Thiagarajar College, Madurai - 625 009

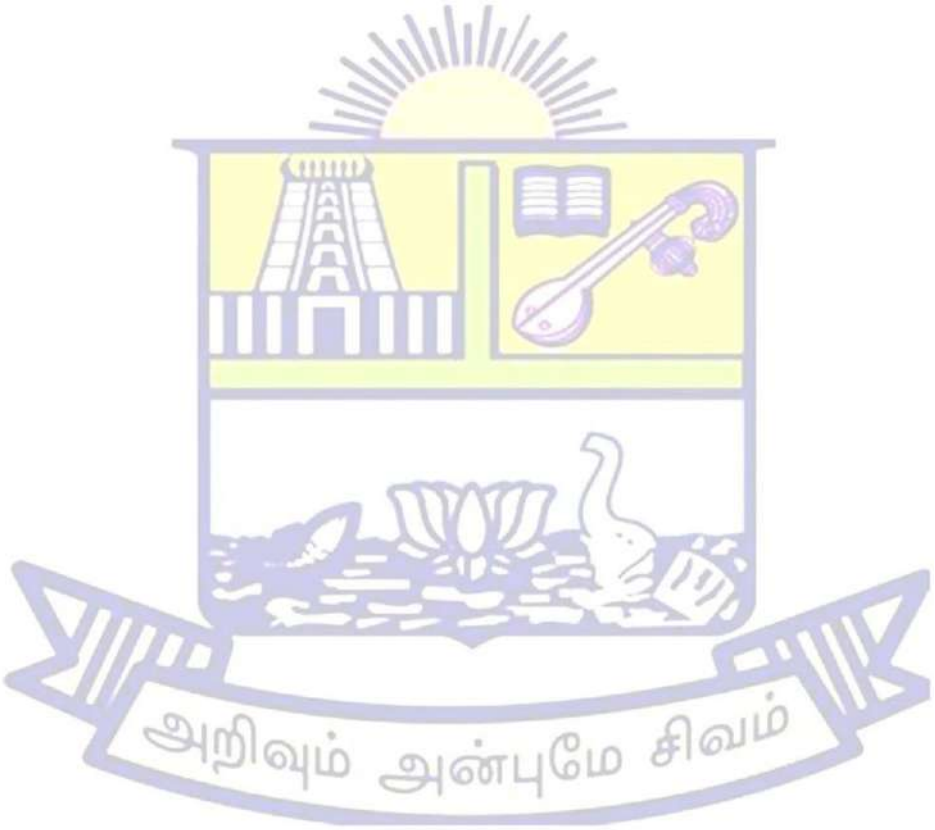
(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re-Accredited with "A^{++}" Grade by NAAC

Academic Council Meeting
June 2023

B.Sc., Biotechnology

Syllabus - 2023 - 2024

Programme Code: UBT



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, and intellectual skills.

THIAGARAJAR COLLEGE, MADURAI – 9.
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Department of Biotechnology

Programme Educational Objectives (PEO)

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

PEO1	Graduates of this program will build up competency in basic Biotechnology required for decisive learning and research.
PEO2	Graduates will develop diversified indispensable professional skills through a wide range of laboratory technical training, communication and presentation skills.
PEO3	Graduates will acquire an ability to identify, formulate, and solve biosafety, environmental and socio-ethical issues to contribute service efforts to community in both the professional and private realm.
PEO4	Gradates will amalgamate related topics from their curriculum such as biochemical techniques, cell biology, microbiology, molecular biology, genetic engineering, plant biotechnology, animal biotechnology, environmental biotechnology, computational biology for higher studies, research and other career.
PEO5	Graduates could develop adequate skill to evaluate the scope of biotechnology, understand the complexities of microbes, plants and animal system and address contentious scientific issues in a lucid way.

Programme Specific Outcomes (PSOs) - B.Sc., Biotechnology

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

PSO1	Recognize various groups of microbes using specific identification keys and characteristic features.
PSO2	Exhibit the acquired knowledge and appreciate the core concepts of Biotechnology at cellular, biochemical and molecular level with basis of physiology of living system.
PSO3	Identify somaclones and gametoclones using appropriate molecular markers and bioinformatics tools.
PSO4	Demonstrate the principles of inheritance, transgenesis and commercial exploitation of recombinant DNA technology.
PSO5	Exhibit proficiency in selected laboratory skills and the use of bioinstrumentation and computational biology skills in the biological analysis.

THIAGARAJAR COLLEGE, MADURAI - 9.
(Re-Accredited With A++ Grade by NAAC)
Department of Biotechnology
B.Sc. Biotechnology Curriculum (w.e.f. 2023 - 24 batch onwards)
Programme Code - UBT
Semester – I

Course	Code No.	Subject	Hrs / Week	Credits	Total Hrs	Max Mark CA	Max Mark SE	Total
Part I	U23P1TA11B	*பொதுத்தமிழ் - I*	6	3	75	25	75	100
Part II	U23P2EN11	General English - I	4	3	60	25	75	100
Core1	UBT23CT11	Fundamentals of Microbiology	4	4	60	25	75	100
Core Lab 1	UBT23CL11	Fundamentals of Microbiology lab	2	1	30	25	75	100
Core2	UBT23CT12	Food Technology	3	3	45	25	75	100
Elective 1	UBT23GT11	Bioinstrumentation	3	2	45	25	75	100
Elective Lab 1	UBT23GL11	Bioinstrumentation lab	2	1	30	25	75	100
NME 1	UBT23NT11	Vocational Biotechnology	2	2	30	25	75	100
Foundation Course	UBT23FT11	Laboratory skills in Life sciences	2	2	30	25	75	100
AECC	UEN23AT11	Introduction to Personality Development	2	2	30	25	75	100
Total			**30**	**23**				**1000**

Semester - II

Course	Code No.	Subject	Hrs / Week	Credits	Total Hrs	Max Mark CA	Max Mark SE	Total
Part 1	U23P1TA21B	*பொதுத்தமிழ் - II*	6	3	75	25	75	100
Part II	U23P2EN21	General English - II	4	3	60	25	75	100
Core3	UBT23CT21	Cell biology	4	4	60	25	75	100
Core lab 2	UBT23CL21	Cell biology lab	2	1	30	25	75	100
Core 4	UBT23CT22	Genetics	3	3	45	25	75	100
Elective 2	UBT23GT21	Biological chemistry	3	2	45	25	75	100
Elective Lab 2	UBT23GL21	Biological chemistry lab	2	1	30	25	75	100
NME 2	UBT23NT21	Mushroom Technology	2	2	30	25	75	100
SEC-1	UBT23ST21	Organic farming Technology	2	2	30	25	75	100
AECC	UEN23AT21	Employability Skills	2	2	30	25	75	100
Total			**30**	**23**				**1000**
Extra Credit	**U23NM21**	**Naan Mudhalvan - Language Proficiency for Employability.**		**02**				

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those join B.Sc. Biotechnology on or after June 2023)
Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23CT11	Fundamentals of Microbiology	Core-1	4	-	-	4

L – Lecture T – Tutorial P- Practical

Year	Semester	Internal marks	External marks	Total marks
I	1	25	75	100

Preamble

Enable students to acquire an exposure to the classification of microorganisms, diversity of microbial structure and the nutritional types of bacteria.

Course Outcomes

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

#	Course Outcome	Expected proficiency	Expected attainment
CO1	Define the differences between prokaryotes & eukaryotes, appreciate the contribution of scientists.	90%	85%
CO2	Acquire an exposure to the classification of microorganisms; Categorize the nutritional types of Bacteria.	92%	90%
CO3	Explain the structure of Bacteria	95%	90%
CO4	Acquire knowledge on the classification of fungi and algae	90%	89%
CO5	Demonstrate the structure of viruses and their replication.	92%	90%

Mapping of COs with POs

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

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5

CO1	M	S	L	M	S
CO2	M	S	S	L	M
CO3	S	M	M	S	M
CO4	S	S	M	L	M
CO5	S	M	L	M	M

S – Strong M- Medium L – Low

Title of the paper: Fundamentals of Microbiology

Unit I: Introduction to microbes: Prokaryotes - protozoa, and mycoplasma. Important milestones in microbiology: contributions of Leewenhoek, Pasteur, Koch – Koch postulates, Paul Ehrlich, Joseph Lister, Tyndall, Jenner.

Unit II: Classification of Bacteria: Characters used in classification – Classical, molecular. Approaches to Classification: Natural, Phylogenetic, Numerical approach and Molecular. Microbial Nutrition: Macro and Micro Nutrients – nutritional types of bacteria – uptake of nutrients: simple diffusion, facilitated diffusion. Microbial growth: sigmoid growth - diauxic growth- generation time- measurement of microbial growth.

Unit III: Morphology and fine structure of bacteria: Structures outer to cell wall, capsule, slime, flagella and pili; structures inner to the cell wall - plasma membrane, cytoplasmic inclusions – poly hydroxy butyrate (PHB), glycogen, ribosome, brief account on chromosomes, plasmids and endospore - cell wall-peptidoglycan structure.

Unit IV: Fungi – structure, characteristics and classification. Algae: Microalgae - structure, characteristics and classification

Unit V: Structure and multiplication of viruses: Classification of Viruses – DNA, RNA. Plant virus -TMV, Bacteriophage - T4, Animal virus - Pox, Corona virus.

Text Books:

- Sharma, P.D. 2019. Microbiology, Fourth revised edition. Rastogi publication, Meerut.
- Daniel, V. Lim. 2002. Microbiology, Revised edition. Kendal, Hunt.807pp.
- Pelczar, M. J. Jr., E. C. S. Chan. and N. R. Krieg. 2020. Microbiology, 7th edition. Tata Mc Graw Hill publication, New Delhi.
- Stanier, R. Y. and J. L. Ingraham, Mark L. Wheelis and Rage R. Painter. 1992. General Microbiology, 5th edition, Macmillan press Ltd. London.

Reference Books:

- Prescott, L.M., J. P. Harley and D. A. Klein. 2020 Microbiology 11th Edition. McGraw Hill Education, New York.
- Atlas, R. M. 1998. Principles of Microbiology, Second edition. Tata Mc Graw Hill publication, New Delhi.

- Karl Maramorosch, Aaron Shatkin and Fredrick Murphy.2002. Advances in Virus Research 1st edition. Academic Press.

Web sources:

- https://uwyo.libguides.com/biology
- https://microbiologysociety.org/news-press/microbe-post.html
- https://microbiologysociety.org/

Course designers: Dr. S. Yogachitra

Course contents and lecture schedule

S.No	Topic	No of lecture hrs.	Method of teaching
1.1	Introduction to microbes: Prokaryotes, protozoa, and mycoplasma.	3	Black board
1.2	Important milestones in microbiology: Contributions of Leewenhock, Pasteur, Koch.	3	Power point
1.3	Koch postulates, Paul Ehrlich, Joseph Lister, Tyndall, Jenner.	3	Power point
2.1	Classification of Bacteria: Characters used in classification- classical, molecular.	3	Black board
2.2	Approaches to Classification-Natural, Phylogenetic, Numerical and Molecular.	4	Black board
2.3	Microbial Nutrition: Macro and Micro Nutrients, Nutritional types of bacteria.	3	Black board
2.4	Uptake of nutrients: simple diffusion, facilitated diffusion.	3	Black board, Power point
2.5	Microbial growth: sigmoid growth - diauxic growth- generation time- measurement of microbial growth.	4	Black board
3.1	Morphology and fine structure of bacteria: Structures outer to cell wall, capsule, slime, flagella and pili.	3	Power point
3.2	Structures inner to the cell wall - plasma membrane, cytoplasmic matrix, Cytoplasmic inclusions- poly hydroxy butyrate (PHB), glycogen, ribosomes, brief account on chromosomes, plasmids and endospore.	4	Black board, Power point
3.3	Cell wall-peptidoglycan structure.	3	Black board,
4.1	Fungi – structure.	4	Black board
4.2	Characteristics and classification.	3	Black board
4.1	Algae: Microalgae – structure.	3	Black board
4.2	Characteristics and classification.	4	Black board
5.1	Structure and multiplication of viruses.	3	Black board
5.2	Classification of Viruses- DNA, RNA.	3	Power point
5.3	Plant virus -TMV, Bacteriophage - T4, Animal virus - Pox, Corona virus.	4	Black board, Power point
	Total hours	**60**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those join B.Sc. Biotechnology on or after June 2023)
Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23CL11	Fundamentals of Microbiology Lab	Core Lab 1	-	-	2	1

L – Lecture T – Tutorial P- Practical

Year	Semester	Internal marks	External marks	Total marks
I	1	25	75	100

Preamble

Acquire knowledge on media preparation, sterilization and pure culture techniques. Have hands on training on various staining techniques.

Course Outcomes

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

#	Course Outcome	Expected proficiency	Expected attainment
CO1	Acquire knowledge on preparation of media.	100%	95%
CO2	Apply the knowledge of pure culture techniques.	96%	94%
CO3	Make use of the staining techniques.	100%	97%
CO4	Develop knowledge in the enumeration of microbes	98%	95%
CO5	Experiment with various biochemical techniques	96%	92%

Title of the paper: Fundamentals of Microbiology Lab

1. Preparation of culture media
2. Isolation of microbes from soil and drinking water.
3. Pure culture techniques: Pour, Spread, Streak plate method, mycelia agar plug method.
4. Observation of motility of Bacteria – Hanging drop method
5. Bacterial Staining methods: a) Simple staining b) Gram‘s staining
6. Fungal staining with lactophenol cotton blue.
7. Enumeration of microbes: a) Bacteria-viable count b) Haemocytometer
8. Growth curve.
9. Micrometry
10. Biochemical tests - IMVIC

Course contents and practical schedule

S.No	Topic	No of lecture hrs.	Method of teaching
1	Preparation of culture media	4	Hands on Training
2	Isolation of microbes from soil and drinking water.	4	Hands on Training
3	Pure culture techniques: Pour, Spread, Streak plate method, mycelia agar plug method.	5	Hands on Training
4	Observation of motility of Bacteria – Hanging drop method	2	Hands on Training
5	Bacterial Staining methods: a) Simple b) Gram‘s	2	Hands on Training
6	Fungal staining with lactophenol cotton blue	2	Hands on Training
7	Measurement of microbial count: a) Bacteria- viable count b) haemocytometer.	2	Hands on Training
8	Growth curve.	2	Hands on Training
9	Micrometry	2	Hands on Training
10	Biochemical tests - IMVIC	5	Demonstration
	Total hours	**30**	

Text books:

- Maheswari, D.K. 2010. Practical Microbiology, Revised edition. S. Chand & Company, India.
- Parija, Subhash Chandra. 2019. Textbook of Practical Microbiology, Second Edition. Ahuja publishing house, New Delhi.
- Arora, B.2020. Practical Microbiology, Second revised Edition. CBS publishers, India.

Reference books:

- Cappuccino, J.G. and Sherman, N.2013. Microbiology, A Laboratory Manual. Tenth Edition, Pearson, New York.

