Thiagarajar College

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

Thirty Eighth Academic Council Meeting

M.Sc. Biotechnology

Dr. Rm. Murugappan
Dean – Curriculum Development

M.Sc., Biotechnology

Programme Code : PBT

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

Knowledge

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

Complementary skills

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

Applied learning

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

Communication

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

Problem solving

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

Environment and sustainability

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

Teamwork, collaborative and management skills.

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

THIAGARAJAR COLLEGE, MADURAI – 9.

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

M.Sc., Biotechnology

Vision:

To achieve excellence in teaching, training, research and innovation in biotechnology

Mission:

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

Program Educational objectives (PEO):

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

PEO1	Equipped with the comprehensive knowledge on biotechnological principles and concepts
PEO2	Able to choose and apply appropriate tools and techniques in life science
PEO3	Competent to implement biotechnological concepts in addressing local, regional and global needs
PEO4	Capable of planning, formulating, executing and managing projects in various domains of biotechnology
PEO5	Enriched with various techniques, skills and approaches, which expands the employment, innovation and bioentrepreneurial opportunities

Program Specific Outcomes (PSOs):- M.Sc., Biotechnology

On completion of M.Sc., Biotechnology programme, the students will be:

PSO1	Distinguish the characteristics and diversity of microbes
PSO2	Exhibit proficiency in the concepts of microbiology, biochemistry, molecular biology, biotechnology, immunology and computational biology.
PSO3	Elucidate the components of environmental, rural and entrepreneurial biotechnology
PSO4	Demonstrate the principles, operation and applications of various bioinstruments
PSO5	Evaluate ethical and environmental issues in recombinant research

THIAGARAJAR COLLEGE (AUTONOMOUS):: MADURAI – 9
(Re-Accredited with 'A' Grade by NAAC)
NATIONAL CENTRE OF EXCELLENCE
M.Sc., BIOTECHNOLOGY: Programme Code:PMB
(Revised syllabus from 2019 – 20 batch onwards)

Course Structure

Semester – I

Course	Code	Title of the paper	Cont Hrs/ W	Cre-dits	Tot Hrs	Max Mks CA	Max Mks SE	Tot
Core 1	PBT19 C11	General Microbiology	5	4	75	25	75	100
Core 2	PBT19 C12	Biochemistry	5	4	75	25	75	100
Core 3	PB19 C13	Cell and Molecular Biology	5	4	75	25	75	100
Elective 1	PBT19 CE11 (A/B)	Bioinstrumentation / Clinical lab technology	5	4	75	25	75	100
Lab	PBT19 CL11	Lab in General Microbiology & Cell biology	5	3	75	40	60	100
Lab	PBT19 CL12	Lab in Biochemistry & molecular biology	5	3	75	40	60	100
			30	22				

Semester – II

Course	Code	Title of the paper	Cont Hrs/ W	Cre-dits	Tot Hrs	Max Mks CA	Max Mks SE	Tot
Core 4	PBT19 C21	Genetic engineering	5	4	75	25	75	100
Core 5	PBT19 C22	Plant Biotechnology	5	4	75	25	75	100
Core 6	PBT19 C23	Animal Biotechnology	5	4	75	25	75	100
Elective 2	PBT19 CE21 (A/B)	Genetics /Developmental Biology	5	4	75	25	75	100
Lab	PBT19 CL21	Lab in Genetic Engineering	5	3	75	40	60	100
Lab	PBT19 CL22	Lab in Plant and Animal Biotechnology	5	3	75	40	60	100
			30	22				

Semester – III

Course	Code	Title of the paper	Cont Hrs/ W	Cre-dits	Tot Hrs	Max Mks CA	Max Mks SE	Tot
Core 7	PBT19 C31	Immunology & Immunotechnology	5	4	75	25	75	100
Core 8	PBT19 C32	Forensic science and bioinformatics	5	4	75	25	75	100
Core 9	PBT19 C33	Biostatistics and Mathematical Modelling	5	4	75	25	75	100
Elective 3	PBT19 CE31(A/B)	Health care biotechnology / Food processing technology	5	4	75	25	75	100
Lab	PBT19 CL31	Lab in Immunology & Immunotechnology	5	3	75	40	60	100
Lab	PBT19 CL32	Lab in Bioinformatics and Biostatistics	5	3	75	40	60	100
			30	22				

Semester – IV

Course	Code	Title of the paper	Cont Hrs/ W	Cre-dits	Tot Hrs	Max Mks CA	Max Mks SE	Tot
Core 10	PBT19 C41	Bioprocess technology	5	4	75	25	75	100
Core 11	PBT19 C42	Rural and entrepreneurial biotechnology	5	4	75	25	75	100
Core 12	PBT19 C43	Project	5	6	75	25	75	100
Elective 4	PBT19 CE41(A/B)	Environmental Biotechnology / Nanobiotechnology	5	4	75	40	60	100
Lab	PBT19 CL41	Lab in Bioprocess technology and environmental biotechnology	5	3	75	40	60	100
Lab	PBT19 CL42	Lab in Rural and Entrepreneurial biotechnology	5	3	75	40	60	100
			30	24		40	60	100

Consolidated of contact hours and credits

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

Thiagarajar College (Autonomous):: Madurai – 625 009

Department of Biotechnology
(For those joined on or after June 2019)
Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C11	General Microbiology	Core – 1	4	1	-	4

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

Preamble

The course will provide knowledge on the systematic position, diversity, basic characteristics and biology of microorganism

Prerequisite

Knowledge about the basic characteristics and biology of microorganism will make to easy understanding steps to this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Classify microorganisms based on their characteristics	K1,K2
CO2	Explicate the methods of sterilization and control of microorganism	K2, K3
CO3	Describe internal and external structural features of bacteria	K1, K4
CO4	Acquire the knowledge on structure and life cycle of various host specific phages	K2, K5
CO5	Depict the morpho-biology of selected fungi and algae	K2, K4

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

Mapping of Course Outcomes with Programme Specific Outcomes

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	**Continuous Assessment**		**End of Semester Marks**
	I Internal Marks	**II Internal Marks**	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: General Microbiology

Unit 1: History and scope of microbiology; Characteristics of microorganisms - Morphological, chemical, cultural, metabolic, antigenic, genetic, pathogenicity and ecological; Microbial classification (Bergy's manual of Systematic Bacteriology), nomenclature and identification

Unit 2: Preparation of solutions and media. Principles, functioning and types of Biosafety cabinets; Common hazards in the laboratory - Electrical equipments, chemicals (corrosive, irritant, toxic, flammable, explosive), Ionizing radiations, Infectious materials, gas and fire. Safety measures – In the use of equipments and gas facility; Personal protection, Waste disposal, First aid

Control of microorganisms - Physical agents and chemical agents; conditions influencing antimicrobial action; Evaluation of antimicrobial chemical agents

Unit 3: Morphology and structure of bacteria - size, shape and arrangement of bacterial cell; External structure and chemical composition of - flagella, pili, capsules, sheaths, prostheca and cell wall (Gram positive and Gram negative); Internal structure - cell membrane, cell inclusions-carbon storage polymers, polyphosphate, sulphur, minerals, magnetosomes, gas vesicles and carbonate; Formation of endospores

Unit 4: Outline classification of viruses; Structure and life cycle of viruses- bacterial virus (T4 and Lamda), Animal virus (Pox, Influenza, Adeno), Plant virus (TMV and CaMV), Insect virus (Baculovirus). Mycophages and cyanophages.

