 3D bioprinting	2
2.8	Application of 3D bioprinting	2
3.1	Synthesis of Nanoparticles and Nanostructures	2
3.2	Mechanism of nanoparticle formation	2
3.3	Strategies for shape and size control	2
3.4	Synthesis methods	3
3.5	Characterization of nanoparticles - spectroscopic methods (UV-visible, FTIR, Raman spectroscopy, NMR),	4
3.6	Differential Scanning Calorimetry (DSC)- Microscopic (AFM, Scanning)	2
3.7	Transmission Electron microscopy), Structural (XRD), EDAX.	2
4.1	Fabrication of nanomaterials: Lithography and Thin film deposition, high energy Arc discharge.	3
4.2	Biomedical applications of nanoparticles	2
4.3	drug carriers-liposomes, nanoshells, micelles, dendrimers and hydrogels	1
4.4	functionalization of nanomaterials and Targeted drug delivery	1
4.5	Imaging technique; quantum dots and magnetic nanoparticles	3

4.6	Implants: orthopaedic and vascular	3
5.1	Health and environmental issues about nanoparticles	3
5.2	Nanotoxicology- Toxicity- Regulation	2
5.3	Toxicity of biodegradable and non-biodegradable structures	2
5.4	Immune response to nanoparticles, Safety concerns about using nanotechnology.	1
5.5	The National Personal Protective Technology Laboratory (NIOSH) Guidelines for working with nanomaterials.	1
	Total	75

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20CE(G)	Microbial Genomics	Elective	5	-	-	5

L - Lecture T – Tutorial P – Practical

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

Preamble

Focused on genome organization, phylogenetic alignment with its expression and culture dependent interactions

Prerequisite

Basic knowledge on microbiology and genetic engineering

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Outline the microbial genomes and structural genomics of *E.coli*	**60**	**70**
CO2	List the general characteristics of microbial genomes-viral, fungal and Protist genome	**60**	**70**
CO3	Introduce the importance of human microbiome interaction network and CRISPR-Cas typing	**70**	**60**
CO4	Analyze the concepts involved in the processing of functional genomics and genome-wide gene expression	**70**	**60**
CO5	Explain the principles and applications of culture independent studies of microorganisms – metagenomics approach	**60**	**70**

Mapping of COS with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	L	M	-	M	M	M
CO2	S	L	M	-	L	M	M
CO3	S	S	S	-	S	M	S
CO4	S	M	S	L	S	L	M
CO5	S	M	S	M	M	S	M

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Blooms taxonomy

Blooms Taxanomy			
	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	**60**	**60**	**150**

Title of the paper: Microbial Genomics

Unit I

Microbial genomes: Introduction to microbial genomics, Genome organization of Archaea and Bacteria. History of genome projects-*E.coli* genome.

Unit II

Genome structure and organization-genome assembly, annotation and identification of an open reading frame and promoter regions. Viral Genomics- Rhinovirus and *SARS*, Fungal Genomics- *Saccharomyces cerevisiae*, Protist Genomics- *Entamoeba histolytica*.

Unit III

Genome editing-Introduction and concepts of genome editing, CRISPR-Cas as typing tool in functional diversity of bacterial mutants and pathogens/Tn-Seq,. CRISPR-based genome editing of microbes for commercial and industrial applications, CRISPR tagging and identification of virulent strains. Future of CRISPR and ethical considerations.

Unit IV

Functional genomics: Genome-wide gene expression analyses, DNA microarray and transcriptomes-gene chips and its applications. RNA sequence analysis and methods in proteomics: Comparative genomics and proteomics, transcriptional networks and metabolomics, interactomics. Protein micro arrays-markers, Clinical proteomics. Personalized medicine and protein engineering.

Unit V

Metagenomics: principle and applications – steps in construction of libraries. Metaproteomics principle and applications. Systems Biology- Metabolic engineering, network concepts and analysis, protein-protein interaction and protein-DNA interaction.

Reference:

1. Madigan, M.T, Bender, K.S, Buckley, D.H, Sattley W.M and Stahl D.A. 2018. Brock Biology of Microorganisms. Global Edition, Published by Pearson, London.
2. Sandhya Mitra. 2017. Genetic Engineering: Principles and Practice. Second Edition, McGraw Hill Education (India) Private Limited, New Delhi, India.
3. Watson, J.D, Baker, T.A, Bell, S.P, Gann, A, Levine, M, Losick R. 2017. Molecular Biology of the Gene, 7th edition. Published by Pearson, London.
4. Brown, T.A. 2015. Gene Cloning and DNA Analysis: An Introduction, 7th edition.