Web sources:

- https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
- https://www.researchgate.net/publication/257380059_Laboratory_Manual_in_General_Microbiology_For_Undergraduate_Students_Short_Version

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
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Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23CT12	Food Technology	Core 2	3	-	-	3

L – Lecture T – Tutorial P- Practicals

Year	Semester	Internal Marks	External Marks	Total Marks
I	II	25	75	100

Preamble

Enable the students to understand the role of microorganisms associated with the food and to differentiate the role of beneficial and harmful effects on association.

Course Outcomes

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

#	Course Outcome	Expected proficiency	Expected attainment
CO1	Gain knowledge on the aspects of Food Microbiology	95%	90%
CO2	Exemplify the role enzymes in the food industry	97%	92%
CO3	Summarize the methods of food spoilage and food preservation	95%	90%
CO4	Understand the role of microorganisms in the food poisoning	96%	94%
CO5	Gain knowledge on the methods of food processing	96%	93%

Mapping of COs with POs

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

Mapping of COs with PSOs

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

S (+++) - Strong M (++) - Medium L (+) – Low

Title of the Paper: Food Technology

Unit I: Food Microbiology: Food as a Substrate for microorganisms. Intrinsic and Extrinsic parameters of foods that influence microbial growth.Microbes as food: Single cell protein (SCP) and edible mushrooms. Probiotics, prebiotics – Benefits & applications.

Unit II: Enzymes in food industry: production and processing - amylase, protease, glucose oxidase, pectinases, hemicellulase, rennin, lipases, catalase, lactase, invertase and amyloglucosidase.

Unit III: Food Spoilage: vegetables, fruits, cereal, cereal products, meat, canned food, Milk and Milk products. Food Poisoning: *Salmonella*, *Staphylococcus*, *Pseudomonas*, *Aspergillus flavus* & *Clostridium botulinum*. Food intoxications: Amoebiasis & Taeniasis.

Unit IV: Food Preservation: physical – Asepsis, filtration, high and low temperature, radiation and anaerobiosis. Chemical – salt, sugar, organic acid, nitrates, nitrites, propylene oxide and wood smoke.

Unit V: Food processing: Fermented dairy products – butter milk, sour cream, yoghurt, Fermented vegetables – saukerkraut, olives, soy sauce and pickles, Fermented meat, Idly batter & leavening of bread

Text Books:

- Adams, M.R. and Moss, M.O, 2008, Food Microbiology. Third Edition, The Royal Society of Chemistry, Cambridge
- Frazier, W.C., and D.C. Westhoff, 2005, Food Microbiology, Fifth edition, Tata McGraw-Hill Publishing Ltd., New Delhi.
- Garbutt, J., 1997, Essentials of Food Microbiology, Second edition, Hodder Education Publishers, London.

Reference Books:

- Banwart, G.J., 2004, Basic Food Microbiology, Second edition, CBS Publishers & Distributors, New Delhi.
- Jay, J.M, 2006, Modern Food Microbiology, Seventh edition, CBS Publishers & Distributors, ND
- Joshi, V.K. and Ashok Pandey (Eds), 1999, Biotechnology: Food fermentation Vol. II,Educational Publishers and Distributors, New Delhi.
- Kulshreshtha, S.K. 1995, Food Preservation, Vikas Publishing House Pvt. Ltd., New Delhi

Course Designer: Dr. S. Yogachitra

Course contents and lecture schedule

Unit	Topic	No of lecture hrs.	Method of teaching
1.1	Food Microbiology: Food as a Substrate for microorganisms.	3	Black board, Power point.
1.2	Intrinsic and Extrinsic parameters of foods that influence microbial growth.	3	Powerpoint
1.3	Microbes as food: Single cell protein (SCP) and edible mushrooms.	4	Powerpoint
1.4	Probiotics, prebiotics – Benefits & applications.	3	Black board, Power point.
2.1	Enzymes in food industry: production and processing.	2	Black board, Power point.
2.2	Amylase, protease, glucose oxidase, pectinases, hemicellulase.	3	Black board
2.3	Rennin, lipases, catalase, lactase, invertase and amyloglucosidase.	3	Power point
3.1	Food Spoilage: vegetables, fruits, cereal, cereal products, meat, canned food, Milk and Milk products.	3	Power point
3.2	Food Poisoning: *Salmonella, Staphylococcus, Pseudomonas, Aspergillus flavus & Clostridium botulinum*.	3	Black board, Power point
3.3	Food intoxications: Amoebiasis & Taeniasis.	2	Black board
4.1	Food Preservation: physical – Asepsis, filtration, high and low temperature, radiation and anaerobiosis.	4	Black board, Power point
4.2	Chemical – salt, sugar, organic acid, nitrates, nitrites, propylene oxide and wood smoke.	4	Black board, Power point
5.1	Food processing: Fermented dairy products – butter milk, sour cream, yoghurt	3	Black board
5.2	Fermented vegetables – saukerkraut, olives, soy sauce and pickles.	2	Black board
5.3	Fermented meat, Idli batter & leavening of bread.	3	Power point
	Total hours	45	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those join B.Sc. Biotechnology on or after June 2023)
Programme Code-UBT

Course code	Course Title	Category	L	T	P	Credit
UBT23GT11	Bioinstrumentation	Generic Elective 1	3	-	-	2

Year	Semester	Internal Marks	External Marks	Total Marks
I	I	25	75	100

Preamble

Understand the principles and working mechanisms of most common laboratory instruments used in life sciences.

Course Outcomes

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

#	Course Outcome	Expected Proficiency	Expected Attainment
CO1	Analyse the importance of Microscopy, Spectrophotometry	80%	78%
CO2	Demonstrate the principles and applications of Chromatography	90%	86%
CO3	Understand the working mechanism of centrifuges	90%	86%
CO4	Appraise the importance of radioisotopes	85%	80%
CO5	Acquire knowledge in electrophoresis	85%	82%

Mapping of COs with POs

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

Mapping of COs with PSOs

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

S (+++) -Strong M (+++) - Medium L (+) –Low

Title of the paper: Bioinstrumentation

Unit I: Principle, Instrumentation and Applications: Microscopy: simple, compound microscopes, light microscopy, TEM and SEM. pH metry - Colorimetry- Spectrophotometry- UV-visible spectrophotometer.

Unit II: Chromatography: Principles and applications of paper chromatography, Thin Layer chromatography, ion exchange chromatography, molecular sieve chromatography and High Performance Liquid Chromatography (HPLC).

Unit III: Centrifugation techniques: Basic principles and sedimentation coefficient – Types of centrifuges and centrifugations- differential centrifugation and density gradient centrifugation.

Unit IV: Radio isotope techniques: The nature of radioactivity – Detection and measurement of radioactivity – Solid-Liquid Scintillation Counter – Geiger Muller counter – Autoradiography. Applications of radioisotopes in biological sciences.

Unit V: Electrophoresis: Principles–Types: Paper electrophoresis, Capillary electrophoresis (CE), Agarose Gel Electrophoresis (AGE), Polyacrylamide gel electrophoresis -Native PAGE-SDS-PAGE.

Text Books:

- Plummer, D. 2017. An introduction to Practical Biochemistry, Tata McGraw – Hill Publishing Company Ltd., New Delhi.
- Rodney Boyer, 2002. Modern Experimental Biochemistry,3rd Edition. Published by Addison Wesley Longman. Singapore.
- Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj university, Madurai.

Reference Books:

- Wilson, K and J. Walker. 2018. Principles and Techniques of Practical Biochemistry, 5th Edition. Cambridge University press, New York.
- Williams, B. L. and K. Wilson. 2010. A Biologist's guide to Principles and Techniques of Practical Biochemistry, Edward Arnold Publishers Ltd., London.
- Wandersee, James H., Ed.; and Others. 1996. Bioinstrumentation: Tools for Understanding Life. The National Association of Biology Teachers.

Web Resources:

1. https://uwyo.libguides.com/biological techniques.
2. https://nptel.ac.in/courses/102103044.
3. https://nptel.ac.in/courses/103105060.

Course Designer: Mrs. S. Siva durga

Course contents and lecture schedule

	Topic	Lecture hrs.	Method
1.1	Principle, Instrumentation and Applications: Microscopy: simple, compound microscopes.	4	Power point
1.2	pH metry: Principles, Operation method and uses. Buffer solutions for biological investigations.	3	Black board
1.3	Colorimetry: principles, instrumentation and applications.	3	Power point
1.4	Spectroscopic techniques: General principles-UV-visible spectrophotometer- principles, instrumentation and applications.	3	PPT
2.1	Chromatography: Principles and applications of paper chromatography	3	Black board
2.2	Thin Layer Chromatography, ion exchange chromatography, molecular sieve chromatography and High Performance Liquid Chromatography (HPLC).	4	Power point
3.1	Centrifugation techniques: Basic principles and sedimentation coefficient.	3	Power point
3.2	Types of centrifuges and centrifugation: different types: differential centrifugation, density gradient centrifugation applications of centrifuge.	4	Black board
4.1	Radio isotope techniques: The nature of radioactivity.	2	Power point
4.2	Detection and measurement of radioactivity –- Liquid Scintillation counting – Geiger-Muller counting of radioactivity	3	Black board
4.3	Autoradiography Applications of radioisotopes in biological sciences.	3	Power point
5.1	Electrophoresis: Principles–Types Paper electrophoresis, Polyacrylamide gel electrophoresis (PAGE).	3	Black board
5.2	Electrophoresis: Principles–Types: Paper electrophoresis, Capillary electrophoresis (CE), Agarose Gel Electrophoresis (AGE).	4	Black board
5.3	Polyacrylamide gel electrophoresis -Native PAGE-SDS-PAGE	3	Power point
	Total hours	**45**	

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Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23GL11	Bioinstrumentation Lab	Elective lab 1	-	-	2	1

Year	Semester	Internal Marks	External Marks	Total Marks
I	I	25	75	100

Preamble

Acquire hands on skills on basic biotechniques.

Course Outcomes

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

#	Course Outcome	Expected Proficiency	Expected Attainment
CO1	Acquire knowledge on pH and buffers	95%	90%
CO2	Understand the applications of colorimeter	90%	88%
CO3	Learn to separate molecules using chromatography	95%	92%
CO4	Perform Agarose Gel Electrophoresis	85%	80%
CO5	Demonstrate Polyacrylamide Gel Electrophoresis	85%	80%

Mapping of COs with POs

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

Mapping of COs with PSOs

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

S (+++)-Strong M (++)- Medium L (+)-Low

Title of the paper: Bioinstrumentation Lab

1. Determination of pH in various samples
2. Buffer preparation (Verification of Handerson – Hasselbalch equation)
3. Determination of complementary wavelength
4. Verification of Beer-Lambert's Law
5. Separation of amino acids by paper chromatography
6. Separation of leaf pigments by Column chromatography
7. Separation of sugars by TLC
8. Agarose gel electrophoresis of DNA
9. Electrophoresis of RNA
10. Demonstration of SDS-PAGE
11. Demonstration of density gradient centrifugation technique.

Text books:

- Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj university, Madurai.
- Anitha Arumugam and Geethalakshmi Sundararaman, 2017. Lab in Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual.

Reference Books:

- Wilson, K and J. Walker. 2018. Principles and Techniques of Practical Biochemistry, 5th Edition. Cambridge University press, New York.
- Himanshu Sharma, Pramod K. Singh. 2018. Laboratory Manual for Bioinstrumentation, Biochemistry, Microbiology, Cell Biology and Enzyme Technology. Excellent Publishing House New Delhi India

Web Resources:

- https://nptel.ac.in/courses/103108100.
- https://nptel.ac.in/courses/102101049.

Course Designer: S. Siva durga

Course contents and practical schedule

Exp. No.	Name of the Experiment	Practical Hours	Method
1.	Determination of pH in various samples	2	Hands on Training
2.	Buffer preparation (verification of Handerson - Hasselbalch equation)	2	Hands on Training
3.	Determination of complementary wavelength	2	Hands on Training
4.	Verification of Beer-Lambert's Law	2	Hands on training
5.	Separation of amino acids by paper chromatography	2+2	Hands on Training
6.	Separation of leaf pigments by Column chromatography	2+2	Hands on Training
7.	Separation of sugars by TLC	2+2	Hands on Training
8.	Agarose gel electrophoresis of DNA	2	Hands on Training
9.	Electrophoresis of RNA	2+2	Hands on Training
10.	Demonstration of SDS-PAGE	2	Demonstration
11.	Demonstration of density gradient centrifugation technique	2	Demonstration
Total hours		**30**	

Thiagarajar College (Autonomous): Madurai – 625 009

Department of Biotechnology

(For those joined B.Sc. Biotechnology on or after June 2023)

Programme Code: UBT

CourseCode	Course Title	Category	L	T	P	Credit
UBT23NT11	Vocational Biotechnology	NME 1	2	-	-	2

L- Lecture T– Tutorial P – Practicals

Year	Semester	Internal Marks	External Marks	Total Marks
I	I	25	75	100

Preamble

Enable the students to comprehend the preparation and applications of organic manures, and biological products for domestic and industrial applications.

Course Outcomes

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

#	Course Outcome	Expected proficiency	Expected attainment
CO1	Understand the importance of organic farming and composting process	90%	88%
CO2	Acquire knowledge on the preparation procedure and its application of vermicomposting and panchakavya	90%	87%
CO3	Demonstrate the cultivation system and their significance for *Spirullina* and *Azospirillum*	80%	75%
CO4	Explain the mass cultivation process of *Azolla* and bacterial biofertilizer and its application	80%	76%
CO5	Study the guidelines of organic certification	80%	75%

Mapping of COs with POs

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

Mapping of COs with PSOs

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

S (+++) – Strong M (++)- Medium L (+) - Low

Title of the paper: Vocational Biotechnology

Unit I: Organic farming: Definition, concepts and principles of organic farming; Advantages of organic farming; Composting –Types, Mechanism and Process of composting, Physico-chemical analysis of compost, Factors affecting composting, Benefits of composting.

Unit II: Panchakavya and Vermicomposting: Preparation procedure of panchakavya and its application, Beneficial effects on crop plants; Vermicomposting process, advantages and disadvantages; Vermiwash- principle, production and their uses.

Unit III: Spirulina: Characteristic features, cultivation method and Production process (microbial screening, choice of raw materials, process engineering and process optimization, technology development, economic consideration / process feasibility, safety concerns) and its application.

Unit IV: Azolla: Distribution, common cultivable species, cultivation process and its application. Mass cultivation of biofertilizer- *Rhizobium*, Azospirillum and its application.

Unit V: Organic certification: Aim and objectives of NPOP (National Programme for Organic Production), Guidelines, Agricultural and Processed Food Products Export Development Authority (APEDA), Tamil Nadu Organic Certification Department (TNOCD) and Food Safety and Standards Authority of India (FSSAI).