Unit 5: Outline classification of fungi and algae; Distribution, importance, structure, nutrition and reproduction of fungi - *Physarum, Rhizopus, Saccharomyces, and Fusarium*; Algae - *Chlamydomonas, Chrysamoeba, Sargassum, Gellidium*; Lichens - Structures and types

Text books:

1. Pelczar, M.J., Schan, E.C. and Kreig, N.R. 2011. Microbiology – An application based approach, V Edn., Tata McGraw Hill Education Pvt. Ltd., New Delhi.

2. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, VII Edn., McGraw Hill, New York.

Reference Books:

1. Alcamo, I.E. 2001. Fundamentals of Microbiology, VI Edn. Addison Wesley Longman, Inc. California.
2. Alexopoulus, E.J., Mims, C.W. and Blackwell, M. 2010. Introductory Mycology, V Edn. John Wiley and Sons, New York.
3. Ananthanarayanan, R. and Paniker, C.K.J. 2009. Textbook of Microbiology. University Press (India) Pvt. Ltd., Hyderabad.
4. Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
5. Cappuccino, G.J. and Sherman, N. 2005. Microbiology – A laboratory manual. VII Edn., Pearson Education Inc., New York.
6. Davis, B.D., Duelcco, R., Fisen, H.N. and Ginsberg, H.S. 1990. Microbiology, IV Edn, Harper & Row Publishers, Singapore.
7. Kreig, N.R. 2012. Bergey's Manual of Systematic Bacteriology Springer Verlag, New York.
8. Madigan, M.T., Martinka, M.J., Dunlap, P.V. and Clark, D.P. 2009. Brock Biology of Microorganisms. XII Edn. Pearson Education Inc., New York.
9. Rangaswami, G. and Bagyaraj, D.J. 2009. Agricultural Microbiology. II edn. PHI Learning Pvt. Ltd., New Delhi.
10. Salle, A.J. 1996. Fundamental Principles of Bacteriology, Tata McGraw Hill Publishing Company, New Delhi.
11. Tortora G.J., Funke, B.R. and Case, C.L.2011. Microbiology An introduction, IX Edn., Pearson Education Inc., New York.

Course designer(s): Mr. S. Kulandaivel and Dr. N. Arun Nagendran

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	History and scope of microbiology	3
1.2	Characteristics of microorganisms - Morphological, chemical, cultural, metabolic, antigenic, genetic, pathogenicity and ecological	5
1.3	Microbial classification (Bergy's manual of Systematic Bacteriology), nomenclature and identification.	5
Unit II		

2.1	Preparation of solutions and media. Principles, functioning and types of Biosafety cabinets.	3
2.2	Common hazards in the laboratory - Electrical equipments, chemicals (corrosive, irritant, toxic, flammable, explosive), Ionizing radiations, Infectious materials, gas and fire.	4
2.3	Safety measures – In the use of equipments and gas facility; Personal protection, Waste disposal, First aid.	5
2.4	Control of microorganisms - Physical agents and chemical agents; conditions influencing antimicrobial action; Evaluation of antimicrobial chemical agents.	6
Unit- III		
3.1	Morphology and structure of bacteria - size, shape and arrangement of bacterial cell.	3
3.2	External structure and chemical composition of - flagella, pili, capsules, sheaths, prostheca and cell wall (Gram positive and Gram negative).	5
3.3	Internal structure - cell membrane, cell inclusions-carbon storage polymers, polyphosphate, sulphur, minerals, magnetosomes, gas vesicles and carbonate.	5
3.4	Formation of endospores.	3
Unit IV		
4.1	Outline classification of viruses; Structure and life cycle of viruses- bacterial virus (T4 and Lamda).	3
4.2	Animal virus (Pox, Influenza, Adeno)	5
4.3	Plant virus (TMV and CaMV)	4
4.4	Insect virus (Baculovirus). Mycophages and cyanophages.	4
Unit V		
5.1	Outline classification of fungi and algae; Distribution, importance, structure, nutrition and reproduction of fungi - *Physarum, Rhizopus, Saccharomyces, and Fusarium.*	6
5.2	Algae - *Chlamydomonas, Chrysamoeba, Sargassum, Gellidium*; Lichens - Structures and types.	5

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Biotechnology
(For those joined in or after June 2019) Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C12	Biochemistry	Core – 1	4	1		4

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

Preamble

The course will provide knowledge on the classification, structure, organization, properties and functions of biomolecules.

Prerequisite

Knowledge about the classification and structure of biomolecules will make to easy understanding steps to this course.

Course outcomes

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

#	Course Outcome	Knowledge Level (Bloom's Taxonomy)
CO1	Classify carbohydrates based on their structure, characteristics and various metabolic pathways	K1, K2
CO2	Describe the structure, properties and metabolism of amino acids and proteins	K2, K3
CO3	Acquire the knowledge on categorization, structure and catabolism of lipids	K1, K3
CO4	Explicate classification of enzymes & mechanism of their action	K1, K2
CO5	Appreciate the structure, biosynthesis, degradation of nucleic acids; types, properties and deficiency of vitamins	K2, K4

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

Mapping of COs with Pos

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Unit 1. Carbohydrates: Classification - structure and properties of monosaccharides (glucose, fructose) and disaccharides (lactose, maltose, sucrose). Properties of polysaccharides – starch and cellulose

Metabolism of carbohydrates: Glycolysis, Kreb's cycle, hexose monophospate shunt, Entner Doudroff pathway, Gluconeogenesis, Glycogen metabolism

Unit 2. Amino Acid: Classification based on structure and polarity; physical properties and chemical reactions, biological importance; an over view of aminoacids biosynthesis.

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

Unit 3. Lipids: Classification, structure, properties and biological importance; Metabolism of lipids - α, β and omega oxidation of fatty acids; ornithine and uric acid mechanism and significance of lipid peroxidation.

Unit 4. Enzymes: Classification, mechanism of enzyme action; Enzyme kinetics – Michaelis Menten equation, Lineweaver Burk plot. Factors influencing enzyme activity; enzyme inhibitors/activators, active site, allosteric enzyme; coenzyme, isozyme, ribozyme and abzyme.

Unit 5. Nucleic acids: Structure, synthesis and degradation of purines and pyrimidines. Vitamins: Types and properties of vitamins – Water soluble vitamins (B, C) and fat soluble vitamins (A, D, E & K), deficiency diseases of vitamins

Text books:

1. Mckee, T. and Mckee, R.K. 1996. Biochemistry and Introduction, Won.C.Brown Publishers, London

2. Deb, A.C. 2011. Fundamentals of Biochemistry, X Edn., New Central Book Agency Pvt. Ltd., Kolkata.

Reference books:

1. Berg J. M., Tymoczko J. L., Stryer L., Biochemistry, V Edn., W. H. Freeman and Company, New York.
2. Bose, S. 1982. Elementary Biophysics. Vijaya Printers, Madurai.
3. Boyer R., Modern experimental Biochemistry, III Edn., Pearson education publication, Singapore.
4. Campbell and Farrell 2008. Biochemistry Cengage Learning India (P) Ltd. New Delhi.
5. Casey, E.J. 1969. Biophysics – Concepts and mechanism. East West Press. New Delhi.
6. Conn, E.E., P.K.Stumpf, G.Bruening and R.H.Doi, 1999. Outline of Biochemistry, John Wiley & Sons Inc., New York.
7. Devlin, T. 2006. Text Book of Biochemistry, VI Edn., Wiley-Liss, USA.
8. Jain, J.L., Sunjay Jain and Nitin Jain. 2010. Fundamentals of Biochemistry, V Edn., S. Chand and Company Ltd, NewDelhi.
9. Jayaraman, J. 2007. Laboratory Manual in Biochemistry, New Age International (P) Limited Publishers, New Delhi.
10. Morris, J.G. 1974. A Biologist's physical chemistry. II Edn. Edward Arnold – A division of Holder and Stoughton, London.
11. Murray, R.K., Granner, D.K. and Rodwell, V.W. 2006. Harper's Illustrated Biochemistry. XXVII Edn. McGraw Hill Publications. New Delhi.
12. Nelson, D.L., and Cox, M.M. 2010, Lehninger Principles of Biochemistry, V Edn., Worth Publishers, New York.
13. Ramarao, A.V.S.S. and Suryalakshmi, A 2009. Textbook of Biochemistry for Medical Students, 11th UVS Publishers Distributors Pvt. Ltd., New Delhi.
14. Rastogi, S.C.2010. Biochemistry, III Edn., Tata McGraw Hill Edition, New Delhi.
15. Satyanarayana, U. and Chakrapani, U. 2010. Biochemistry, Books and Allied Pvt. Ltd., Kolkata.
16. Shanmugam, A. 1998, Fundamentals of Biochemistry for Medical students, Published by the Author, Madras.
17. Stryer, L., 2000. Biochemistry, IV Edn. W.H. Freeman and Company, New York.
18. Voet, D. and J.G.Voet, 1995, Biochemistry, II Edn. John Wiley & Sons Inc, New York.
19. Zubay, G. 1993, Biochemistry, third edition Won.C.Brown Communications Inc., Oxford, England

Course designer(s):

Dr. M. Karthikeyan

Dr. C. Ravi

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Carbohydrates: Classification -structure and properties of	5

	monosaccharides (glucose, fructose) and disaccharides (lactose, maltose, sucrose).	
1.2	Properties of polysaccharides – starch and cellulose	3
1.3	Metabolism of carbohydrates: Glycolysis, Kreb's cycle, hexose monophospate shunt, Entner Doudroff pathway,	5
1.4	Gluconeogenesis, Glycogen metabolism	5
Unit II		
2.1	Amino Acid: Classification based on structure and polarity.	3
2.2	physical properties and chemical reactions, biological importance; an over view of aminoacids biosynthesis.	4
2.3	Protein: Classification, physical and chemical properties.	4
2.4	Structure – primary, secondary (Ramachandran plot), tertiary and quaternary structure of proteins – structure and biosynthesis of haemoglobin and myoglobin.	6
Unit- III		
3.1	Lipids: Classification, structure, properties and biological importance.	4
3.2	Metabolism of lipids - α, β and omega oxidation of fatty acids.	4
3.3	Ornithine and uric acid mechanism and significance of lipid peroxidation.	4
Unit IV		
4.1	Enzymes: Classification, mechanism of enzyme action.	3
4.2	Enzyme kinetics – Michaelis Menten equation, Lineweaver Burk plot.	4
4.3	Factors influencing enzyme activity; enzyme inhibitors/activators, active site, allosteric enzyme.	4
4.4	coenzyme, isozyme, ribozyme and abzyme.	4
Unit V		
5.1	Nucleic acids: Structure, synthesis and degradation of purines and pyrimidines.	5
5.2	Vitamins: Types and properties of vitamins – Water soluble vitamins (B, C) and fat soluble vitamins (A, D, E & K),	4
5.3	Deficiency diseases of vitamins.	5

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C13	**Cell and Molecular Biology**	Core - 1	4	1		4

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

Preamble

The course will provide knowledge on the structure and functions of cell and cell organelles, expression of genes.

Prerequisite

Knowledge about the basic structure and function of cell will make to easy understanding steps to this course.

Course outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Describe the organisation of plant and animal cells.	K1, K2
CO2	Enlighten various signalling pathways, apoptosis and characteristics of cancer cells.	K2, K3
CO3	Elucidate the types, damage and repair of DNA, types of RNAs, genetic code.	K1, K3
CO4	Explicate the mechanism of gene regulation in prokaryotes.	K1, K5
CO5	Understand the concept of gene expression in eukaryotes	K4, K3

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

Mapping of COs with POs

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

S-Strong M- Medium L-Low

Blooms Taxonomy			
Category	**Continuous Assessment**		**End of Semester Marks**
	I Internal Marks	**II Internal Marks**	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper : Cell and Molecular Biology

Unit 1. Structure of plant and animal cells; Cell theory, Cell types; Structure and functions of Plasma membrane, nucleus, endoplasmic reticulum, golgi complex, mitochondria, plastids, ribosomes, lysosomes; Structural organization of chromosomes and giant chromosomes

Unit 2. Cell cycle, mitosis and meiosis; Cell migration and Cell-cell interaction; Cell signalling - G-protein coupled and TGFβ receptor system, JAK/STAT, Ras and MAP kinase pathway, Cell ageing, Cell death and its regulation in plants and animals, Molecular and biochemical characteristics of cancer cells, metastasis

Unit 3. DNA as genetic material - experimental evidences; DNA - forms and types, replication (both prokaryotes and eukaryotes); DNA damage: lesions, dimerization, AP sites, oxidative damage, alkylation and genotoxic effects; repair – photoreactivation, NER, mis-match repair, SOS repair; RNA – mRNA, tRNA, rRNA, SiRNA & SnRNA;
Genetic code and characteristics

Unit 4. Transcription in prokaryotes: Initiation - promoters and binding of RNA polymerase, elongation - role of RNA polymerase, termination – rho dependent and rho independent process;
Translation in prokaryotes: Initiation – Shine-Dalgarno sequence, initiation complex and initiation factors, elongation – peptide bond formation and translocation, termination
Gene regulation in prokaryotes: lac, trp operon models

Unit 5. Transcription in eukaryotes: Initiation – promoters, pre initiation complex, elongation, termination and post transcriptional modifications Translation in eukaryotes: Initiation – binding of ribosome and scanning of start codon, circularization of mRNA – elongation – binding and translocation of tRNA, termination, Mono and poly cistronic mRNAs; post translational modifications

Gene regulation in eukaryotes – acetylation and methylation

Text books:

1. De Roberties E.D.P and E.M.F.De Roberties 2011. Cell and Molecular Biology.VIII Edn. Lippincott Williams & Wilkins, Pheladelphia.
2. Frifelder, D. 2000. Molecular Biology II Edn. Narosa Publishing House, New Delhi**.**

Reference Books:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Robersts, K. and Walter, P. 1994. Molecular Biology of the Cell, III Edn. Garland Publishing, Inc.,
2. Cooper, GM and Hawman RE. 2013. Cell a Molecular Approach VI Edn. Sinauer
3. Griffiths, A.J.F., Lewontin, R.C., Gelbart, W.M. and Miller, J.H. 2002. Modern Genetic Analysis. II Edn., W.H. Freeman and Company, New York.
4. Hardin J., Bertoni, G.P. and Lewis, J. 2011 Becker's World of the Cell VIII Edn. Pearson Education Inc., New York
5. Karp G. 2013. Cell and Molecular Biology Concepts and Experiments. John Wiley & Sons, Inc., New York.
6. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. 2011 Lewin's Genes X, Jones and Bartlett
7. Lodish, H., Berk, A., Zipursky, S.L., Matsudara, P., Baltimore, D. and Darnell, J. 2000.
8. Molecular Cell Biology, IV Edn. W.H.Freeman and Company, Newyork.
9. Watson, J.D., N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 2004. Molecular.
10. Biology of the Gene, IV Edn. Pearson Education Inc., New York.
11. Wolfe, L.S., 1993. Molecular and Cellular Biology, Wadsworth publishing company, California.