Published by Wiley-Blackwell. New Jersey, United States.
5. Wilson, K. and Walker, J. 2010. Principles and Techiques of Biochemistry and Molecular Biology, 7th Edition. Cambridge University Press. New York, United States.
6. Primrose, S.B, Twyman, R.M. 2009. Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell Publishing, UK.

ICT Tutorials

- Genome editing with crispr-cas9:https://www.youtube.com/watch?v=4YKFw2KZA5o
- DNA microarray:https://www.youtube.com/watch?v=6ZzFihESjp0
- Metagenomics:https://www.youtube.com/watch?v=oLu6UdazPxM

Course Designers:

1. **Dr. K. Renugadevi – Assistant Professor**
2. **Dr. J. Vinoth – Assistant Professor**

Lecture Schedule

#	Topic	No of lecture hrs.
1.1	Microbial genomes: Introduction to microbial genomics	3
1.2	Genome structural organization of archaea and bacteria	3
1.3	History of genome projects	3
1.4	E.coli genome	3
1.5	Operon concepts	3
2.1	Genome structure and organization	3
2.2	genome assembly, annotation and identification of an open reading frame and promoter regions.	3
2.3	Viral Genomics- Rhinovirus and SARS-COV,	3
2.4	Fungal Genomics- Saccharomyces cerevisiae,	3
2.5	Protist Genomics- Entamoeba histolytica.	3
3.1	Genome editing-Introduction and concepts of genome editing,	3
3.2	CRISPR-Cas as typing tool in functional diversity of bacterial mutants and pathogens/Tn-Seq.	3
3.3	CRISPR-based genome editing of microbes for commercial and industrial applications	3
3.4	CRISPR tagging and identification of virulent strains.	3
3.5	Future of CRISPR and ethical considerations.	3
4.1	Functional genomics: Genome-wide gene expression analyses, DNA microarray and transcriptomes-gene chips and its applications.	3
4.2	RNA sequence analysis and methods in proteomics: Comparative genomics and proteomics	3
4.3	Transcriptional networks and metabolomics, interactomics.	3
4.4	Protein micro arrays-markers, Clinical proteomics.	3
4.5	Personalized medicine and protein engineering.	3
5.1	Metagenomics: principle and applications	3
5.2	Steps in construction of libraries.	3
5.3	Metaproteomics principle and applications.	3
5.4	Systems Biology- Metabolic engineering, network concepts and analysis	3
5.5	Protein-protein interaction and protein-DNA interaction.	3
	Total	75

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Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PMB20CE(H)	Computational Biology	Core-1	5	-	-	5

L - Lecture T – Tutorial P – Practical

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

Preamble

Impart the knowledge on basic computational tools and drug designing components to implement in biological research

Preamble

Basic knowledge on chemistry and microbiology

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate the various biological data bases and its significance	**60**	**70**
CO2	Summarize theoretical knowledge about the data retrieval concepts and basic alignment programs	**60**	**70**
CO3	Explain the modeling method and proteomic tools for its visualization	**70**	**60**
CO4	Interpret virtual and theoretical knowledge on lead compound selection and drug designing	**70**	**60**
CO5	Appraise the *in-silico* procedures involved in drug toxicity prediction	**60**	**70**

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	L	L	L	M
CO2	S	S	M	M	S	-	M
CO3	S	S	S	L	S	-	S
CO4	S	S	S	M	S	-	-
CO5	S	S	S	L	S	S	L

S: Strong M: Medium L: Low

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Blooms taxonomy

Blooms Taxanomy			
	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	**60**	**60**	**150**

Title of the paper: Computational Biology

Unit I

Introduction – Bioinformatics and Biological databases – Types of database, Primary Databases-Nucleotide sequence databases-GenBank, EMBL, DDBJ. Protein Sequence Databases-UniProt, TrEMBL, Swiss-Prot, UniProt Archive. Specialized data bases-mouse and yeast genome database. Literature Databases- PubMed, PLOS, BioMed Central, structure database-rcsb PDB & domain, application and scope.

Unit II

Data retrieval and analysis. Sequence alignment: Types - local and global alignment. Alignment methods – pair wise sequence alignment: FASTA and BLAST. EXPASY Translate tools. Introduction to ORF and primer designing. Secondary structure prediction: GOR, Chou – Fasman.

Unit III

Multiple sequence alignment – methods and softwares – MUSCLE, Clustal W, Multalign. Phylogenetic analysis-tools, construction and analysis of phylogenetic trees-MEGA and PHYLIP. Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure-SAVES. Protein structure prediction-Analysis and Structure visualization software. Proteomics tools-MASCOT, and SWISS 2D PAGE.