Text books:

- Dubey. R. C. 2002. A text book of biotechnology S. Chand & Co, New Delhi.
- Sapna E. Thottathil, India's Organic farming revolution, University of Iowa Press, Iowa City.
- Kannaiyan,S. 2002. Biotechnology of Biofertilizers. Narosa publishing house, New Delhi

Reference books:

- Venkataraman, L.V. and E.W. Beaker 1985.Biotechnology and utilization of algae: The Indian experience. CFTRI Mysore pp 257.
- Ann Larkin Hansen, 2010. The organic farming manual: A comprehensive guide to starting and running a certified organic farm. Storey publishing LLC.

Course designer(s): Dr. C. Balachandran

Course contents and lecture schedule

Units	Topic	Hrs.	Mode of teaching
1.1	Organic farming: Definition, concepts, principles and advantages and; Composting –Types	2	Black/white board
1.2	Mechanism and Process of composting and types	2	Power point
1.3	Physico-chemical analysis of compost	1	Black/white board
1.4	Factors affecting composting, Benefits of composting	1	Power point
2.1	Vermicomposting- process, advantages and disadvantages of vermicomposting	2	Black/white board
2.2	Vermiwash- principle, production and their uses	1	Power point
2.3	Preparation procedure of panchakavya and its application	2	Power point
2.4	Beneficial effects on crop plants.	1	Black/white board
3.1	*Spirulina*: Characteristic features, cultivation method	1	Black/white board
3.2	Production process - microbial screening, choice of raw materials for *Spirulina* production	2	Power point
3.3	Process engineering and process optimization, technology development, economic consideration / process feasibility, safety concerns on *Spirulina* production	2	Black/white board
3.4	Application of *Spirulina*	1	Power point
4.1	*Azolla*: Distribution, common cultivable species	1	Black/white board
4.2	*Azolla* - cultivation process and its application.	2	Power point
4.3	Mass cultivation of biofertilizer- *Rhizobium*	2	Black/white board
4.4	Application of biofertilizers	1	Black/white board
5.1	Organic certification: Aim and objectives of NPOP (National Programme for Organic Production), Guidelines.	2	Black/white board
5.2	Agricultural and Processed Food Products Export Development Authority (APEDA)	2	Black/white board
5.3	Tamil Nadu Organic Certification Department (TNOCD)	1	Power point
5.4	Food Safety and Standards Authority of India (FSSAI).	1	Black/white board
	Total	**30**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those join B.Sc. Biotechnology on or after June 2023)
Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23FT11	Laboratory skills in Life sciences	Foundation Course	2	-	-	2

L – Lecture T – Tutorial P- Practicals

Year	Semester	Internal Marks	External Marks	Total Marks
I	**I**	**25**	**75**	**100**

Preamble

Develop knowledge in basic lab skills of life sciences

Course Outcomes

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

#	Course Outcome	Expected proficiency	Expected attainment
CO1	Learn basic laboratory skills	80%	76%
CO2	Acquire knowledge on lab safety	75%	73%
CO3	Prepare chemicals and media	80%	78%
CO4	Learn sterilization and disposal techniques	75%	73%
CO5	Gain knowledge on record writing	80%	78%

Mapping of COs with POs

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

Mapping of COs with PSOs

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

S (+++) – Strong M (++) - Medium L (+) – Low

Title of the paper: Laboratory skills in Life sciences

Unit I: Laboratory Skills: Cleaning and Management of Lab, Usage and storage of chemicals, Methodology for cleaning and storage of Lab wares.

Unit II: Lab safety and Record Maintenance: Personal safety gears-safety symbols-Hazardous signs-equipment and chemical safety protocols-labelling of samples and reagents as per SOPs.

Unit III: Principles of preparation of chemicals and Culture Media: Stock, Standard, Molarity, Molality, Normality, Percentage solution, ppm, Solid and Liquid culture media.

Unit IV: Sterilization, Decontamination and disposal: Sterilization Protocols - Procedure for safe disposal of used chemicals, media and decontamination of cultures.

Unit V: Laboratory record writing: Method of record writing, data collection, reporting of results - discussion-Interpretation- summary writing.

Text Books:

- Senthilkumar Balakrishnan, Zothansanga, 2013. Practical Microbiology - A Laboratory Manual. Publisher: Panima Publishing Corporation, New Delhi, India.
- Surajit Das and Anchal Singh Ashish S Verma, S, 2015. Laboratory Manual for Biotechnology, Chand Publishing.

Reference Books:

- Laboratory safety manual, 2022. Environmental health and safety, university of Washington.
- Swamy,P.M . 2008 Laboratory Manual on Biotechnology, Rastogi Publications.

Web Sources:

- https://www.ncbs.res.in/sitefiles/labsafety.pdf.
- https://www.researchgate.net/publication/359002162_Laboratory_manual_of_Biotechnology_2017.

Course designer(s)

Dr. S. Yogachitra
S. Siva Durga

Course contents and lecture schedule

Unit	Topic	No of lecture hrs.	Method of teaching
1.1	Laboratory Skills: Cleaning and Management of Lab.	2	Black board, Power point
1.2	Usage and storage of chemicals, Methodology for cleaning and storage of Lab wares.	3	Powerpoint
2.1	Lab safety and Record Maintenance: Personal safety gears.	2	Black board, Power point
2.2	safety symbols - Hazardous signs- equipment and chemical safety protocols	3	Black board, Power point
2.3	Labelling of samples and reagents as per SOPs.	2	Black board
3.1	Principles of preparation of chemicals and Culture Media: Stock, Standard, Molarity, Molality, Normality, Percentage solution, ppm.	4	Black board
3.2	Solid and Liquid culture media.	2	Black board
4.1	Sterilization, Decontamination and disposal: Sterilization protocols - Procedure for safe disposal of used chemicals, media.	4	Black board, Power point
4.2	Decontamination of cultures	1	Black board
5.1	Laboratory record writing: Method of record writing, data collection, reporting of results.	4	Black board
5.2	Discussion-Interpretation-summary writing.	3	Black board, Power point.
	Total hours	**30**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those joined B.Sc. Biotechnology on or after June 2023)
Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23CT21	Cell Biology	Core-3	4	-	-	4

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
I	II	25	75	100

Preamble

To afford the students with basic knowledge on cell types, cell cycle, cellular organelles and chromosome organization.

Course Outcomes

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

#	Course Outcome	Expected Proficiency	Expected Attainment
CO1	Reveal the structural organization of prokaryotic and eukaryotic cells	80%	78%
CO2	Demonstrate the levels of organization, chemical composition and its significance of cell wall and membrane of living cells.	90%	86%
CO3	Illustrate the structure and functions of various cell organelles of living organisms.	90%	86%
CO4	Evaluate the structural organization of nucleus and chromosomes.	85%	80%
CO5	Analyze the pattern of cell cycle, various stages of cell division and the structural and numerical changes in chromosomes,	85%	82%

Mapping of COs with POs

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

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	M
CO2	S	S	S	S	M

CO3	S	M	L	S	L
CO4	L	M	S	M	L
CO5	S	L	M	M	M

S (+++) – Strong;M(++) – Medium; L(+)-Low

Title of the paper: Cell Biology

Unit I: History of Cell biology, Cell as a basic unit, Cell theory, Ultra structure and functions of prokaryotic cell - Bacteria, Eukaryotic cell - plant and animal cells, Structure, Composition and function of cell wall-Bacteria and plant cell.

Unit II: Ultra structure and function of Plasma membrane- fluid mosaic model and Membrane fluidity; Transport across membranes – passive and active transport; Cytoskeletal structure – microtubules and microfilaments.

Unit III: Structure and functions of cell organelles: Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi complex, Lysosomes, Microsomes and Ribosomes. Non-living inclusions- Vacuoles, Pigments, Inorganic salts and their special functions.

Unit IV: Structural organization of Nucleus – Nuclear membrane, Chromosomes – structural organization of chromatids, centromere, telomere, nucleosomes, Chromatin – Euchromatin and Heterochromatin, Abnormal chromosomes- Lamp brush chromosomes.

Unit V: Cell cycle- Cyclin dependent kinase, Mitosis and Meiosis – Different stages and its significance, Basics in cell signalling – G protein receptors, Apoptosis, Structural and Numerical changes in chromosomes – Aneuploidy and Euploidy.

Text Books:

- Gerald Karp. 2002 Cell and Molecular Biology, John Wiley & Sons, New York
- Geoffery. H. Cooper et al., 2004. Cell – Molecular approach, ASM press, Washington.
- Gupta, P.K. 2004. Cell and Molecular Biology. Third Edition. Rastogi Publications.
- Sharma, A.K and Sharma, A. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering, Harwood Academic Publications, Australia.
- Verma, P.S and Agarwal, V.K.2016. Cell Biology- Cytology, Bio molecules and Molecular Biology. S. Chand & Co, New Delhi.
- Powar, C.B. 2009. Cell Biology. Himalayan Publishing House, New Delhi.
- Sunil Kumar-Text Book of Cell Biology. 2010. S. Chand & Co, New Delhi.
- Dnyansagar, V.R. 1987. Cell and Molecular Biology. Holt Saunders International, New York, USA.
- Becker, W.M., Kleinsmith, L.J. and Hardin, J. 2007. The World of the cell, sixth edition, Pearson Education, Inc.

Reference Book:

- Alberts, B. et al., 1994. Molecular Biology of the Cell (3rdedition). Garland Publishing, Inc., New York
- De Roberties E.D.P and E.M.F.DeRoberties. 2011. Cell and Molecular Biology. (8th edition). B.I. Publicatons Pvt. Ltd., India.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Essentials of Cell and Molecular Biology, Saunders College Publishing, Japan.

Web Resources:

- https://uwyo.libguides.com/cell biology
- https://cell bio.com/education

Course Designer: Dr. C. Karthikeyan

Course contents and lecture schedule

Unit	Topic	Lecture hrs.	Teaching Method
1.1	History of cell biology, Cell as a basic unit of structure and function.	2	Power point
1.2	Cell theory	2	Power point
1.3	Ultra structure and functions of prokaryotic	2	
1.4	Structure and functions of eukaryotic cells.	3	Power point
1.5	Structure, Composition and function of cell wall-Bacteria and plant cell	3	
2.1	Plasma membrane- structure and functions	2	Power point
2.2	Fluid mosaic model	2	
2.3	Membrane fluidity and their functions.	2	Power point
2.4	Transport across membranes - passive and active transport.	3	PPT
2.5	Cytoskeletal structures - microtubules and microfilaments.	3	Power point
3.1	Ultrastructure and functions of mitochondria and chloroplast. microsomes,	3	Power point
3.2	Ultrastructure and functions of endoplasmic reticulum and golgi complex.	3	Black/white board
3.3	Ultrastructure and functions of lysosomes, microsomes and ribosomes.	3	Black/white board
3.4	Non-living inclusions- different forms and their special functions.	3	Power point
4.1	Structure and organization of nucleus, nuclear membrane	3	Power point
4.2	Structure and organization of chromosomes	3	Power point
4.3	Structure and organization of chromatin and its types.	3	Black board
4.4	Abnormal chromosomes- Lamp brush chromosomes.	3	Power point
5.1	Cell cycle- Cyclin dependent kinase.	2	Black board
5.2	Mitosis and Meiosis - Different stages and its significance	3	Blackboard
5.3	Meiosis - Different stages and its significance.	2	Power point
5.4	Bsaics in cell signaling - G protein receptors & Apoptosis	2	Black board
5.5	Structural and Numerical changes in chromosomes - Aneuploidy and Euploidy.	3	Power point
	Total hours	**60**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Botany and Biotechnology
(For those joined B.Sc. Biotechnology on or after June 2020)
Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23CL21	Cell Biology Lab	Core Lab-2	-	-	2	2

Year	Semester	Internal Marks	External Marks	Total Marks
I	II	25	75	100

Preamble

To provide the students with the basic practical knowledge on structure and function of cells, cellular organelles and chromosome organization.

Course Outcomes

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

#	Course Outcome	Expected Proficiency	Expected Attainment
CO1	Prepare microscopic slides, examine the structural organization and diversity of prokaryotic and eukaryotic cells.	85%	82%
CO2	Distinguish different cell organelles and non-living inclusions.	90%	86%
CO3	Demonstrate transpiration and plasmolysis.	90%	86%
CO4	Prepare smear, illustrate the stages of mitosis and appraise their importance in growth and development.	84%	80%
CO5	Study of cell counting, viability and cell dimension by micrometry	90%	88%

Mapping of COs with POs

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

S-Strong, M- Medium, Low-Low

Mapping of COs with PSOs

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

Title of the paper: Cell Biology Lab

1. Observation of plant cells: onion peel and guard cell in Rhoeo.
2. Preparation of microscope slide for Dicot/monocot leaf section
3. Observation of animal cells: epithelial cells
4. Preparation of Root Tip squash and identification of stages in mitosis.
5. Observation of anther in Hibiscus.
6. Blood smear preparation: observation of different cells
7. Determination of stomatal index
8. Determination of Osmotic potential of cell sap using plasmolysis method.
9. Study of Non-living inclusions: Starch grain of potato tuber, rice and banana. Cystolith of Ficus,Raphide of Acalypha
10. Cell counting and viability of Yeast / Bacterial cells.
11. Determination of cell dimension by Micrometry.

Reference Book

- Harris, N. and K. J. Oparka. 1994. Plant Cell Biology- A practical approach. IRL Press, OUP, Oxford.
- Dixon, R. A. and R. A. Gonzales. 1994. Plant Cell Culture. A Practical Approach. Oxford University Press, Oxford.
- Krishnamoorthy, K. V. 1988. Methods in Plant Histochemistry. Viswanathan publishers, Chennai, India.

Web Resources:

- https://uwyo.libguides.com/cell biology practical manual.

Course Designed by: Dr. C. Karthikeyan

Course contents and practical schedule

Exp. No.	Name of the Experiment	Practical hours	Teaching Method
1.	Observation of plant cells: onion peel, guard cell in Rhoeo	2+2	Hands on training
2.	Preparation of microscope slide for Dicot/monocot leaf section	2	Hands on training
3.	Observation of animal cells: epithelial cells	2	Hands on training
4.	Preparation of onion root tip squash and observation of stages in mitosis.	2	Hands on training
5.	Observation of anther in *Hibiscus*	2	Hands on training
6.	Blood smear preparation: observation of different cells	2	Hands on training
7.	Determination of stomatal index	2	Hands on training
8.	Determination of Osmotic potential of cell sap using plasmolysis method	2+2	Hands on training
9.	Study of Non-living inclusions: Starch grain of potato tuber, rice and banana. Cystolith of *Ficus*, Raphide of *Acalypha*	2+2	Hands on training
10.	Cell counting and viability of Yeast / Bacterial cells	2	Hands on training
11.	Determination of cell dimension by Micrometry	2+2	Hands on training
Total hours		**30**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those joined B.Sc. Biotechnology on or after June 2023)
Programme Code: UBT

CourseCode	Course Title	Category	L	T	P	Credit
UBT23CT22	Genetics	Core 4	3			3

L – Lecture T – Tutorial P- Practicals

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

Preamble

This course provides the knowledge and understanding of basic genetic principles.