Course designer(s):

Dr. N. Arun Nagendran

Mrs. V. Santhi

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Structure of plant and animal cells; Cell theory, Cell types.	2
1.2	Structure and functions of Plasma membrane, nucleus, endoplasmic reticulum, golgi complex.	5
1.3	Structure and functions of mitochondria, plastids, ribosomes, lysosomes.	5
1.4	Structural organization of chromosomes and giant chromosomes.	4

Unit II		
2.1	Cell cycle, mitosis and meiosis.	3
2.2	Cell migration and Cell-cell interaction.	3
2.3	Cell signalling - G-protein coupled and TGFβ receptor system, JAK/STAT, Ras and MAP kinase pathway.	5
2.4	Cell ageing, Cell death and its regulation in plants and animals, Molecular and biochemical characteristics of cancer cells, metastasis.	5
Unit- III		
3.1	DNA as genetic material - experimental evidences.	3
3.2	DNA - forms and types, replication (both prokaryotes and eukaryotes).	5
3.3	DNA damage: lesions, dimerization, AP sites, oxidative damage, alkylation and genotoxic effects.	3
3.4	Repair – photoreactivation, NER, mis-match repair, SOS repair.	3
3.5	RNA – mRNA, tRNA, rRNA, SiRNA & SnRNA.	3
Unit IV		
4.1	Transcription in prokaryotes: Initiation - promoters and binding of RNA polymerase.	3
4.2	Elongation - role of RNA polymerase, termination – rho dependent and rho independent process;	5
4.3	Translation in prokaryotes: Initiation – Shine-Dalgarno sequence, initiation complex and initiation factors, elongation – peptide bond formation and translocation, termination	6
4.4	Gene regulation in prokaryotes: lac, trp operon models	4
Unit V		
5.1	Transcription in eukaryotes: Initiation – promoters, pre initiation complex, elongation, termination and post transcriptional modifications.	3
5.2	Translation in eukaryotes: Initiation – binding of ribosome and scanning of start codon, circularization of mRNA – elongation – binding and translocation of tRNA, termination.	3
5.3	Mono and poly cistronic mRNAs; post translational modifications Gene regulation in eukaryotes – acetylation and methylation.	3

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Biotechnology
(For those joined in or after June 2017)
Programme Code :PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CE11A	**Bioinstrumentation**	Elective- 1	4	1		4

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

Preamble

The course will enlighten principle, working process and their applications of bioinstruments in various fields.

Prerequisite

Knowledge about the basic working process and their applications will make to easy understanding steps to this course.

Course outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Acquire the knowledge on basic principle, working and applications of microscopy.	K1,K3
CO2	Depict the principle and types of centrifugation and their applications in biological sciences	K2, K3
CO3	Demonstrate the theoretical basis, procedure and uses of chromatography.	K1, K4
CO4	Elucidate different types of spectrophotometery and electrophoretic techniques.	K1,K4
CO5	Expound the techniques of measurement of radioactivity and their applications	K2, K5

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

Mapping of COs with POs

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

S- Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper : Bioinstrumentation

Unit 1. Microscopy: Resolving powers of different microscopes; Principle, instrumentation, working and applications of light, phase contrast, confocal, fluorescent, scanning and transmission microscopes, fixation and staining techniques for EM, freeze etch and freeze fracture methods for EM, image processing methods in microscopy.

Unit 2. Centrifugation: Basic principle - centrifugal force, sedimentation coefficient; types of rotors; types of centrifugation – differential and density gradient; types of centrifuges – instrumentation and applications of clinical, high speed, ultra, refrigerated centrifuges; Principle and applications of pH meter, sonicator, lyophilizer, flame photometer

Unit 3. Chromatography: Introduction and types of chromatography – principle, working and applications of paper, TLC, column, GLC, FPLC, HPLC, GCMS, LCMS, HTPLC

Unit 4. Spectrophotometry: Principle, apparatus, working and applications of UV/Vis Spec (single and double beam), AAS, FTIR, NMR and ICP
Electrophoresis: Principle, working and applications of agarose gel electrophoresis, Native PAGE, SDS PAGE, PFGE; Gel documentation and molecular weight analysis

Unit 5. Radiolabelling techniques: Radioisotopes – properties and biological applications; Detection and measurement of radioactivity – based on gas ionization (ionization chamber, proportional counters, GM counters), based on excitation (solid scintillation counters, liquid scintillation counters), photographic methods (autoradiography), immunological method (RIA)

Text books:

1. Boyer R., Modern experimental Biochemistry, III EDn., Pearson education publication, Singapore.
2. Jayaraman, J. 2007. Laboratory Manual in Biochemistry, New Age International (P) Limited Publishers, New Delhi.

Reference books:

1. Bier, M. 2013. Electrophoreis. Theory, methods and applications. Academic press.
2. Hoppert, M. and Holzenburg, A. 1998. Electron microscopy in microbiology (Microscopy hand books) Springer-verlag, New York Inc.
3. Knoll, G.F. 2010. Radiation detection and measurement. IV edn., John Willey & Sons publishers.
4. Mann, W.B., Rytz, A. and Spernol, A. 2012. Radioactivity measurements: Principle and Practice (Kindle edn.) Pergamon publications.
5. Sharma, B.K. 2014. Chromatography. Krishna's educational publishers.
6. Torrence, A. 2015. Microscopy: A very short introduction, OUP Oxford publishers.

Course designer(s):

Dr. A. Surendran Mr. S. Kulandaivel

Dr. N. Arun Nagendran

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Microscopy: Resolving powers of different microscopes; Principle, instrumentation, working and applications of light microscopes.	4
1.2	phase contrast, confocal, fluorescent, scanning and transmission microscopes.	5
1.3	Fixation and staining techniques for EM, freeze etch and freeze fracture methods for EM, image processing methods in microscopy.	5
Unit II		
2.1	Centrifugation: Basic principle - centrifugal force, sedimentation coefficient; types of rotors.	4
2.2	Types of centrifugation – differential and density gradient;	4
2.3	Types of centrifuges – instrumentation and applications of clinical, high speed, ultra, refrigerated centrifuges;	5
2.4	Principle and applications of pH meter, sonicator, lyophilizer, flame photometer.	5
Unit- III		
3.1	Chromatography: Introduction and types of chromatography – principle, working and applications of paper, TLC, column, GLC, FPLC, HPLC, GCMS, LCMS, HTPLC	5
3.2	Principle, working and applications of GLC, FPLC, HPLC.	5
3.3	Principle, working and applications of GCMS, LCMS, HTPLC.	5

Unit IV		
4.1	Spectrophotometry: Principle, apparatus, working and applications of UV/Vis Spec (single and double beam), AAS, FTIR, NMR and ICPe.	6
4.2	Electrophoresis: Principle, working and applications of agarose gel electrophoresis, Native PAGE, SDS PAGE, PFGE.	5
4.3	Gel documentation and molecular weight analysis.	4
Unit V		
5.1	Radiolabelling techniques: Radioisotopes – properties and biological applications.	3
5.2	Detection and measurement of radioactivity – based on gas ionization (ionization chamber, proportional counters, GM counters)	3
5.3	Detection and measurement of radioactivity – based on excitation (solid scintillation counters, liquid scintillation counters), photographic methods (autoradiography), immunological method (RIA)	5

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CE11B	**Clinical lab technology**	Elective- 1	4	1		4

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

Preamble

The course will enlighten safety measures in clinical labs and diagnose the nature of the diseases by examining the clinical samples.