Unit IV

Drug discovery process, Role of Bioinformatics in drug design, Target identification and validation, lead optimization and validation, Structure based drug design and ligand based drug design-chemical libraries- ZINC, PubChem, Chemspider, SWISS ADME, SWISS target prediction. Molecular modelling of protein and target-small molecule interactions, Molecular dynamics and simulations, Visualization tools-Rasmol/Pymol.

Unit V

Drug toxicity prediction and analysis. virtual screening, drug likeness and compound filtering, pharmacokinetic and Pharmacodynamics property analysis-QSPR, Absorption, distribution, metabolism, excretion and toxicity (ADMET) property prediction, computer based tools for drug design-AutoDock/DockThor.

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Reference Books

- Madigan, M.T, Bender, K.S, Buckley, D.H, Sattley W.M and Stahl D.A. 2018. Brock Biology of Microorganisms. Global Edition, Published by Pearson, London.

- Watson, J.D, Baker, T.A, Bell, S.P, Gann, A, Levine, M, Losick R. 2017. Molecular Biology of the Gene, 7th edition. Published by Pearson, London.
- Brown, T.A. 2015. Gene Cloning and DNA Analysis: An Introduction, 7th edition. Published by Wiley-Blackwell. New Jersey, United States.
- Primrose, S.B. and Twyman R.M. 2013. Principles of Gene Manipulation and Genomics. John Wiley and Sons. USA.
- Wilson, K. and Walker, J. 2010. Principles and Techiques of Biochemistry and Molecular Biology, 7th Edition. Cambridge University Press. New York, United States.

ICT Tutorials

- Multiple sequence alignment: https://www.youtube.com/watch?v=TZaA_-4j19w
- Drug discovery process and target identification: https://www.youtube.com/watch?v=6yqixEIJW10
- Drug toxicity prediction and analysis-ADMET: https://www.youtube.com/watch?v=I6094_0dTtc

Course Designers:

1. Dr. K. Renugadevi – Assistant Professor

2. Dr. M. Karthikeyan – Assistant Professor

Lecture Schedule

#	Topic	No of lecture hrs.
Unit-I		
1.1	Introduction – Bioinformatics and Biological databases – Types of database, Primary Databases-Nucleotide sequence databases-GenBank, EMBL, DDBJ	3
1.2	Protein Sequence Databases-UniProt, TrEMBL, Swiss-Prot, UniProt Archive.	3
1.3	Specialized data bases-mouse and yeast genome database.	3
1.4	Literature Databases- PubMed, PLOS, BioMed Central, structure database-rcsb	3
1.5	PDB & domain, application and scope	3
Unit-II		
2.1	Data retrieval and analysis. Sequence alignment: Types - local and global alignment.	2
2.2	Alignment methods – pair wise sequence alignment: FASTA and BLAST.	3
2.3	EXPASY Translate tools. Introduction to ORF and primer designing.	3
2.4	Secondary structure prediction: GOR, Chou –Fasman.	3
Unit-III		
3.1	Multiple sequence alignment – methods and softwares – MUSCLE, Clustal W, Multalign	3
3.2	Phylogenetic analysis-tools, construction and analysis of phylogenetic trees MEGA and PHYLIP.	3
3.3	Homology modeling - SPDB viewer.	3
3.4	Ramachandran plot for evaluation of predicted structure-SAVES.	3
3.5	Protein structure prediction-Analysis and Structure visualization software.	3
3.6	Proteomics tools-MASCOT, and SWISS 2D PAGE.	3

Unit-IV		
4.1	Drug discovery process, Role of Bioinformatics in drug design, Target identification and validation	3
4.2	lead optimization and validation, Structure-based drug design and ligand based drug design	3
4.3	chemical libraries- ZINC, PubChem, Chemspider, SWISS ADME, SWISS target prediction.	4
4.4	Molecular modelling of protein and target-small molecule interactions	3
4.5	Molecular dynamics and simulations, Visualization tools-Rasmol/Pymol.	3
Unit-V		
5.1	Drug toxicity prediction and analysis	3
5.2	virtual screening, drug likeness and compound filtering,	3
5.3	pharmacokinetic and Pharmacodynamics property analysis-QSPR	3
5.4	Absorption, distribution, metabolism, excretion and toxicity (ADMET) property prediction	3
5.5	computer based tools for drug design-AutoDock/DockThor	3
	Total	75