Course Outcomes

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

#	Course Outcome	Expected proficiency	Expected attainment
CO1	Exhibit Mendel's principle of inheritance and recognize the deviations from them	60%	58%
CO2	Explain the multiple allele inheritance with examples. and inheritance of sex-linked diseases	60%	59%
CO3	Demonstrate the sex determination and inheritance of sex-linked diseases.	60%	55%
CO4	Realize the mechanism of genetic linkage and crossing over.	65%	63%
CO5	Comprehend the Cytoplasmic inheritance in eukaryotes and Chloroplast inheritance of plant.	65%	62%

Mapping of COs with POs

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

Mapping of COs with PSOs

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

S (+++) – Strong M (++)- Medium L (+) – Low

Title of the paper: Genetics

Unit I: Mendelian genetics: Mendel's experimental design, monohybrid and di-hybrid, Law of segregation & independent assortment; Backcross and test cross; Deviation from Mendelian principles: Codominance, incomplete dominance, epistasis.

Unit II: Multiple alleles: Characters of multiple alleles, Symbolism for multiple alleles, Examples of multiple allelism- coat colour in rabbits and eye colour in *Drosophila*; Inheritance of ABO blood types and Rh factor.

Unit III: Sex determination: XX-XO, ZW-ZZ type, Genic balance concept; sex chromosomes and sex-linked inheritance (Colour blindness); Sex limited inheritance: baldness and length of index finger. Genetic disorders- Sickle cell anaemia, Down's, Klienfelter's and Turner's syndrome.

Unit IV: Linkage: types - complete & incomplete linkages; Linkage in maize and Drosophila; Crossing over: Mechanism and theories of meiotic crossing over, Types - simple, double & multiple crossing over, Factors affecting crossing over.

Unit V: Cytoplasmic Inheritance: Extra-nuclear inheritance in Eukaryotes- Maternal inheritance (shell coiling in Limnaea); Chloroplast inheritance in variegated four o'clock plant.

Text books:

- Verma, P.S. and Agarwal, V. K. 2014. Genetics. S. Chand PVT. LTD company.
- Gardner E.J., Simmons, M.J. and Snustad, D. P. (2006) Principles of Genetics, 8th edition, Wiley India Pvt. Ltd., New Delhi.

Reference Books:

- Thomas, A. 2014. Introducing Genetics: From Mendel to Molecules. United States: CRC Press.
- Robert Brooker. 2015. Concepts of Genetics. McGraw-Hill US Higher Ed USE Legacy.
- Benjamin A.P. 2020. Genetics: A Conceptual Approach. 7th Edition, WH Freeman publisher.
- Klug, W.S., Cummings, M. R., Spencer, C. A. and Palladino, M.A. 2016. Genetics, X Edn. Pearson Education India, New Delhi.
- Strickberger, 2015. Genetics, IV Edn. Pearson Education India, New Delhi.

Course designer(s): Dr. C. Balachandran

Course contents and lecture schedule

Units	Topic	Hrs.	Mode of teaching
1.1	Mendelian genetics: Mendel's experimental design, monohybrid and dihybrid experiments	3	Black/white board
1.2	Law of segregation & independent assortment; Backcross and test cross	2	Power point
1.3	Deviation from Mendelian principles: Codominance, incomplete dominance	2	Black/white board
1.4	Epistasis	2	Power point
2.1	Multiple alleles: Characters of multiple alleles	3	Black/white board
2.2	symbolism for multiple alleles	2	Power point
2.3	Examples of multiple allelism- coat colour in rabbits and eye colour in *Drosophila*	2	Power point
2.4	Inheritanceof ABO blood types and Rh factor	2	Power point
3.1	Sex determination: XX-XO, ZW-ZZ type, Genic balance concept.	2	Power point
3.2	sex chromosomes and sex-linked inheritance (Colour blindness)	2	Power point
3.3	Sex limited inheritance: baldness and length of index finger	2	Black/white board
3.4	Genetic disorders (Sickle cell anemia, Down's, Klienfelter's and Turner's syndrome)	3	Power point
4.1	Linkage: types - complete & incomplete linkages	2	Black/white board
4.2	Linkage in maize and Drosophila;	2	Power point
4.3	Crossing over: Mechanism and theories of meiotic crossing over,	2	Black/white board
4.4	Types - simple, double &multiple crossing over	2	Black/white board
4.5	Factors affecting crossing over.	1	Power point
5.1	Cytoplasmic Inheritance – An introduction -	2	Black/white board
5.2	Extra-nuclear inheritance in Eukaryotes	2	Black/white board
5.3	Maternal inheritance (shell coiling in Limnaea)	2	Power point
5.4	Chloroplast inheritance in variegated four o'clock plant.	3	Black/white board
	Total	**45**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those join B.Sc. Biotechnology on or after June 2023)
Programme Code UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23GT21	Biological Chemistry	GE-2	3	-	-	2

L – Lecture T – Tutorial P- Practicals

Year	Semester	Internal Marks	External Marks	Total Marks
I	II	25	75	100

Preamble

Familiarize the students, the chemical architecture and functions of biomolecules

Course Outcomes

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

#	Course Outcome	Expected Proficiency	Expected Attainment
CO1	Analyse the molecular architecture of carbohydrates.	95%	91%
CO2	Classify the amino acids; compare the various structural organizations of proteins.	90%	88%
CO3	Learn the various concepts involved in the mechanism of enzyme action.	90%	85%
CO4	Elaborate the structure and function of nucleic acids.	95%	90%
CO5	Categorize the lipids, appreciate their importance	90%	89%

Mapping of COs with POs

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

S – Strong M- Medium L - Low

Mapping of COs with PSOs

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

Title of the paper: Biological chemistry

Unit I: Carbohydrates: Structure and functions - Monosaccharides (Glucose, fructose) – Disaccharides (Sucrose, lactose) – Cell wall polysaccharides (Cellulose) – storage polysaccharides (Starch).

Unit II: Amino acids: Classification – based on polarity – Proteins – biological functions and Structure- primary, secondary, tertiary and quaternary.

Unit III: Enzymes: Classification and nomenclature — Mechanism of enzyme action – Factors affecting enzyme action - enzyme inhibition – Michaelis Menten Constant-Theories on enzyme action.

Unit IV: Structure and functions of Nucleic acids: Nucleosides – Nucleotides – Purines and pyrimidines – phosphodiester bonds. DNA double helix (Watson & Crick Model) – A, B, Z forms of DNA – RNA types: mRNA, tRNA, rRNA, small RNA and hnRNA.

Unit V: Lipids: Classification (outline) –Saturated and unsaturated fatty acids -Simple non - saponifiable lipids: terpenes, steroids, sterols – Cholesterol, Ergosterol - phosphotidylcholine – complex saponifiable lipids: triglycerides, phosphoglycerides - membrane lipids – lipoprotein complex.

Text Books:

- Zubay, G. 1998. Biochemistry, Fourth edition. Won C. Brown publishers, London.
- Conn. E. E., P. K. Stumpf, G. Bruening and R.H. Doi, 2009.Fifth edition. Outlines of Biochemistry, John Wiley & sons Inc., New York.
- Trudy McKee and J.R. McKee. 2012. Seventh edition. Biochemistry - The molecular basis of life. Won C. Brown publishers, London.
- S.R. Mishra. 2020. Biomolecules. Discovery publishing house.New Delhi

Reference Books:

- Berg, Jeremy M, John L. Tymoczko, Lubert Stryer and Lubert Stryer. 2015. Biochemistry, eighth edition .W.H. Freeman and company, New York.
- Voet, D. and J. G. Voet, 1995. Biochemistry, Seventh edition. John Wiley & Sons lnc, New York.
- Nelson, D. L. and M. M. Cox, 2017. Seventh edition Lehninger Principles of Biochemistry, W H Freeman publishers, New York.
- Ferveir, Denise R. 2014. Lippincotts – Biochemistry sixth edition. CCH, a wolters Kluwer business.
- Victor W. Rodwell, David Bender, Keethieen M. Botham, Peter J. Kennelly, P. Anthony well 2018. Harper's illustrated Biochemistry 31st edition. Mc Graw-Hill education.
- Donald voelt and Jaedith G. voet 2011. Biochemistry fourth edition. CBS publishers and distributors, New delhi.

- Donald voet, Judith G. voet and Charlolte W. paratt 2016. Fundamentals of Biochemistry: Life at the molecular level. John wiley and sons.

Web Resources:

- http://med.fau.edu/students/md_m1_orientation/Overview.pdf
- https://www.sciencedirect.com/topics/engineering/biomolecule
- https://www.mdpi.com/journal/biomolecules
- https://nptel.ac.in/courses/104103121.

Course designer: S. Siva Durga

Course contents and lecture schedule

	Topic	Lecture hrs.	Teaching
1.1	Carbohydrates: Structure and functions - Monosaccharides (Glucose, fructose) – Disaccharides (Sucrose, lactose)	4	Black board
1.2	Cell wall polysaccharides (Cellulose) – storage polysaccharides (Starch).	2	Black board
2.1	Proteins – Structure, properties and functions of Protein.	3	PPT
2.2	Primary structure, Secondary structure, tertiary and quaternary structure	3	Black board
3.1	Enzymes: Classification and nomenclature.	3	Power point
3.2	Mechanism of enzyme action.	4	Power point
3.3	Factors affecting enzyme action - enzyme inhibition – Michaelis Menten constant -Theories on enzyme action.	4	Black board
4.1	Structure and functions of Nucleic acids	4	Black board
4.2	Nucleosides – Nucleotides – Purines and pyrimidines – phosphodiester bonds.	3	Power point
4.3	DNA double helix (Watson & Crick Model) – A, B, Z forms of DNA.	3	Power point
4.4	RNA types: mRNA, tRNA, rRNA, small RNA and hnRNA.	3	Black board
5.1	Lipids: Classification (outline) –Saturated and unsaturated fatty acids	3	Black board
5.2	Simple non-saponifiable lipids: terpenes, steroids, sterols – Cholesterol, Ergosterol - phosphotidylcholine	3	Black board
5.3	Complex saponifiable lipids: triglycerides, phospho-glycerides - membrane lipids – lipoprotein complex	3	Power point
Total Hours		**45**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those joined B.Sc. Biotechnology on or after June 2023)
Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23GL21	Biological Chemistry Lab	GE-Lab 2	-	-	2	1

Year	Semester	Internal Marks	External Marks	Total Marks
I	II	25	75	100

Preamble

Acquire hands on skills on colorimetric and titrimetric analysis.

Course Outcomes

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

#	Course Outcome	Expected Proficiency	Expected Attainment
CO1	Quantify the Carbohydrates	100%	95%
CO2	Analyse and estimate amino acids	100%	98%
CO3	Experiment with enzymes and proteins	100%	98%
CO4	Estimate DNA and RNA	100%	95%
CO5	Quantify the Lipids	100%	95%

Mapping of COs with POs

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

Mapping of COs with PSOs

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

S (+++) – Strong **M (++) - Medium** **L (+) - Low**

Title of the paper Biological chemistry Lab

1. Quantification of soluble sugars by phenol sulphuric acid method
2. Estimation of glucose by anthrone method.
3. Measurement of pH of amino acid
4. Quantification of total amino acids – ninhydrin method.
5. Estimation of Protein by Lowry's Method

6. Effect of Substrate concentration on Amylase enzyme activity
7. Estimation of DNA by Diphenylamine method.
8. Estimation of RNA by Orcinol method.
9. Saponification of fats –titration method.
10. Quantification of Lipids

Text Books:

- Rajagopal, G. Toora, B.D. 2005. Practical Biochemistry. Ahuja Publishing House, New Delhi.
- Shawney, S.H.1999. Introductory Practical Biochemistry. Narosa publishing House, New Delhi.
- Damodaran Geetha, K. 2016. Practical Biochemistry. 2nd eds. Jaypee Brothers, India.
- David, T. Plummer. 2006. An Introduction to Practical Biochemistry. Tata Mc Graw Hill Education.

Reference books:

- Andreas Hofmann and Samuel Clokie. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Eighth Edition. Cambridge University Press, USA.

Web sources:

- https://www.researchgate.net/publication/332028407_Biochemistry_A_Practical_Manual
- https://www.researchgate.net/publication/301647645_PRACTICAL_BIOCHEMISTRY

Course designer: S. Siva Durga

Course contents and lecture schedule

	Topic	lecture hrs.	Method of teaching
1	Measurement of pH of aminoacid	2	Hands on Training.
2	Quantitative estimation of soluble sugars by phenol sulphuric acid method	3	Hands on Training.
3	Quantitative Estimation of Protein by Lowry's Method	3	Hands on Training
4	Quantitative estimation of DNA by Diphenylamine method	3	Hands on Training.
5	Quantitative estimation of RNA by Orcinol method	4	Hands on Training.
6	Quantitative estimation of glucose by anthrone method.	3	Hands on Training.
7	Quantitative estimation of total amino acids – ninhydrin method.	2	Hands on Training.
8	Saponification of fats –titration method.	3	Hands on Training.
9	Effect of Substrate concentration, pH and Temperature on Amylase enzyme activity	4	Demonstration
10	Quantification of Lipids	3	Hands on Training
Total Hours		**30**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those join B.Sc. Biotechnology on or after June 2023)
Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23NT21	Mushroom Technology	NME 2	2	-	-	2

L – Lecture T – Tutorial P- Practical

Year	Semester	Internal Marks	External Marks	Total Marks
I	II	25	75	100

Preamble

Appreciate the importance of mushrooms, develop entrepreneurial skills.

Course Outcomes

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

#	Course Outcome	Expected proficiency	Expected attainment
CO1	Acquire basic knowledge on mushrooms	80%	76%
CO2	Learn the morphology and life cycle of mushrooms	75%	73%
CO3	Make use of the knowledge in spawn production.	80%	78%
CO4	Develop suitable skills involved in mushroom cultivation	75%	73%
CO5	Apply the knowledge in the production of mushroom products	80%	78%

Mapping of COs with POs

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

S (+++) – Strong M (++) - Medium L (+) – Low

Mapping of COs with PSOs

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

S (+++) – Strong M (++) - Medium L (+) – Low

Title of the paper: Mushroom Technology

Unit I: Introduction to mushrooms: History of mushroom Cultivation- Morphology of mushrooms – Life cycle of mushrooms.

Unit II: Types of mushrooms: cultivable, non – cultivable, edible, poisonous, miscellaneous. Nutritional value of mushrooms – mushrooms as functional food.

Unit III: Mushroom Cultivation – Factors - temperature, moisture, ventilation, growing space. Cultivation of *Pleurotus sp* and *Agaricus* sp.

Unit IV: Spawn and types of spawning: grain spawn – storage of spawn – casing – cropping and harvesting of fruiting body, Preservation.

Unit V: Do's and don'ts of mushroom growing. Mushroom products: Neutraceuticals, pharmaceuticals, cosmaceuticals and value-added products for commercially important species.