Prerequisite

Knowledge on the clinical sample collection with its aseptic nature, prevalent diseases and causing agents will make to easy understanding steps to this course.

Course outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Acquire the knowledge on Biosafety in containment laboratory and explain the importance of GLP and GMP.	**K1,K3, K5**
CO2	Depict the blood collection and their determination of blood components and its clinical significance.	**K2, K4, K5**
CO3	Describe the physico-chemical properties of urine sample and its determination test	**K1, K4, K5**
CO4	Elucidate the macroscopic and microscopic examination of stool.	**K1,K4**
CO5	Expound the sputum examination and semen analysis	**K2, K5**

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

Mapping of COs with POs

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

S- Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper : : Clinical Lab Technology

Unit 1. Laboratory management – Biosafety in containment laboratory - Personal hygiene for Laboratory Technologists, National and International GLP and GMP, Accidents - types and safety measures. Normal flora of human systems – skin, respiratory tract, gastrointestinal tract and genitourinary tract. Nosocomial infections. Nucleic acid based microbial diagnostic techniques – LCR, NASBA and QBRDA. Biomedical waste management

Unit 2. Collection and processing of blood sample. Determination of TC, DC, ESR, Hb, BT & CT. ABO Blood group system and determination of blood group. Blood transfusion and Compatibility testing.Determination of blood glucose, Urea, Cholesterol and Bilirubin. VDRL and Widal test. Blood culture and sensitivity.

Unit 3. Collection, transport and Storage of Urine sample. Physical properties of Urine. Chemical examination of urine - sugar, albumin, bile salts, bile pigments and ketone bodies. Microscopic Examination of Urine – Cast Crystals and Cells. Pregnancy Test. Urine culture and sensitivity.

Unit 4. Collection and transport of stool sample. Macroscopic and Microscopic examination of stool. Chemical examination of stool. Stool Culture and sensitivity. Occult blood and its clinical significance

Unit 5. Collection and transport of sputum specimen. Macroscopic and Microscopic examination of sputum. AFB staining. Sputum culture and sensitivity. Collection of semen. Semen analysis – motility, total count and abnormality.

Text books:

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

Reference Books:

1. Alex, C., Sonnenwirth, 1998. Gradwohl's Clinical Laboratory Methods and Diagnosis, Vol. 1&2, eighth edition, B.I. Publications Ltd., New Delhi.
2. David, S. Jacob, Wayne R. Demott, Paul R. Finley, 1994. Laboratory Test Hand Book, third edition, Key word index, Laxi-Compinc, Hudson.
3. Jacques Wallac, L., 1986. Interpretation of Diagnostic Tests: A Synopsis of Laboratory Medicine, Little Brown and Company, Boston/Toronto, USA.
4. Kathleenbecan, M.C., Bride, 1982. Text Books of Clinical Laboratory supervision, Century Crosts, New York.
5. Mukherjee, L.K. 2010. Medical Laboratory Technology – 3 volumes – second edition – Hill Publishing Ltd., New Delhi.
6. Rapael, S.S., 1983. Lynch Medical Laboratory Technology, Fourth edition, W.B. Saunders Co, Singapore.
7. Woohan, I.D.P., Heather Freeman, 1990. Micro Analysis in Medical Biochemistry, VI edition, Churchil Livingstone Publishing Ltd., USA.

Course designer(s):
Mr.S.Kulandaivel
Ms.S.Padmavathy
Mrs.V.Ananthi
Dr.M.Karthikeyan

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Laboratory management – Biosafety in containment laboratory - Personal hygiene for Laboratory Technologists, National and International GLP and GMP.	4
1.2	Normal flora of human systems – skin, respiratory tract, gastrointestinal tract and genitourinary tract. Nosocomial infections	5
1.3	Nucleic acid based microbial diagnostic techniques – LCR, NASBA and QBRDA.	4
1.4	Biomedical waste management	2

Unit II		
2.1	Collection and processing of blood sample. Determination of TC, DC, ESR, Hb, BT & CT.	3
2.2	ABO Blood group system and determination of blood group.	2
2.3	Blood transfusion and Compatibility testing.	3
2.4	Determination of blood glucose, Urea, Cholesterol and Bilirubin.	4
2.5	VDRL and Widal test; Blood culture and sensitivity.	3
Unit- III		
3.1	Collection, transport and Storage of Urine sample..	3
3.2	Physical and Chemical properties of Urine	5
3.3	Microscopic Examination of Urine – Cast Crystals and Cells. Urine culture and sensitivity	5
3.4	Pregnancy Test	2
Unit IV		
4.1	Collection and transport of stool sample.	2
4.2	Macroscopic and Microscopic examination of stool.	3
4.3	Chemical examination of stool. Stool Culture and sensitivity.	4
4.4	Occult blood and its clinical significance	2
Unit V		
5.1	Collection and transport of sputum specimen. Sputum culture and sensitivity.	3
5.2	Macroscopic and Microscopic examination of sputum. AFB staining.	3
5.3	Collection of semen. Semen analysis – motility, total count and abnormality.	4

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Programme Code :PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CL11	**Lab in General Microbiology & Cell biology**	Lab	-	-	5	3

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

Preamble

This course will give hands on experience about the methods involved in isolation, basic staining and characterization of different microorganisms.

Prerequisite

General knowledge about the microbial morphology, growth and cell division will be useful to make the learning option of this course.

Course outcomes

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

#	Course Outcome	Level
CO1	Elaborate the basic rules, regulations and different sterilization methods involved in microbiology	K1, K2
CO2	Identify the morphology of isolated microbes by different staining methods and its size measurement	K2, K3
CO3	Demonstrate the motility and biochemical characterization of microbes	K3, K4
CO4	Identify the anaerobic microbes by pyrogallic acid method	K2, K5
CO5	Exhibit the cell division methods and development of practical skills in microbiology	K3, K5

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

Mapping of COs with POs

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

S: Strong M: Medium L: Low

Title of the paper: Lab in General Microbiology & Cell biology

1. Laboratory rules, regulations and GLP
2. Cleaning and methods of sterilization
3. Isolation of microbes from soil/water/air
4. Simple staining techniques - Simple, negative,
5. Differential staining technique - Gram's staining
6. Special staining techniques – capsule and spore staining
7. Motility test – Hanging drop method
8. Biochemical characterization of bacteria
9. Cultivation of anaerobic microbes by pyrogallic acid method
10. Identification of fungi by lactophenol cotton blue staining method
11. Fungi slide culture technique
12. Determination of bacterial cell size by micrometry
13. Development of Winogradsky column
14. Display of giant chromosome
15. Observation of cell divisions (mitosis and meiosis)

Course designer(s):

Mr. S. Kulandaivel

Dr. N. Arun Nagendran

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Biotechnology
(For those joined on or after June 2019)
Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CL12	Lab in Biochemistry & Molecular Bbiology	Core Lab	-	-	5	3

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

Preamble

This course will reveals practical experience about the methods involved in qualitative/quantitative measurement of carbohydrates, proteins and lipids; also various separation techniques and isolation of DNA and RNA materials.

Prerequisite

Basic knowledge about the biochemistry and molecular biological practical tools will be help full to get advanced information about this course.

Course outcomes

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

#	Course Outcome	Level
CO1	Demonstrate the qualitative analysis of carbohydrates, proteins and lipids from various samples	K1, K2
CO2	Elaborate the preparation of different buffers and measurement of its pH level	K2, K4
CO3	Expose the beer's law and determination of λ max; Elaborate the estimation of carbohydrates, proteins and lipids from various samples	K3, K4
CO4	Illustrate the different separation techniques by paper, TLC and column chromatography	K3, K4
CO5	Demonstrate the isolation of genomic DNA and RNA from different sources and analysis of its purity	K3, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Title of the paper: Lab in Biochemistry & molecular biology

1. Qualitative analysis of Carbohydrates
2. Qualitative analysis of Proteins
3. Qualitative analysis of Lipid
4. Preparation of buffers, normal and molar solutions
5. Determination of pH in different samples
6. Verification of Beer's law and determination of λ max
7. Extraction and estimation of bacterial carbohydrates
8. Extraction and estimation of yeast protein
9. Quantitative estimation of lipids
10. Separation of amino acids/pigments/dyes by Paper Chromatography
11. Separation of amino acids/pigments TLC
12. Separation of pigments by column chromatography
13. Extraction and estimation of genomic DNA from bacteria/yeast/coconut endosperm/liver
14. Extraction and estimation of total RNA from bacteria/yeast/coconut endosperm/liver
15. Determination of purity of DNA and RNA by spectrophotometric method

Course designer(s):

Dr. N. Arun Nagendran

Dr. M. Karthikeyan

Dr. C. Ravi

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Biotechnology
(For those joined on or after June 2019)
Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C21	Genetic Engineering	Core - 4	4	1		4

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

Preamble

This course will give awareness on the methods involved in cloning, different types of sequence analysis and expression of genes.

Prerequisite

Knowledge about the cloning tools involved in genetic engineering strategies will make to easy understanding steps to this course.

Course outcomes

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

#	Course Outcome	Level
CO1	Describe the restriction enzymes and different vector system as molecular tools for cloning	K1, K2
CO2	Introduce DNA into cells by transformation, transcription and identify recombinant cells	K2, K4
CO3	Select the clones by various molecular techniques	K2, K4
CO4	Acquire the knowledge on various types of sequence reactions and gene mapping methods	K3, K5
CO5	Explore the expression of cloned genes and artificial synthesis of hormones	K3, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Genetic Engineering

Unit 1: Molecular Tools: Restriction enzymes – nomenclature, type I, II and III, DNA modifying enzymes – nucleases, alkaline phosphatase, polymerases, terminal nucleotidyl transferase, polynucleotide kinase, ligases. Ligation – mode of action of ligase, sticky end and blunt end ligation, linkers, adapters and homopolymer tailing; Vectors – plasmid vectors pBR322, pUC18 (lac selection), phagemid (M13), Cosmids (λ), BAC, YAC, BIBAC, TAG

Unit 2: Introduction of DNA into living cells: Transformation – preparation of competent cells, selection of transformed cells; Identification of recombinant cells – insertional inactivation, colony hybridization; Transfection – *in vitro* packaging of λ cloning vectors, identification, recombinant phages – insertional inactivation of lacZ'gene; transformation into individual cells – liposome mediated gene transfer, electroporation, microinjection, biolistics

Unit 3: Selection of clones – direct selection, colony hybridization (nucleic acid hybridization using radiolabelled, non radiolabelled; probes – oligonucleotide, heterologous probes) by translation products (Western blotting), by locating genes within DNA molecule (Southern blotting), within chromosomes (FISH), by amplifying gene (PCR)

Unit 4: Sequence analysis: Sanger-Coulson method, Maxam-Gilbert method, automated DNA sequencing; Genome sequencing – shot gun approach, clone contig approach, chromosomal walking; Gene mapping – RFLP, RAPD, microsatellites; Gene library and genomic library
Transcript analysis: Northern blotting, RACE, RT-PCR; DNA foot printing; translation product analysis: HRT and HART techniques

Unit 5: Expression of cloned genes and role of promoters – in *E.coli* and *S.cerevisiae,* cassettes and gene fusion, synthesis and expression of artificial insulin gene, synthesis of human growth hormone

Text book:

1. Brown, T.A. 2008. Gene Cloning and DNA analysis – An Introduction. V Edn., Blackwell Publishing Ltd., UK.
2. Das, H.K. 2011. Textbook of Biotechnology. IV Edn., Wiley India Pvt. Ltd., New Delhi
3. Sathyanarayana, U. 2012. Biotechnology. Books and Allied (P) Ltd., Kolkatta.

Reference books:

1. Brown, T.A. 2007. Genomes 3. Garland Science Publishing, New York.
2. Brown, T.A. 2011. Genetics – A molecular approach, III Edn., BIOS Scientific Publishers, New York.
3. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
4. Glick, B.K. and Pasternak, J.J. 2007. Molecular Biotechnology Principles and Applications of Recombinat DNA, III EDn. ASM Press, Washington, D.C.
5. Hammong, J., Mc Garvey, P. and Springer, V.Y. 2000. Plant Biotechnology.
6. Ignachimuthu, S. 2008. Biotechnology – An introduction. Narosa Publishing House, New Delhi.
7. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2011. Lewin's Gene X. Jones and Bartlett Publishers, London.
8. Kumaresan, V. 2009. Biotechnology, Saras publications, Nagercoil.
9. Lesk, A.M. 2008. Introduction to Genomics. Oxford University Press, New York.
10. Mitra, S. 2007. Genetic Engineering Principles and Practice. MacMillan India Ltd., New Delhi.
11. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, VII Edn., Blackwell publishing, UK.
12. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
13. Symonds, N., Toussaint, A., Van De Putte, P. and Howe, M.M. 1987. Phage Mu. Cold Spring Harbor Laboratory.
14. Talwar, G.P., Rao, K.V.S. and Chauhan, V.S. 1994. Recombinant and Synthetic Vaccines, Narosa Publishing House, New Delhi.
15. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
16. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz , J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, IV Edn. The Benjamin Cummings Publishing Company Inc., Tokyo.
17. Winnaker, E.L. 1987. From Gene to Clone: Introduction to Gene Technology, VCH
18. Young, M.M. 1992. Plant Biotechnology, Pergmen Press, Oxford London.