Text Books:

- Nita Bahl. 2000. Hand Book of Mushroom. 4th edition. Oxford & Ibh Publishing Co. Pvt Ltd
- Kapoor, J.N.2016. Mushroom cultivation ICAR. New Delhi.
- Banwart George, J. 2012. Basic Food Microbiology, 2nd Edition. CBS publishers and distributors, New Delhi.
- Gogoi R, Rathaiah Y, Borah T.R. 2006. Mushroom Cultivation Technology. Scientific Publishers, India.
- Rajan S, 2020. Mushroom Technology. 2nd Edition. CBS Publishers and Distributors
- Krieger, L. C. 2010. The Mushroom Handbook. Sufi Press. 578 P

Reference Books:

- Aneja, K.R. 2003. Experiments in Microbiology, Plant pathology. Tissue culture and Mushroom cultivation. Wishwa Prakashan, (New Age International (p) Ltd), New Delhi
- Anil K. Thakur , Susheel K. Bassi, Atri N.S. 2020. Vinesh Mushroom Cultivation Technology

Web Sources:

- http://mushroomspawn.cas.psu.edu/SixSteps.shtml
- http://pubs.cas.psu.edu/PubTitle.asp?varTitle=mushroom
- http://pubs.cas.psu.edu/PubTitle.asp?varTitle=mushroom

Course designer: Dr. S. Yogachitra

Course contents and lecture schedule

Unit	Topic	No of lecture hrs.	Method of teaching
1.1	Introduction to mushrooms – History of mushroom Cultivation	3	Black board, Power point.
1.2	Morphology of mushrooms– Life cycle of mushrooms.	4	Powerpoint
2.1	Types of mushrooms – cultivable, non – cultivable, edible, poisonous, miscellaneous.	4	Powerpoint
2.2	Nutritional value of mushrooms – mushrooms as functional food.	3	Black board, Power point.
3.1	Mushroom Cultivation – Factors - Temperature, Moisture, Ventilation, growing space.	2	Black board, Power point.
3.2	Cultivation of *Pleurotus sp* and *Agaricus* sp.	4	Black board, Power point.
4.1	Spawn and types of spawning – grain spawn, – storage of spawn.	2	Powerpoint
4.2	Casing – cropping and harvesting of fruiting body, Preservation.	2	Black board
5.1	Do‘s and don’ts of mushroom growing	2	Black board
5.2	Mushroom products-Nutraceuticals, pharmaceuticals, cosmaceuticals.	4	Black board, Power point.
	Total hours	**30**	

Thiagarajar College (Autonomous): Madurai – 625 009
Department of Biotechnology
(For those joined B.Sc. Biotechnology on or after June 2023)
Programme Code: UBT

Course Code	Course Title	Category	L	T	P	Credit
UBT23ST21	Organic farming Technology	SE	3			3

L – Lecture T – Tutorial P- Practicals

Year	Semester	Int. Marks	Ext.Marks	Total
I	II	25	75	100

Preamble

This course provides the knowledge on organic farming, mass production of eco-friendly biofertilizers and its application.

Course Outcomes

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

#	Course Outcome	Expected proficiency	Expected attainment
CO1	Explain the characteristics and types of organic farming	60%	58%
CO2	Acquire sound knowledge on the vermicomposting and Preparation procedure of panchakavya and its application	60%	59%
CO3	Illustrate the Mass production of Bacterial biofertilizers and its application	60%	55%
CO4	Develop the Cyanobacterial Biofertilizer production and Post harvest management of organic farming	65%	63%
CO5	Demonstrate the organic symbol, code, organic certification and their guidelines	65%	62%

Mapping of COs with POs

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

Mapping of COs with PSOs

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

S (+++) – Strong M (++)- Medium L (+) – Low

Title of the paper: Organic farming technology

Unit I: Organic Farming- Concept, Characteristics and its advantages, Scope of organic farming in India, Principles and types: Pure organic farming and Integrated organic farming. Challenges and opportunities for sustainable agriculture; Benefits and differentiation of manures and compost.

Unit II: Composting- Process of composting, benefits and factors affecting composting; Vermicomposting – process and its application. Coir-pith composting. Preparation of Panchakavya and its applications.

Unit III: Biofertilizers: Definition – Organisms involved – Bacteria: *Rhizobium*, *Azotobacter*, *Azospirillum* and *Phosphobacteria* - Screening, characterization, identification, mass cultivation and its application.

Unit IV: Cyanobacterial Biofertilizer: Mass production of single cell protein; Azolla – Morphology – Mass cultivation and its application. Post harvest management – Financial consideration of organic farm, processing, Labelling, Storage, Transport and marketing products.

Unit V: Organic symbol; PLU code; Organic certification - guidelines- Agricultural and Processed Food Products Export Development Authority, Tamil Nadu Organic Certification Department and Food Safety and Standards Authority of India.

Text books:

- Dubey, R. C. 2002. A text book of biotechnology S. Chand & Co, New Delhi.
- Sapna, E. Thottathil, India's Organic farming revolution, University of Iowa Press, Iowa City.
- Kannaiyan, S. 2002. Biotechnology of Biofertilizers. Narosa publishing house, New Delhi

Reference books:

- Venkataraman, L.V. and E.W. Beaker 1985.Biotechnology and utilization of algae: The Indian experience. CFTRI Mysore pp 257.
- Ann Larkin Hansen, 2010. The organic farming manual: A comprehensive guide to starting and running a certified organic farm. Storey publishing LLC.

Course designer(s): Dr. C. Karthikeyan

Course contents and lecture schedule

Units	Topic	Hrs.	Mode of teaching
1.1	Organic Farming- Concept, Characteristics and its advantages	2	Black/white board
1.2	Scope of organic farming in India	2	Power point
1.3	Principles and types: Pure organic farming and Integrated organic farming	2	Black/white board
1.4	Challenges and opportunities for sustainable agriculture	1	Power point
1.5	Benefits and differentiation of manures and compost	2	Black/white board
2.1	Composting- Process of composting, benefits and factors affecting composting	3	Black/white board
2.2	Vermicomposting – process and its application	2	Power point
2.3	Coir pith composting	2	Power point
2.4	Preparation of Panchakavya and its applications	2	Power point
3.1	Biofertilizers: Definition – Organisms involved – Bacteria: *Rhizobium, Azotobacter*	2	Power point
3.2	Organisms involved – Bacteria: *Azospirillum* and *Phosphobacteria*	2	Power point
3.3	Screening, characterization, identification of microbes	3	Black/white board
3.4	Mass cultivation of biofertiizers and its application	2	Power point
4.1	Cyanobacterial Biofertilizer: Mass production of single cell protein	3	Black/white board
4.2	*Azolla* –Morphology – Mass cultivation and its application	2	Power point
4.3	Post harvest management – Financial consideration of organic farm, processing, Labelling	2	Black/white board
4.4	Post harvest management - Storage, Transport and marketing products	2	Black/white board
5.1	Organic symbol; PLU code; Organic certification - guidelines	2	Power point
5.2	Agricultural and Processed Food Products Export Development Authority	2	Black/white board
5.3	Tamil Nadu Organic Certification Department	2	Power point
5.4	Food Safety and Standards Authority of India	3	Black/white board
	Total	**45**	

Thiagarajar College

(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re-Accredited with "A^{++}" Grade by NAAC

Academic Council Meeting (ACM)

June-2023

Department of Biotechnology

M.Sc., Biotechnology

Syllabus - 2023-2024

M.Sc., Biotechnology

(Programme Code:PBT)

Dr.RM.Murugappan
Dean, Curriculum Development

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

PO1 Knowledge
Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

PO 2 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;

PO3 Applied learning
Students will be able to apply disciplinary or interdisciplinarylearning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate.

PO 4Communication
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.

PO5 Problem solving
Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

PO6 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.

PO7 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 to Madurai Kamaraj University
Re-Accredited with 'A' Grade by NAAC
M.Sc., Biotechnology Course Structure (w.e.f. 2023 batch onwards)
Programme code: PBT

Vision

- To achieve excellence in teaching, training, research and innovation in Biotechnology

Mission

- To ensure academic excellence by designing and teaching need-based curriculum
- To impart inclusive knowledge with equal emphasis on theory and practical
- To encourage students to focus on national eligibility / entrance tests for acquiring potential career opportunities
- To develop creativity skills by organizing various co-curricular activities
- To enhance adoptability and employability by stimulating team work

Programme Educational Objectives (PEO)

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

PEO1	Endow with a spirit of three fundamental aspects in biological phenomenon: a) what to seek; b) how to seek; c) why to seek?
PEO2	Explicate the various facets of molecular procedures. (a)Describe fundamental molecular principles of genetics; (b) Explain the relationship between phenotype and genotype in human genetic traits; (c) Describe the basics of genetic mapping; (d) Understand how gene expression is regulated.
PEO3	Basics and current updates in the areas of Microbiology, Immunology, Biotechnology, Genetic Engineerinng are included to train the students and also sensitize them to scope for research.
PEO4	The laboratory training in addition to theory will equip the student for careers in the industry, agriculture, and applied research.
PEO5	Perform functions that demand higher competence in national/international organizations.

Programme specific outcomes- M.Sc., Biotechnology

On the successful completion of M.Sc., Biotechnology the students will

PSO1	Proficient in recent trends and core concepts in plant, animal, industrial biotechnology, molecular biology, genetic engineering, genetics and allied courses like microbiology, immunology and bioinformatics etc.,
PSO2	Have significant knowledge on various aspects of Biotechnology with special reference to microbes and their products
PSO3	Possess theoretical basis and practical skills in the use of basic and advanced instruments. Further able to create, select and apply appropriate techniques, resources and modern technology in multi-disciplinary environment.
PSO4	Apply theoretical knowledge gained for prominent career and for further academic study. Have ability to plan and execute experiments as well as to analyze & interpret data for any research.
PSO5	Appear for competitive exams like CSIR NET, SET etc and also to write research proposals for grants.

Thiagarajar College, Madurai – 9
An Autonomous Institution Affiliated to Madurai Kamaraj University
Re-Accredited with 'A^{++}' Grade by NAAC
M.Sc., Biotechnology Course Structure (w.e.f. 2023 batch onwards)
Programme code: PBT

I semester

Course	Code	Subject/Paper	Hr/ w	Cred	Tot Hr	CA	SE	Total
PART -A								
Core-I	PBT23CT11	Biochemistry	4	4	60	25	75	100
Core-II	PBT23CT12	Cell and Molecular Biology	4	4	60	25	75	100
Core- L1	PBT23CL11	Lab in Biochemistry	4	2	60	25	75	100
Core- L2	PBT23CL12	Lab in cell and Molecular Biology	4	2	60	25	75	100
Core Elec-I	PBT23ET11	Bioinstrumentation	4	4	60	25	75	100
Core Elect-II	PBT23ET12	Biostatistics	4	4	60	25	75	100
PART -B								
SEC-I	PBT23ST11	IPR and Bioethics	3	2	30	25	75	100
AECC I	PBT23AT11	Bioentrepreneurship	3	2	30	25	75	100
		Total	**30**	**24**		25	75	100

II Semester

Course	Code	Subject/Paper	Hrs/ w	Cred	Tot Hrs	CA	SE	Total
PART- A								
Core-III	PBT23CT21	Microbiology	4	4	60	25	75	100
Core-IV	PBT23CT22	Genetic Engineering	4	4	60	25	75	100
Core-L3	PBT23CL21	Lab in Microbiology	4	2	60	25	75	100
Core- L4	PBT23CL22	Lab in Genetic Engineering	4	2	60	25	75	100
Core Elec-III	PBT23ET21	Environmental Biotechnology	4	4	60	25	75	100
Core Elective-IV	PBT23ET22	Plant and Animal Biotechnology	4	4	60	25	75	100
PART- B								
SEC-II	PBT23ST21	Diary Technology	3	2	30	25	75	100
AECC-II	PBT23AT21	Pharmaceutical Biotechnology	3	2	30	25	75	100
		Total	**30**	**24**		25	75	100

THIAGARAJAR COLLEGE, MADURAI:: 9
An Autonomous Institution affiliated by Madurai Kamaraj University
(Re-Accredited with 'A^{++}' Grade by NAAC)
DEPARTMENT OF BIOTECHNOLOGY
(For those joined M.Sc., Biotechnology on or after June 2023)
Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credits
PBT23CT11	**Biochemistry**	Core – I	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.

Prerequisites

Fundamental concept of biological structure and chemistry

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Understand the basics of pH and related principles and carbohydrate metabolism.	**70**	**60**
CO2	Provide basic knowledge about lipid metabolism and related significance.	**70**	**60**
CO3	Enlighten the knowledge on Bio-energetics and Biological oxidation pathways	**60**	**70**
CO4	Update the knowledge on Amino acids and Protein.	**70**	**60**
CO5	Assess and appraise the role of Nucleic acids.	**70**	**60**

Mapping of COS with POs

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

S: Strong M: Medium L: Low

Mapping of COs with PSOs

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

S: Strong M: Medium L: Low

Blooms Taxonomy

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

Title of the paper:Biochemistry

Unit I

pH, pK . acid, base .Buffers- Henderson- Haselbach equation, biological buffer system –Phosphate buffer system, protein buffer system, bicarbonate buffer system, amino acid buffer system and Hb buffer system. Water, Carbohydrates: Nomenclature, classification, structure,chemical and physical properties of carbohydrates. Metabolisms: glycogenesis, glycogenolysis, gluconeogenesis, pentose phosphate pathway

Unit II

Lipids: Nomenclature, classification, structure, chemical and physical properties of fatty acids. Metabolisms: biosynthesis of fatty acids, triglycerols, phospholipids, glycol lipids. Cholesterol biosynthesis, bile acids and salt formation. Eicosanoids, sphingolipids and steroid hormones.

Unit III

Bioenergetics – Concept of energy, Principle of thermodynamics, Relationship between standard free energy and Equilibrium constant, ATP ads universal unit of free energy in Biological systems. Biological oxidation: Electron transport chain, oxidative phosphorylation, glycolysis, citric acid cycle, cori.s cycle, glyoxalate pathway. Oxidation of fatty acids- mitochondrial and peroxisomal ß-oxidation, alpha and beta oxidation, oxidation of unsaturated and odd chain fatty acids, ketone bodies. Photosynthesis, urea cycle, hormonal regulation of fatty acids and carbohydrates metabolisms, Mineral metabolism

Unit IV

Amino acids and Protein: Nomenclature, Classification, structure, chemical and physical properties of amino acids and proteins. Metabolisms: Biosynthesis of amino acids. Degradation of proteins, nitrogen metabolisms and carbon skeleton of amino acids. Over all in born error metabolisms

Unit V

Nucleic acids: Nomenclature, Classification, structure, chemical and physical properties of purine and pyrimidines. In de novo and salvage synthesis of purines, pyrimidine bases, nucleosides and nucleotides. Catabolisms of purines and pyrimidines bases. Synthetic analogues of nitrogenous bases

Reference Books:

- Nelson, D.L. and Cox, M.M. (2021). Lehingers‟s Principles of Biochemistry, Eighth Edition, Macmillan Learning Publishers, USA.
- Jeremy M. Berg, Gregory J. Gatto, Justin K. Hines, John L. Tymoczko, and Lubert L. Stryer. (2023). Biochemistry, Tenth Edition, W.H. Freeman& Company.
- Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, Matthew W. Sattley, and David A. Stahl. (2020). Sixteenth Edition, Brock Biology of Microorganisms, Pearson Higher Ed Publishers.
- Albert G. Moat, John W. Foster, and Michael P. Spector (2002). Microbial Physiology, Fourth Edition, A John Wiley and Sons, USA.
- Peter J. Kennelly, Kathleen M. Botham, Owen McGuinness, Vicotr W. Rodwell and P. Anthony Weil. (2022). Harper‟s Illustrated Biochemistry, 32nd Edition, McGraw Hill Lange.