Course designer(s):

S. Kulandaivel & N. Arun Nagendran

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Molecular Tools: Restriction enzymes – nomenclature, type I, II and III	3
1.2	DNA modifying enzymes – nucleases, alkaline phosphatase, polymerases, terminal nucleotidyl transferase, polynucleotide kinase, ligases	5
1.3	Ligation – mode of action of ligase, sticky end and blunt end ligation, linkers, adapters and homopolymer tailing	5
1.4	Vectors – plasmid vectors pBR322, pUC18 (lac selection), phagemid (M13), Cosmids (λ), BAC, YAC, BIBAC, TAG	5
Unit II		
2.1	Introduction of DNA into living cells: Transformation – preparation of competent cells, selection of transformed cells	3
2.2	Identification of recombinant cells – insertional inactivation, colony hybridization	3
2.3	Transfection – *in vitro* packaging of λ cloning vectors, identification, recombinant phages	5
2.4	Insertional inactivation of lacZ'gene; transformation into individual cells – liposome mediated gene transfer, electroporation, microinjection, biolistics	6
Unit- III		
3.1	Selection of clones – direct selection, colony hybridization (nucleic acid hybridization using radiolabelled, non radiolabelled;	3
3.2	Probes – oligonucleotide, heterologous probes) by translation products (Western blotting),	4
3.3	By locating genes within DNA molecule (Southern blotting), within chromosomes (FISH), by amplifying gene (PCR)	5
Unit IV		
4.1	Sequence analysis: Sanger-Coulson method, Maxam-Gilbert method, automated DNA sequencing	3
4.2	Genome sequencing – shot gun approach, clone contig approach, chromosomal walking	5
4.3	Gene mapping – RFLP, RAPD, microsatellites	4
4.4	Gene library and genomic library	4
4.5	Transcript analysis: Northern blotting, RACE, RT-PCR; DNA foot printing	5
4.6	Translation product analysis: HRT and HART techniques	3
Unit V		
5.1	Expression of cloned genes and role of promoters – in *E.coli* and *S.cerevisiae*,	3
5.2	cassettes and gene fusion, synthesis and expression of artificial insulin gene, synthesis of human growth hormone	3

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Programmme Code :PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C22	Plant Biotechnology	Core - 5	4	1		4

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

Preamble

The course will deliver knowledge on plant genome structural organization, functional aspects, transgenic crop improvements, tissue culture and genetic resources maintenance.

Prerequisite

Knowledge about the basics of plant genome, tissue culture and transgenic plant importance will enable to understand this course.

Course outcomes

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

#	Course Outcome	Level
CO1	Describe plant genome structure, organization and mechanism of gene transfer	K1,K3
CO2	Determine crop improvement by transgenic plant development	K2, K4
CO3	Elucidate secondary metabolite productions	K1, K2
CO4	Outline the basic requirements and types of plant tissue culture	K2, K4
CO5	Explore plant genetic resources and storage techniques	K3, K5

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

Mapping of COs with POs

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

S- Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Plant Biotechnology

Unit 1: Plant genome and gene transfer: structural organization and functions of molecular, mitochondrial and plastid genome. Gene transfer: *Agrobacterium tumefaciens*: Ti and Ri vectors, mechanism of DNA transfer and role of virulence genes, crown gall formation and hairy root culture, selectable marker genes, use of 35S and other promters as genetic markers, use of reporter genes and transgene stability.

Unit 2: Transgenic plants and crop improvement: transgenic plants with insect resistance (Bt cotton), tolerance to abiotic stress (drought and salinity resistance), improved nutrition (golden rice), improved photosynthetic efficiency. Crop improvement: DNA marker assisted selection, antisense RNA and gene silencing in crop improvement

Unit 3: Secondary metabolite production: Control mechanisms and manipulation of (Shikimate and PHA pathway), high yielding cell line selection, biotransformation, plant bioreactor, large scale industrial production of alkaloids (reserpine), pigment (flavinoid), biodegradable plastics (PHP), PMF for therapeutic proteins (HGH), edible vaccines (banana), factors affecting secondary metabolite production, immobilization of plant cells. A brief note on plant molecular farming

Unit 4: Plant tissue culture: Concept of cellular totipotency, explant, nutritional requirements: MS medium, callus, micro-propagation, somaclonal and gametoclonal variation, embryoids. Types of culture – callus culture, cell suspension culture, organ culture, meristem culture, embryo culture, somatic embryogenesis, haploid and double haploid production, protoplast culture: somatic hybridization and cybrid production.

Unit 5: Plant Genetic Resources – Germplasm conservation: *in-vitro* collection, recalcitrant and slow growth cultures, Principles and types of storage: cryopreservation and cryoprotectants, *In-vitro* conservation of key crops, gene bank, artificial seeds, and embryo rescue. Gene silencing; farmer's and breeder's rights

Text books:

1. Chawla, H.S. 2009. Introduction to Plant Biotechnology. III Edn. CRC Press, USA.
2. Keshavachandran, R. and Peter, K.V. 2009. Plant Biotechnology – Methods in Tissue Culture and Gene Transfer, University Press (India) Pvt. Ltd., Hyderabad.

References:

1. Brown, T.A. 2007. Genomes 3. Garland Science Publishing, New York.
2. Brown, T.A. 2008. Gene Cloning and DNA analysis – An Introduction. V Edn., Blackwell Publishing Ltd., UK.
3. Brown, T.A. 2011. Genetics – A molecular approach, III Edn., BIOS Scientific Publishers, New York.
4. Das, H.K. 2011. Textbook of Biotechnology. IV Edn., Wiley India Pvt. Ltd., New Delhi.
5. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
6. Glick, B.K. and Pasternak, J.J. 2007. Molecular Biotechnology Principles and Applications of Recombinat DNA, III EDn. ASM Press, Washington, D.C.
7. Hammong, J., Mc Garvey, P. and Springer, V.Y. 2000. Plant Biotechnology.
8. Ignachimuthu, S. 2008. Biotechnology – An introduction. Narosa Publishing House, New Delhi.
9. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2011. Lewin's Gene X. Jones and Bartlett Publishers, London.
10. Lesk, A.M. 2008. Introduction to Genomics. Oxford University Press, New York.
11. Mitra, S. 2007. Genetic Engineering Principles and Practice. MacMillan India Ltd., New Delhi.
12. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, VII Edn., Blackwell publishing, UK.
13. Sathyanarayana, U. 2012. Biotechnology. Books and Allied (P) Ltd., Kolkatta.
14. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
15. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
16. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz , J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, IV Edn. The Benjamin Cummings Publishing Company Inc., Tokyo.
17. Young, M.M. 1992. Plant Biotechnology, Pergmen Press, Oxford London.

Course designer(s):

Dr. K. Saraswathi

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Course contents and lecture schedule

Units	Topic	Lecture

		hrs.
Unit I		
1.1	Plant genome and gene transfer: structural organization and functions of molecular, mitochondrial and plastid genome	2
1.2	Gene transfer: *Agrobacterium tumefaciens*: Ti and Ri vectors, mechanism of DNA transfer and role of virulence genes, crown gall formation and hairy root culture	6
1.3	Selectable marker genes, use of 35S and other promters as genetic markers, use of reporter genes and transgene stability	5
Unit II		
2.1	Transgenic plants and crop improvement: transgenic plants with insect resistance (Bt cotton)	4
2.2	Tolerance to abiotic stress (drought and salinity resistance), improved nutrition (golden rice), improved photosynthetic efficiency	5
2.3	Crop improvement: DNA marker assisted selection, antisense RNA and gene silencing in crop improvement	5
Unit- III		
3.1	Secondary metabolite production: Control mechanisms and manipulation of (Shikimate and PHA pathway), high yielding cell line selection,	5
3.2	Biotransformation, plant bioreactor, large scale industrial production of alkaloids (reserpine), pigment (flavinoid), biodegradable plastics (PHP)	6
3.3	PMF for therapeutic proteins (HGH), edible vaccines (banana), factors affecting secondary metabolite production, immobilization of plant cells	5
3.4	A brief note on plant molecular farming	2
Unit IV		
4.1	Plant tissue culture: Concept of cellular totipotency, explant	2
4.2	Nutritional requirements: MS medium, callus, micro-propagation, somaclonal and gametoclonal variation, embryoids	3
4.3	Types of culture – callus culture, cell suspension culture, organ culture, meristem culture, embryo culture, somatic embryogenesis	4
4.4	Haploid and double haploid production, protoplast culture	2
4.5	Somatic hybridization and cybrid production	2
Unit V		
5.1	Plant Genetic Resources – Germplasm conservation: *in-vitro* collection, recalcitrant and slow growth cultures	4
5.2	Principles and types of storage: cryopreservation and cryoprotectants, *In-vitro* conservation of key crops	4
5.3	Gene bank, artificial seeds, and embryo rescue	2
5.4	Gene silencing; farmer's and breeder's rights	2

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Department of Biotechnology
(For those joined on or after June 2019)
Programme code- PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C23	**Animal Biotechnology**	Core - 6	4	1		4

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

Preamble

The course plan will provide knowledge on the systematic position, diversity, basic characteristics and biology of microorganism

Prerequisite

Basic idea in animal cell culture, vaccines and animal models will help to get complete knowledge about the course.