Web Resources

- mcdb-webarchive.mcdb.ucsb.edu/.../biochemistry/.../website-tourf.htm
- www.biochemweb.org/
- http://golgi.harvard.edu/biopages.html
- webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-

Course Designers:

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

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DEPARTMENT OF BIOTECHNOLOGY
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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credits
PBT23CT12	**Cell and Molecular Biology**	Core – II	4	-	-	4

L - Lecture **T - Tutorial** **P – Practical**

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

Preamble

Acquire knowledge on the fundamental concepts of cell and molecular biology for genome regulation and expression aspects.

Prerequisites

Be aware of the principles behind the basic genetic and molecular biology concepts

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Understand the fundamentals principles of structure and function of cells in prokaryotes and eukaryotes	60	70
CO2	Explore the system of cell cycle and cell division mechanism	60	70
CO3	Acquire the knowledge about basic mechanism of transcription and translation in prokaryotes and eukaryotes	70	60
CO4	Gather an extempore knowledge on the basic principles in gene regulation	70	60
CO5	Become familiar with epigenetic concepts and gene nexpression	60	70

Mapping of COS with POs

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

Mapping of COs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	L	L
CO2	S	M	L	M	L
CO3	S	M	M	M	M
CO4	M	S	L	L	M
CO5	S	M	M	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: Cell and Molecular Biology

Unit I

Cell Biology: Structure and function of cells in prokaryotes and eukaryotes; Structure and organization of Membrane - Membrane Model, active and passive, transport channels and pumps., Structure & Biogenesis of Mitochondria and Chloroplast. Structure of Endoplasmic reticulum, Golgi complex, lysosomes.

Unit II

Cell division: Mitosis, Meiosis, regulation of cell cycle; factors regulating cell cycle. Nucleic acid structure,Genome Organization. DNA replication: Enzymes and mechanisms of DNA replication in prokaryotes and eukaryotes, Telomeres, telomerase and end replication. Role of telomerase in aging and cancer. DNA replication models DNA damage, Mutations, DNA repair and recombination.

Unit III

Transcription: Basic mechanism in prokaryotes and eukaryotes. RNA polymerase, Reverse transcriptase and regulation. Post- transcriptional processing: 5'-Cap formation; 3'-end processing and polyadenylation; splicing: RNA editing; Nuclear export of mRNA; mRNA stability.Translation-Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co-and post-translational modifications of proteins and localization.

Unit IV

Gene regulation: Prokaryotic gene regulation- Operon concept ; Lac operon and tryptophan operon. Eukaryotic gene regulation: Chromatin Structure, Regulation at transcriptional Level: DNA binding domains of the regulatory proteins. Biochemistry and applications of ribozyme technologies. Transposable genetic elements

Unit V

Epigenetics: Epigenetic regulation of gene expression, Modifications, Cancer Epigenetics. Cancer Biology: Viral and cellular oncogenes; Tumor suppressor genes - Structure, function and mechanism of action of pRB and p53, p21, BRACA1.Oncogenes as transcriptional activators.

Reference Books:

- Molecular cell Biology, by Darnell, Lodish, Baltimore, Scientific American Books,Inc.,1994.
- Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth PublishingCompany,1993.
- Cell and Molecular Biology: Concepts and Experiments 5th Ed,Gerald Karp. Wileypublications,2013.
- Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd.,Oxford,1991.
- Molecular Biology of the Gene (4th Edition), J.D.Watson, N.H.Hopkins, J.W.Roberts, J.A. Steitz and A.M.Weiner, The Benjamin/Cummings Publ. Co., Inc., California,1987.
- Genes VI (6th Edition) Benjamin Lewin, Oxford University Press, U.K.,1998

Web Resources

- https://facultystaff.richmond.edu/~lrunyenj/bio554/lectnotes/chapter13.pdf
- https://microbenotes.com/translation-protein-synthesis/
- https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/regulation-of-gene-expression-and-cell-specialization/a/overview-of-eukaryotic-gene-regulation
- https://courses.lumenlearning.com/wm-biology1/chapter/reading-eukaryotic-epigenetic-gene-regulation/

Course Designers:

- **Dr. K. Renugadevi**

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credits
PBT23CL11	**Lab in Biochemistry**	Core Lab-I	-		4	2

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	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 biomolecules	**70**	**60**
CO4	Interpret the procedures involved in the purification 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 Biochemistry

1. Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v)& pH.
2. Transition interval of commonly used pH indicators
3. Preparation of buffers (Phosphate and Tris) and other chemicals
4. Extraction of Proteins from biological materials
5. Protein separation methods:-Ammonium sulphate Precipitation, and membrane dialysis
6. Qualitative and quantitative analysis of carbohydrate (mono, di and polysaccharides).
7. Qualitative and Quantitative analysis of proteins.
8. Qualitative and Quantitative analysis of DNA
9. Qualitative and Quantitative analysis of RNA
10. Purity check of DNA/RNA by UV Spectrophotometry - A260/280
11. Determination of λ max (Wavelength scan) using UV visible spectrophotometry.
12. Separation of amino acids by Paper chromatography – circular.
13. Separation of amino acids and lipids by Thin layer chromatography.
14. Separation of pigments by column chromatography.
15. Separation of microbial secondary metabolites and pigments by Ultrasonication
16. Determination of functional groups by FTIR spectroscopy
17. Thermal Denaturation of DNA and UV absorption studies

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. Vijayasarathy- Assistant Professor**

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23CL12	Lab in Cell and Molecular Biology	Core lab II	-		4	2

L-Lecture T – Tutorial P–Practical

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

Preamble

Focused the hands-on training of basic techniques in cell and molecular biology 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

CourseOutcomes

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 manipulation the genes	**70**	**80**
CO4	Simplify and explain the various methods used for genetic recombination and cloning methods	**60**	**70**
CO5	Appraise the importance and analysis of genetic material	**60**	**80**

MappingofCOswithPOs

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

S:Strong M:Medium L: Low

Mappingof COS withPSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	L	L
CO2	S	S	M	M	L
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 cell Biology

1. Isolation and estimation of genomic DNA from bacteria/yeast.
2. Isolation and estimation of RNA from bacteria/yeast.
3. Isolation and estimation of protein from bacteria/yeast.
4. Separation of Nucleic acids by agarose gel electrophoresis.
5. Determination of melting temperature of DNA
6. Detection of proteins by SDS-PAGE
7. Elution & quantification of DNA from agarose gel.
8. Preparation of competent cells and transformation
9. PCR
10. Gene Cloning
11. Isolation of Total RNA from bacteria
12. Synthesis of cDNA by Reverse transcription polymerase chain reaction

ReferenceBooks

- Rajamanickam,C. 2001, Experimental protocols in basic molecular biology, Osho Scientific Publications, Madurai.
- Sambrook, I., Fritsch, E.F. and Maniatis, T. 2001.Third Edition, MolecularCloning1,2,3 -A Laboratory Manual, ColdSpring 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 & SonsInc., 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.

Web Resources:

- https://www.genome.gov/genetics-glossary/Polymerase-Chain-Reaction
- https://labettor.com/combos/detail/id/4003/
- IsolationandestimationofRNA-https://www.youtube.com/watch?v=l5xlb8kkkt4
- DetectionofproteinsbySDS-PAGE-https://www.youtube.com/watch?v=ve4nysv-gfu
- https://www.youtube.com/watch?v=VT_nNVO95eI

CourseDesigner

1.Dr.K. Renugadevi

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23ET11	**Bioinstrumentation**	Core Elective-I	4		-	4

L – Lecture T – Tutorial P – Practicals

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

Preamble

The course provide knowledge on elemental concepts of microalgal technology for commercial application in industrial sectors.

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	Demonstrate the principle and mechanism of basic laboratory equipments.	**60**	**70**
CO2	Apply chromatography in separation of biomolecules	**60**	**70**
CO3	Illustrate molecular techniques in biological applications	**70**	**60**
CO4	Acquire knowledge on spectroscopic techniques	**70**	**60**
CO5	Demonstrate the application of radioisotopes in biological research	**60**	**70**

K1 – Knowledge K2 – Understand K3 – Apply K4 – Analyse K5 – Evaluate

Mapping of COs with POs

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

Unit-I

Basic laboratory Instruments – Biosafety Cabinets - Fume Hood, pH meter, Lyophilizer, Flow cytometry. Centrifugation techniques: Basic principles of centrifugation - Standard sedimentation coefficient - measurement of sedimentation co-efficient; Principles, methodology and applications of differential, rate zonal and density gradient centrifugation.

Unit-II

General principles of chromatography - Chromatographic Performance parameters; Types- Thin layer chromatography, Paper Chromatography, Liquid chromatography (LPLC &HPLC), Adsorption, ion exchange, Gel filtration, affinity, Gas liquid (GLC). Flash Chromatography and Ultra Performance convergence chromatography. Two dimensional chromatography. Stimulated moving bed chromatography (SEC).

Unit III

Electrophoresis: General principles - electrophoretic mobility – supportive materials – electro endosmosis – types (horizontal, vertical and two dimensional electrophoresis) - Principle and applications - paper electrophoresis, Serum electrophoresis, starch gel electrophoresis, Disc gel, Agarose gel, SDS – PAGE, Immuno electrophoresis. Blotting techniques -Southern, northern and western blotting.

Unit IV

Spectroscopic techniques: Principle, theory of absorption of light by molecules, electromagnetic spectrum, instrumentation and application of UV- visible, Raman, FTIR spectrophotometer, spectrofluorimetry, Atomic Absorption Spectrophotometer, Flame spectrophotometer, NMR, and GC-MS. Detection of molecules in living cells - FISH and GISH. Biophysical methods: Analysis of biomolecules by Spectroscopy UV/visible.

Unit V

Radioisotopic techniques: Principle and applications of tracer techniques in biology. Radioactive isotopes - radioactive decay; Detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, auto radiography and its applications. Commonly used isotopes in biology, labeling procedures and safety aspects.

Reference Books:

- Jayaraman J. (2011). Laboratory Manual in Biochemistry. (2nd Edition). Wiley Eastrn Ltd., New Delhi.
- Mitchell G. H. (2017). Gel Electrophoresis: Types, Applications and Research. Nova Science Publishers Inc.
- Chatwal G. R and Anand S. K. (2014.) Instrumental Methods of Chemical Analysis. Himalaya Publishing House.
- Ponmurugan P. and Gangathara P. B. (2012). Biotechniques. (1st Edition). MJP Publishers.
- Holme D. Peck H. (1998). Analytical Biochemistry. (3rd Edition). Prentice Hall.

Web Resources

- http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction- types-uses-and-other-details-with-diagram/12489
- https://www.watelectrical.com/biosensors-types-its-working-and-applications
- https://study.com/academy/lesson/what-is-chromatography-definition-types-uses
- https://norcaloa.com/BMIA

Course Designers:

1. **D**

   r. M. Karthikeyan- Assistant Professor

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credits
PBT23ET12	**Biostatistics**	Core Elective-II	4	-	-	4

L - Lecture T - Tutorial P – Practical

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

Preamble

The course strives to emphasize the understanding of inherent variation, bias, and uncertainty in sampling.

Prerequisites

Basic knowledge statistical concepts in biology

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	To define the basic concepts on biostatics, methods of collection and presentation of data.	**60**	**70**
CO2	Organize the data for appropriate statistical analysis.	**60**	**70**
CO3	Define the principal concepts of probability, Apply hypothesis testing to the data and make statistical decision.	**70**	**60**
CO4	Demonstrate proficiency in analyzing data using various statistical tools- correlation, regression and ANOVA	**70**	**60**
CO5	Apply statistical knowledge to design and conduct research studies Analyze data using excel	**60**	**70**

Mapping of COS with POs

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

S: Strong M: Medium L: Low

Mapping of COs with PSOs

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

Unit I

Definition, scope and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.

Unit II

Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, Quartile Deviation, standard deviation, standard error and coefficient of variation.

Unit III

Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.

Unit IV

Hypothesis testing: Null and alternate hypothesis,Student,,*t*‟‟ test - paired sample and mean difference,,*t*‟‟ tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.

Unit V

Chi-square test, Analysis of variance: one way and two way classification. CRD,RBD, LSD. Role of MS- office Excel in statistical analyses. Data analysis with comprehensive statistical software.

Text Books:

- Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
- Veer bala Rastogi. 2011. Fundamentals of Biostatistics. Ane books Pvt Ltd, Chennai.
- Khan., IA, Khanum, A. 2004 Fundamentals of Biostatistics second edition, Ukaaz publications, Hyderabad, Andhra Pradesh.India
- Arora, P.N and P.K.Malhan 2008. Biostatistics. Himalaya Publications, Mumbai.India

Reference Books:

- Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India.
- Rosner,B 2005. “Fundamentals of Biostatistics”, Duxbury Press.
- Warren,J; Gregory,E; Grant,R 2004. “Statistical Methods in Bioinformatics”,1st edition, Springer
- Milton,J.S.1992.. “Statistical methods in the Biological and Health Sciences”, 2nd edition ,Mc Graw Hill,
- Sundar Rao P. S.S., Jesudian G. & Richard J. 1987, “An Introduction to Biostatistics”, 2nd edition,. Prestographik, Vellore, India,.

Web Resources

- www.statsoft.com/textbook/ biosun1.harvard.edu/
- www.bettycjung.net/Statsites.htm
- www.ucl.ac.uk/statistics/biostatistics

Course Designers:

- **Dr. RM.Murugappan**

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23ST11	**IPR and Bioethics**	SEC-I	2	1	-	2

L – Lecture T – Tutorial P – Practicals

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

Preamble

The course provides the elemental concepts of bioethics, IPR, patent filling and infringement of biotechnological process and products. Impart knowledge on regulations and guidelines for the ethical treatment of animals and clinical trials.

Prerequisite

Basic knowledge on biology.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define the fundamental concepts of Patents, Trademarks and copyrights	**60**	**70**
CO2	Appraise the process of patent filing and licensing process	**60**	**70**
CO3	Categorize and implement the intellectual property law and policy.	**70**	**60**
CO4	plybioethics in GMO, food crops and its biodiversity	**70**	**60**
CO5	Outline the protocol for ethical and legal implications for GMOs	**60**	**70**

K1 – Knowledge K2 – Understand K3 – Apply K4 – Analyse K5 – Evaluate

Mapping of COs with POs

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

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	L	L	L
CO2	L	L	M	L	L
CO3	L	L	L	L	M
CO4	M	L	L	L	L
CO5	M	M	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: IPR and Bioethics

Unit-I

Intellectual Property Rights: Different forms of Intellectual Property Rights – their relevance, importance to industry, Academia. Role of IPR‟s in Biotechnology, Patent Terminology - Patents, trademarks, copyrights, industrial designs, geographical indications, trade secrets, non-disclosure agreements. International organizations and IPR - Overview of WIPO

Unit-II

Process involved in patenting. Patent Search - Procedural steps in patenting, process of filing, PCT application, pre-grant & post-grant opposition, patent databases and libraries, online tools, patent mapping

Unit III

Patentability of biotechnology inventions - Patentability of biotechnology inventions in India, statutory provisions regarding biotechnological inventions under the current Patent Act 1970 (as Amended 2005).

Unit IV

Introduction to bioethics - need of bioethics, applications and issues related to bioethics, social and cultural issues. Bioethics and biodiversity - conserving natural biodiversity, convention on protecting biodiversity, protocols in exchanging biological material across borders. Bioethics & GMO‟s

Unit V

Bioethics in medicine - Protocols of ethical concerns related to prenatal diagnosis, gene therapy, organ transplantation, xeno transplantation, ethics in patient care, informed consent. bioethics and cloning - permissions and procedures in animal cloning, human cloning,

Reference Books:

- Jecker, N.S., Johnson, A.R., and Pearlman R.A. 2011. Bioethics: An Introduction to history, methods and practice, Jones and Barlett Publishers.
- Manomy V. 2009 Animal Experimentation: A guide to the issues, Second edition, - Cambridge university press.
- Goel, D., and Parashar, S. 2013. IPR, Biosafety and Bioethics, First edition, Pearson Education, India.
- BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd.,

Web Resources

- http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf.
- https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
- https://bioethics.msu.edu/what-is-bioethics
- https://www.cdc.gov/training/quicklearns/biosafety/
- https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Course Designers:

Dr. M. Karthikeyan- Assistant Professor

THIAGARAJAR COLLEGE, MADURAI:: 9

An Autonomous Institution affiliated by Madurai Kamaraj University

(Re-Accredited with 'A^{++}' Grade by NAAC)

DEPARTMENT OF BIOTECHNOLOGY

(For those joined M.Sc., Biotechnology on or after June 2023)

Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23AT11	**Bio-Entrepreneurship**	AEC-I	2	1	-	2

L - Lecture T – Tutorial P – Practicals

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

Preamble

Provide fundamental concepts in the area of entrepreneurship, and the role and importance of entrepreneurship for economic development. It helps in personal creativity and entrepreneurial initiative, adopting the key steps in the elaboration of business ideas.

Prerequisite

Basic knowledge on plant science and biology

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Describe and apply several entrepreneurial ideas and business theories in practical framework.	**80**	**75**
CO2	Analyse the business environment in order to identify business opportunities, identify the elements of success of entrepreneurial ventures	**80**	**75**
CO3	Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides	**80**	**75**
CO4	Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits.	**80**	**75**
CO5	Integrate and apply knowledge of the regulation of biotechnology industries	**80**	**75**

K1 – Knowledge K2 – Understand K3 – Apply K4 – Analyze K5 –Evaluate

Mapping of COs with POs

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

S: Strong M: Medium L: Low

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	L
CO2	S	S	S	M	M
CO3	S	S	M	L	L
CO4	S	M	S	M	M
CO5	M	M	S	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)	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: Bio-entrepreneurship

Unit I

Bio-Entrepreneurship -traits of an entrepreneur in bio-business. Copyright, Patents, trademark, plant breeders and farmers‟ rights, biodiversity-related issues. Biopiracy.

Unit II

Entrepreneurship opportunity in agricultural biotechnology–Essential requirement, marketing strategies, challenges and scope. Herbal source:drug compounds, nutraceuticals, value-addedproducts,bioethanol production. Biosensor development in agri-management.

Unit III

Entrepreneurship opportunity in industrial biotechnology- Pollution monitoring and Bioremediation for Industrial pollutants. Integrated compost production - microbe enriched

compost. Bio pesticide/ insecticide production. Biofertilizers. Single-cell protein.

Unit IV

Therapeutic and Fermented products - Stem cell bank, production of monoclonal antibodies, bioactive secondary metabolite - antibiotics, probiotic and prebiotics products.

Unit V

Project and Technology Management and Startup Schemes in India (BIRAC, DBT, Incubation centers. etc.,). Indian Company act for biobusiness - schemes and subsidies. Project proposal preparation, Successful start-ups-case study.

Reference Books:

1. Crueger, W, and Crueger . A. (2017). Biotechnology: A Text Book of Industrial Microbiology. (2nd Edition). Medtech. ISBN-10 : 9385998633
2. Shimasaki C. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies- Academic Press. ISBN: 978-0-12-404730-3
3. Acton A. Q. (2021). Biological Pigments - Advances in Research and Application- (Scholarly Editions). Atlanta, Georgia. ISBN: 978-1-481-68574-0
4. Agarwal S., Kumari S. and Khan S. (2021). Bioentrepreneurship and Transferring Technology into Product Development. Business Science Reference . ISBN-10 : 1799874125
5. Anil Kumar (2020). Small Business and Entrepreneurship, Willey Distributions, Dream Tech Press.

Course Designers:

1. **Dr. M. Vijayasarathy**

THIAGARAJAR COLLEGE, MADURAI:: 9
An Autonomous Institution affiliated by Madurai Kamaraj University
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DEPARTMENT OF BIOTECHNOLOGY
(For those joined M.Sc.,Biotechnologyon or after June 2023)
Programme Code: PMB

Course Code	Course Title	Category	L	T	P	Credit
PBT23CT21	**Microbiology**	Core-III	4	-	-	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. Explains the significance of beneficial microbes and methods for the control of pathogenic microbes

Prerequisite

Basic knowledge on microbes, culture media, staining methods.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Acquire knowledge on the principles of different types of microscopes and their applications.	**80**	**75**
CO2	Compare and contrast the structure of bacteria. Illustrate nutritional requirements and growth in bacteria.	**80**	**75**
CO3	Exemplify, isolate and cultivate microalgae and fungi from diverse environmental sources.	**80**	**75**
CO4	Explain various pure culture techniques and discuss sterilization methods.	**80**	**75**
CO5	Discuss the importance and conservation of microbial diversity.	**80**	**75**

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: Microbiology

Unit I

History and scope of microbiology. Microscopy – Principles and applications. Types of Microscopes - Bright field, Dark-field, Phase-contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Sample preparation for SEM & TEM. 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). Numerical Taxonomy- 16S rRNA based classification. Bacterial identification methods. Ribotyping, Ribosomal Database Project.

Unit II

Bacterial Structure, properties and biosynthesis of cellular components – Internal structure- cell membrane, cell inclusions. Cell wall (Gram positive and Gram negative). External structure and chemical composition of -flagella, pili, capsules, sheaths, prostheca and cell wall (Gram positive and Gram negative).Sporulation. Growth and nutrition - Nutritional requirements, Growth curve, Kinetics of growth, Batch culture, Synchronous growth, Measurement of growth and factors affecting growth. Actinomycetes- Distribution, morphology, classification, reproduction and economic importance

Unit III

Algae - Distribution, morphology, classification (Fristch System), reproduction and economic importance. Isolation of algae from soil and water. Media and methods used for

culturing algae, Strain selection and large-scale cultivation. Life cycle - *Chlamydomonas*, *Volvox Spirogyra* (Green algae), *Nostoc.* (Cyanobacteria) *Ectocarpus, Sargassum* (Brown algae), *Polysiphonia, Batrachospermum* (Red algae). Fungi - Distribution, morphology, classification (Alexopoulos method), reproduction and economic importance- *Rhizopus*, *Saccharomyces*, *Agaricus* and *Fusarium*. Lichens - Structures and types.

Unit IV

Safety guidelines in Microbiology Laboratories. Sterilization- Physical and chemical agents. Disinfection and its validation. Staining methods – Simple, Differential and Special staining. Automated Microbial identification systems - Pure cultures techniques – Cultivation of Anaerobic organisms. Maintenance and preservation of pure cultures. Culture collection centres - National and International. Indicator microorganism for sterilization methods. Evaluation of antimicrobial chemical agents – MIC and MBC assays.

Unit V

Biodiversity - Introduction to microbial biodiversity – Thermophiles - Classification, Thermophilic Archaebacteria and its applications. Methanogens - Classification, Habitats, applications. Alkaliphiles and Acidophiles - Classification, discovery basin, its cell wall and membrane. Barophiles - Classification and its applications. Halophiles - Classification, discovery basin, cell walls and membranes – purple membrane, compatible solutes, Osmoadaptation / halotolerance - Applications of halophiles. Conservation of Biodiversity.

Reference Books:

- Tortora G. J., Funke B. R. and Case C. L. (2015). Microbiology: An Introduction (12th Edition).Pearson, London, United Kingdom
- 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 M. T., Bender K.S., Buckley D. H. Sattley W. M. and Stahl (2018) Brock Biology of Microorganisms. (15th Edition). Pearson.
- 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.

Online Resource:

- http://sciencenetlinks.com/tools/microbeworld
- https://www.microbes.info/
- https://www.asmscience.org/VisualLibrary

Course Designers:

1. Dr. A. Kanakalakshmi –Assistant professor

THIAGARAJARCOLLEGE, MADURAI::9
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DEPARTMENTOFBIOTECHNOLOGY
(For those joined M.Sc., Biotechnology on or after June2023)
Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credits
PBT23CT22	**Genetic Engineering**	Core-IV	4	-	-	4

L-Lecture T- Tutorial P– Practical

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

Preamble

Introduce the core principles of genetic engineering and applications including the basic tools, various vector system and manipulation techniques for industrial applications.

Prerequisite

Basic concepts of molecular biology and applications of biotechnology

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Focus the introduction and enzymes for genetic engineering	**60**	**70**
CO2	Illustrate the structure, types and functions of didifferent types of vectors in gene cloning	**60**	**70**
CO3	Explain the mechanism of gene cloning strategies and transformation techniques	**60**	**70**
CO4	Analyze the concepts of Selection, Screening, and analysis of recombinants	**60**	**70**
CO5	Compare the methods of basic Genetic Engineering Techniques for industrial application	**70**	**70**

Mapping of COs with POs

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

S: Strong M: Medium L: Low

Blooms Taxonomy

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

Title of the paper: Genetic Engineering

Unit I

Introduction and tools for genetic engineering-Enzymes - endo &exo nucleases, Restriction endonucleases- types, nomenclature, recognition sequences and mechanism of action; Isochizomers, Iso customers - star activity, Methylation, and modification. Ligases – types (NAD and ATP dependent), mechanism of action. Alkaline phosphatase, Reverse transcriptase - Taq polymerase.

Unit II

Different types of vectors-Cloning vectors: General characteristics of vectors, Brief account of naturally occurring plasmids. The promoter, MCS, Ori, and Marker genes-lac Z. Construction of pBR 322, pUC8, vectors, and Expression vectors, Bacteriophage vectors, Lambda phage, Insertion vectors, Replacement vectors, Cosmids, Phagemids, Mini chromosomes, BAC‟ s, YAC‟ s, Shuttle vectors, Ti plasmids, Vectors for animals-SV40 and Bovine papilloma virus.

Unit III

Gene cloning strategies and transformation techniques: Chimeric DNA, Cloning strategies- ligation, Transformation and selection, use of adaptors and linkers, Homopolymer tailing in cDNA cloning, genomic DNA libraries, Short gun method, Partial digestion, End modification, Cloning from mRNA- Isolation and purification of RNA, Synthesis of cDNA, Isolation of plasmids, Cloning cDNA in plasmid vectors, Cloning cDNA in bacteriophage vectors. cDNAlibrary. Transformation techniques by preparation of competent cells.

Unit IV

Selection, screening, and analysis of recombinants- Genetic selection- Insertional inactivation, Antibiotic Resistant genes, lac Z genes, Blue white screening, α - Complementation, colony hybridization, Immunological screening, Plaque hybridization, Blotting techniques, DNA sequencing - chemical and enzymatic methods, PCR and its variants, Preparation of radio labelled and non - radiolabelled probes and its applications.

Unit V

Applications of rDNA technology: Production of vaccines – Hepatitis B, Edible Vaccine, Hormones – Somatotropin, Humulin, Blood clotting factor VIII, Interferons, Diagnostics of inherited disorders and infectious diseases, Gene therapy, ADA- 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.

Webresources

- Meselson&Stahlexperiment-https://www.youtube.com/watch?v=yDQg7uXShUs
- Transcriptioninprokaryotes-https://www.youtube.com/watch?v=nJK-l7ByQAs
- Differencesin translation between prokaryotes and eukaryotes:https://www.youtube.com/watch?v=WNZf4ip_R9s
- https://www.biologydiscussion.com/genetics/engineering/genetic-engineering-history-molecular-tools-and-everything-else/9833
- https://www.bio-techne.com/reagents/antibodies/recombinant-antibodies

Course Designer

1. **Dr. K. Renugadevi–Assistant Professor**

THIAGARAJAR COLLEGE, MADURAI:: 9
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DEPARTMENT OF BIOTECHNOLOGY
(For those joined M.Sc.,Biotechnologyon or after June 2023)
Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23CL21	**Lab in Microbiology**	Core Lab III	-	-	4	2

L - Lecture T - Tutorial P – Practicals

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

Preamble

Provide practical knowledge on isolation, cultivation and characterization of microorganisms.

Prerequisite

Basic knowledge on sterilization techniques, characteristics of different microbes (Bacteria fungi, yeast and viruses) and types of media.

Course Outcomes

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

	Course outcomes	Expected Proficiency %	Expected Attainment %
CO1	Elaborate physical and chemical means of sterilization.Prepare various Culture media, for culturing different types of microbes.	70	75
CO2	Perform microbial techniques for isolation of pure cultures of bacteria, fungi and algae.	70	75
CO3	Comprehend the various methods for identification of unknown microorganisms.	60	75
CO4	Interpret the Microbiology techniques in research or internship activities.	70	75
CO5	Develops basic skills necessary to work in the microbiology laboratory or start a clinical lab.	70	75

K1 – Knowledge K2 – Understand K3 – Apply K4 – Analyze K5 – Evaluate

Mapping of COS with POs

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

Mapping of COS with PSOs

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

S: Strong M: Medium L: Low

Title of the Paper: Microbiology

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

Reference Books:

- Cappuccino, J.H. 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.
- Kannan, N. 1996. Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani.
- Aneja, K.R. (1993). Experiments in Microbiology: Plant Pathology and Tissue Culture, Wishwa Prakashan, New Delhi.

Course Designers:

1.

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THIAGARAJAR COLLEGE, MADURAI:: 9
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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23CL22	**Lab in Genetic Engineering**	Core Lab IV			4	2

L - Lecture T – Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	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 genetic engineering

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	70
CO2	alyze the restriction endonuclease activity and its significance	70	80
CO3	Demonstrate the procedures of gene cloning and PCR analysis	60	70
CO4	Execute thecloning technologies to elucidategenetic issues	70	60
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 Genetic Engineering

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 / p Bluescript – 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 ofDiagnostic 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 andMcCartney Practical Medical Microbiology, 14th Edn. Churchill Livingstone,London.

Web Resources

- Protoplast Fusion: https://www.youtube.com/watch?v=utlKKvqxbWw
- Demonstration of T4 DNA Ligation: https://www.youtube.com/watch?v=51brWA7j-OU
- Acrylamide gel electrophoresis and silver stainingprocedure: https://www.technologynetworks.com/analysis/articles/polyacrylamide-gel-electrophoresis-how-it-works-technique-variants-and-its-applications-359100
- Cloning of DNA fragment-https://www.youtube.com/watch?v=26SoY5obNxs
- WesternBlotting analysis-https://www.youtube.com/watch?v=-Zchea9xGT0

Course Designer:

1. Dr. K. Renugadevi – Assistant Professor

THIAGARAJAR COLLEGE, MADURAI:: 9
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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23ET21	**Environmental Biotechnology**	Core Elective-III	4	-	-	4

L - Lecture T - Tutorial P – Practical

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

Preamble

Elaborates basic knowledge and understanding about the functions of ecosystem and reduction of pollution by biotechnological tools.

Prerequisite

Basic knowledge on ecology and pollution

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Explain various waste management methods	**80**	**75**
CO2	Classify potential methods of biodegrading organic pollutants.	**80**	**75**
CO3	Examine the techniques involved in remediation of polluted environments	**80**	**75**
CO4	Assess types of pollution & its control	**80**	**75**
CO5	Compile biotechnological approaches to degrade xenobiotic compounds	**80**	**75**

Mapping of COS with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	L	M	L	M	L
CO2	S	S	S	L	M	M	L
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	L
CO3	S	S	M	L	M
CO4	S	S	L	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: Environmental Biotechnology

Unit I

Environment: Basic concepts and issues; Environmental management and Conservation, Environmental Laws & Agencies involved in conservation. Environmental Pollution: Types of pollution & its control strategies -Air pollution, Soil pollution, Water pollution, Oil pollution & Radioactive pollution

Unit II

Biofilm Kinetics: Completely mixed biofilm reactor-Soluble microbial products and inert biomass-Special-case biofilm solution. Reactor types:- batch reactor - continuous-flow stirred-tank reactor- Plug-flow reactor. Engineering design of reactors- Reactors in series

Unit III

Waste water management, source of waste water, Waste water treatment- physical, chemical and biological treatment. Microbiology of Waste water; Aerobic and anaerobic process, BOD and COD.

Unit IV

Toxicity: Types and Test for evaluating Toxicity. Biosensors, Biomonitoring of toxic materials. Biomagnification, Biomining and Biofuels

Unit V

Bioremediation; *In-situ and Ex-situ* Bioremediation of contaminated soils and waste land; Microbiology of degradation of Xenobiotics in environment; Pesticides, Surfactants, Degradative plasmids. Solid waste: Composting, Vermiculture and methane production.

Reference Books:

- Gareth M. Evans, Gareth G. Evans, Judy Furlong 2011
- Environmental biotechnology: theory and application John Wiley & Sons, Ltd. West Sussex, UK
- M. Moo-Young, W.A. Anderson, A.M. Chakrabarty, 2010. Environmental Biotechnology: Principles and Applications. Springer.
- M. H. Fulekar, 2010 Environmental Biotechnology, by Science Publishers Department of Life Sciences, University of Mumbai, India,
- Stanley E. Manahan, 2009. Environmental Chemistry, Ninth Edition, CRC Press.
- Environmental chemistry 5th edition by A.K.De. 1997.
- Bruce E. Rittmann and Perry L. McCarty. 2001. Environmental Biotechnology :Principles and applications. McGraw Hill, Newyork.

Online Resource:

- lbewww.epfl.ch/LBE/Default_E.htm
- http://lbe.epfl.ch

Course Designers:

1. Dr. A. Kanakalakshmi –Assistant professor

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DEPARTMENTOFBIOTECHNOLOGY
(ForthosejoinedM.Sc.,Biotechnology onorafter June2023)
ProgrammeCode: PBT

CourseCode	CourseTitle	Category	L	T	P	Credits
PBT23ET22	Plant and Animal Biotechnology	Core Elective IV	4	-	-	4

L-Lecture **T- Tutorial** **P– Practical**

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

Preamble

Explore the comprehensive knowledge about the applications of plant and animal Molecular biotechnology for increasing agricultural production, environment improvement, human, nutrition and health.

Prerequisites

Basic concepts of molecular biotechnology and applications in industrial improvement

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Illustrate the basic concepts in Plant and Animal biotechnology	**60**	**70**
CO2	Explain the mechanism of animal cell culture techniques	**60**	**70**
CO3	Explain the mechanism of animal cell culture techniques	**60**	**70**
CO4	Analyze the concepts of Industrial applications of animal reproductive biotechnology	**60**	**70**
CO5	Compare the methods of gene transfer mechanism and its significance in plant gene manipulation	**70**	**70**

Mapping of Cos with POs

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

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: Plant and Animal Biotechnology

Unit I

Basics in Plant and Animal biotechnology - Plant biotechnology constituents and concepts of sterilization – media preparation – nutrients and plant hormones; sterilization techniques; isolation and selection of explant, totipotency; organogenesis; Somatic embryogenesis; establishment of cultures.

Animal biotechnology-equipment and media used for animal cell culture technology. Primary and established cell line culture and culture media. Applications of animal cell cultures. Serum protein media viability and cytotoxicity.

Unit II

Plant tissue culture: Suspension cell culture, callus culture, micropropagation; soma clonal variation; androgenesis and its applications in genetics and plant breeding; germplasm conservation and cryopreservation; synthetic seed production; protoplast isolation, culture & fusion. Anther and pollen culture for production. somatic hybridization - methods and applications; cybrids and somatic cell genetics; plant cell cultures for secondary metabolite production.

Unit III

Animal cell culture: brief history of animal cell culture; cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, continuous cell lines, suspension cultures; application of animal cell culture for virus isolation and in vitro testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

Unit IV

Animal reproductive biotechnology-Animal reproductive biotechnology: structure of sperms and ovum; cryopreservation of sperms and ova of livestock; artificial insemination; super ovulation, embryo recovery and in vitro fertilization; culture of embryos; cryopreservation of embryos; embryo transfer technology; transgenic manipulation of animal embryos; applications of transgenic animal technology; animal cloning - basic concept, cloning for conservation endangered species. Testing of drugs, testing the toxicity of environmental pollutants in cell culture, Cytotoxicity, Apoptosis, Tissue, Diagnostic antigens. Human Gene Therapy.

Unit V

Biotechnology in Plant Manipulation: Agrobacterium-plant interaction; virulence; Ti and Ri plasmids; opines and their significance; T-DNA transfer; Genetic transformation - Agrobacterium-mediated gene delivery; cointegrate and binary vectors and their utility; direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods; screenable and selectable markers; characterization of transgenics; chloroplast transformation; marker-free methodologies; advanced methodologies - cisgenesis, intragenesis and genome editing; molecular pharming - concept of plants as biofactories, production of industrial enzymes and pharmaceutically important compounds. Application of transgenesis for crop improvement: Insect resistance, disease a n d virus resistance.

Reference Books:

- Razdan. M. K., 2011. Plant tissue culture. Oxford and IBH publishing Company Pvt. Ltd, New Delhi.
- Chawla. H. S., 2010. Introduction to plant biotechnology. Oxford and IBH publishing company pvt. Ltd, New delhi.
- Ian Freshney, 2010. Culture of animal cells. 6th edition, Wiley-Blackwell publishers.
- Slater, 2008. Plant Biotechnology: The Genetic manipulation of plants, Second Edition, Oxford University Press, USA.
- J.D.Watson, Gillman, J.Witknowski and M.Zoller, 2006. Recombinant DNA. 3rd ed.
- W.H.Freeman. 26 K. Dass. 2005, Text book of Biotechnology, Second Edition, Wiley Dreamtech, India (P) Ltd.

WebResources:

- https://pravara.in/wpcontent/themes/twentyseventeen/essentials/pdf/elearn/Principles-of-Plant-Biotechnology.pdf
- https://www.deshbandhucollege.ac.in/pdf/resources/1589512953_Z(H)-VI-Biotech-4.pdf
- http://www.lscollege.ac.in/sites/default/files/Plant%20Tissue%20culture.pdf

CourseDesigners:

1. **Dr. K. Renugadevi–Assistant Professor**

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23ST21	**Diary Technology**	SEC-II	2	1	-	2

L - Lecture T - Tutorial P – Practical

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

Preamble

Provide comprehensive knowledge on ofbasic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety

Prerequisite

Basic knowledge on chemistry and biology

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Acquire themicrobialknowledge inmilk	**80**	**75**
CO2	Tolearntheprocessingof milkmicrobiologicalmethods	**80**	**75**
CO3	Outline the quality of milk products in dairy industry	**80**	**75**
CO4	Analyse and differentiatethetraditionalandindustrialmake dairyproductsanditsprocessing	**80**	**75**
CO5	Provides knowledge about the milk borne diseases	**80**	**75**

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: Dairy Technology

Unit I

Common microbes in milk and their significance. Sources of microbial contamination of raw milk in influencing quality of milk during production, collection, transformation and storage.

Unit II

Microbiological processing techniques: bactofugation, thermization, pasteurization, sterilization, boiling, UHT, non-thermal processes and membrane filtration of milk role of psychrophilic mesophilic, thermophilic and thermoduric bacteria in spoilage of processed milks and prevention microbiological standards (BIS/PFA) of heat treated fluid milks.

Unit III

Microbiological quality of dairy products; fat rich (cream and butter), frozen (ice cream), concentrated (evaporated and condensed milk), dried milks (roller and spray dried), infant dairy foods and legal standards. Factors affecting microbial quality of these products during processing, storage and distribution.

Unit IV

Microbiology quality of traditional dairy products; heat desiccated (khoa, burfi), acid coagulated(paneer), fermented (lassi)and frozen (kulfi). Sources of microbial contaminants and their role in spoilage.

Unit V

Milk-borne diseases–viral and bacterial, zoonotic infections, pathogens associated with fluids milks, dairy products and their public health significance. sources of pathogens and their prevention. Regulatory control of dairy products, testing of milk and milk products, treatment of dairy wastes.

Reference Books:

- Hobbs BC and Roberts D. (1993) food poisoning and food hygiene, Edward Arnold (adivision of Hodder and Stoughton), London.
- May JM.(1987) Modern food microbiology, CBS publishers and distributors, New Delhi.
- Robinson RK. (1990).The microbiology of milk. Elsevier Applied Science.London
- Edward Harth, J.T.Steele. (!998) Applied dairy microbiology. MarcelDeekerInc.
- Modi, HA(2009) Dairy microbiology. Pointer publishers, India. Marth, E. Handsteel

Course Designers:

1. Dr. A. Kanakalakshmi –Assistant professor

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT23AT21	**Pharmaceutical Biotechnology**	AECC-II	2	1	-	2

L - Lecture T - Tutorial P – Practical

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

Preamble

Elaborates a basic knowledge and understanding about the pharmaceutical products produced based on biotechnological methods and its biomedical applications.

Prerequisite

Basic knowledge on biology and chemistry

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Explain the basic components of pharmaceutical and biotechnology industry and methods and applications of biosensor	**80**	**75**
CO2	Describe the Scientific, technical and economic aspects of vaccine & rDNA technology	**80**	**75**
CO3	Enlightens the basic concepts of protein Engineering, therapeutic proteins and enzyme immobilization techniques	**80**	**75**
CO4	Elaborates the concepts of hybridoma technology, microbial biotransformation and microbial bio-transformed products	**80**	**75**
CO5	Explain the basic components of somatic gene therapy, Xeno-transplantation and fermenter and bio safety methods	**80**	**75**

Mapping of COS with POs

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

Mapping of COS with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	S	L
CO2	S	S	S	L	L
CO3	S	S	M	L	M
CO4	S	S	L	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: Pharmaceutical Biotechnology

Unit I

Introduction to concepts and technologies in pharmaceutical biotechnology and industrial applications, Biosensors- Working and applications of biosensors in pharmaceutical Industries; Pharmacology and Ethnopharmacology: Scope, applications and Importance.

Unit II

Scientific, technical and economic aspects of vaccine research and development, Preparation of bacterial vaccines, toxoids, viral vaccine and antitoxins, Storage conditions and stability of vaccines, Recombinant DNA technology, Application of rDNA technology and genetic engineering in the production of: Hormones – Insulin, Brief introduction to Protein Engineering, Therapeutic proteins, Production of Enzymes- General consideration – Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase, Methods of enzyme immobilization and applications

Unit III

Hybridoma technology - Production, Purification and Applications, Formulation of biotech products - Rituximab, Introduction to Microbial biotransformation and applications, Study of the production of – penicillin, citric acid, Vitamin B12, Glutamic acid and Griseofulvin Somatic gene therapy, Xenotransplantation in pharmaceutical biotechnology, Large scale production fermenter design and its various controls, Bio safety in pharmaceutical industry

Unit IV

Pharmacological activity of Plant drugs, Plant Chemicals in modern pharmacology; biochemistry and pharmacology of atropine, caffeine, ephedrine, opioids, taxol, vinca alkaloids, synthetic substitutes for therapeutically active plant constituents; drug improvement by structure modification and bio-transformation. Criteria for pharmacological evaluation of drugs.

Unit V

Clinical Pharmacology, Drug therapy, therapeutic situation, benefits and risk of use of drugs, Mechanism of drug action, Therapeutic efficacy, Therapeutic index, tolerance, dosage forms and routes of drug action , factors affecting drug action; Adverse Drug reactions and drug poisoning-classification and causes of ADR; principle clinical manifestations and treatment of ADR, General principles of management of drug poiosoning; antidotes, classisfication of drugs..

Reference Books:

- Harbans lal, 2011. Pharmaceuticals biochemistry. CBS Publishers and distributors Pvt. Ltd, Chennai.
- Carlos A. Guzmán and Giora Z. Feuerstein, 2009. Pharmaceutical Biotechnology, 1st edition, Springer.
- Daniel Figeys (Ed.). 2005. Industrial Proteomics: Applications for Biotechnology and Pharmaceuticals. Wiley, John & Sons, Incorporated.
- Kayser, O and Muller R.H.. 2004. Pharmaceutical Biotechnology Drug Discovery and Clinical Applications. WILEY-VCH
- Leon Shargel, Andrew B. C. Yu, Susanna Wu-Pong, and Yu Andrew B. C. 2004. Applied Biopharmaceutics & Pharmacokinetics. McGraw-Hill Companies

Online Resource:

- https://tugasakhirsttifbogor.files.wordpress.com/2018/08/pharmaceutical-biotechnology.pdf
- http://library.nuft.edu.ua/ebook/file/Gad2007.pdf
- https://oasis.iik.ac.id:9443/library/repository/a932eb462c49885a2c72755977036b81.pdf

Course Designers:

1. Dr. A. Kanakalakshmi –Assistant professor