Course outcomes

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

#	Course Outcome	Level
CO1	Outline animal cell culture techniques	K1, K2
CO2	describe media preparation for animal cell culture process	K1, K2
CO3	Illustrate construction of recombinant animal viral vectors for gene transfer by knock in and knock out technology	K2, K4
CO4	Acquire the knowledge on transgenic animal models and various types of vaccines	K2, K4
CO5	Describe manipulation and reproduction; elucidate inoculums strategies	K3, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Animal Biotechnology

Unit 1: Animal cell culture: Historical perspective, biology and characterization of cultured cells; Biosafety level 1 – 4, safety data sheet, personal protective equipment, safety laboratory practice, requirements for animal cell culture – equipments and media; types of cell culture – primary, secondary cultures and cell line; categories of tissue culture – organ culture and cell culture (stem cells, precursor cells and differentiated cells), cell culture systems – monolayer culture and suspension culture

Unit 2: Protocol for animal cell culture – preparation of substratum, inoculums (physical and chemical disaggregation of cells), culture media, methods of cell culture (slide, Carrel flask and test tube culture), Applications of animal cell culture: in vitro testing of drugs, testing of toxicity of environmental pollutants

Unit 3: Biology of animal viral vectors – SV40, adeno virus, retro virus, vaccinia virus and baculovirus; Construction of recombinant animal viral vectors; Targeted gene transfer – knock in and knock out technology.

Unit 4: Transgenic animals – methods of production and its applications (reteroviral, microinjection and embryonic stem cell); Transgenic mice as model organism; Transgenic sheep, transgenic goat, transgenic pig, transgenic mosquitoes and transgenic birds; Vaccine: Types – killed, attenuated vaccine, recombinant vaccines and DNA vaccines

Unit 5: Manipulation of reproduction – IUI, AI, IVF and ET; Gamete intrafallopian transfer, Zygote intrafallopian transfer, intravaginal culture, cytoplasmic transfer, micromanipulation of animals and cryopreservation; Bioethics and IPR – ethical issue, IPR, TRIPS and patenting.

Text books:

1. Das, H.K. 2011. Textbook of Biotechnology. IV Edn., Wiley India Pvt. Ltd., New Delhi.
2. Glick, B.K. and Pasternak, J.J. 2007. Molecular Biotechnology: Principles and Applications of Recombinat DNA, III EDn. ASM Press, Washington, D.C
3. Sathyanarayana, U. 2012. Biotechnology. Books and Allied (P) Ltd., Kolkatta.

Reference books:

1. Brown, T.A. 2008. Gene Cloning and DNA analysis – An Introduction. V Edn., Blackwell Publishing Ltd., UK.
2. Brown, T.A. 2011. Genetics – A molecular approach, III Edn., BIOS Scientific Publishers, New York.
3. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
4. Ignachimuthu, S. 2008. Biotechnology – An introduction. Narosa Publishing House, New Delhi.
5. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2011. Lewin's Gene X. Jones and Bartlett Publishers, London.
6. Kumaresan, V. 2009. Biotechnology, Saras publications, Nagercoil.
7. Lesk, A.M. 2008. Introduction to Genomics. Oxford University Press, New York.
8. Mitra, S. 2007. Genetic Engineering Principles and Practice. MacMillan India Ltd., New Delhi.
9. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, VII Edn., Blackwell publishing, UK.
10. Susan, R.B. 2008. Biotechnology, Cengage Learning Pvt. Ltd., New Delhi.
11. Symonds, N., Toussaint, A., Van De Putte, P. and Howe, M.M. 1987. Phage Mu. Cold Spring Harbor Laboratory.
12. Talwar, G.P., Rao, K.V.S. and Chauhan, V.S. 1994. Recombinant and Synthetic Vaccines, Narosa Publishing House, New Delhi.
13. Thieman, W.J. and Palladino, M.A. 2009. Introduction to Biotechnology, Dorling Kindersley India Pvt. Ltd., Noida.
14. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, IV Edn. The Benjamin Cummings Publishing Company Inc., Tokyo.

Course designer(s)

Dr. C. Balachandran
Dr. C. Ravi
Dr. N. Arun Nagendran
Mr. S. Kulandaivel

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Animal cell culture: Historical perspective, biology and	2

	characterization of cultured cells	
1.2	Biosafety level 1 – 4, safety data sheet, personal protective equipment, safety laboratory practice, requirements for animal cell culture – equipments and media	5
1.3	types of cell culture – primary, secondary cultures and cell line	3
1.4	Categories of tissue culture – organ culture and cell culture (stem cells, precursor cells and differentiated cells),	3
1.5	Cell culture systems – monolayer culture and suspension culture	3
Unit II		
2.1	Protocol for animal cell culture – preparation of substratum	3
2.2	Inoculums (physical and chemical disaggregation of cells),	1
2.3	Culture media, methods of cell culture (slide, Carrel flask and test tube culture)	6
2.4	Applications of animal cell culture: in vitro testing of drugs, testing of toxicity of environmental pollutants	5
Unit- III		
3.1	Biology of animal viral vectors – SV40, adeno virus, retro virus, vaccinia virus and baculovirus	3
3.2	Construction of recombinant animal viral vectors	3
3.3	Targeted gene transfer – knock in and knock out technology	3
Unit IV		
4.1	Transgenic animals – methods of production and its applications (reteroviral, microinjection and embryonic stem cell);	2
4.2	Transgenic mice as model organism; Transgenic sheep, transgenic goat, transgenic pig, transgenic mosquitoes and transgenic birds	1
4.3	Vaccine: Types – killed, attenuated vaccine, recombinant vaccines and DNA vaccines	2
Unit V		
5.1	Manipulation of reproduction – IUI, AI, IVF and ET	3
5.2	Gamete intrafallopian transfer, Zygote intrafallopian transfer, intravaginal culture, cytoplasmic transfer	3
5.3	Micromanipulation of animals and cryopreservation	3
5.4	Bioethics and IPR – ethical issue, IPR, TRIPS and patenting	5

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Programme Code PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CE21A	**Genetics**	Elective 2	4	1		4

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

Preamble

This course provides basic knowledge to the students regarding the concepts of genes. Enrich the knowledge to comprehend the basis of inheritance

Prerequisite

Knowledge on classical genetic inheritance concept will make to easy understanding and enrich the knowledge to this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Explain the concept of gene, Mendelian principles and their extensions	K1, K2
CO2	Elucidate the mechanism of linkage and crossing over; Discuss the different types of gene mapping methods.	K2, K4
CO3	Understand the knowledge on quantitative genetics with details on the genetic disorder	K1, K3
CO4	Describe the different types of mutation and mutagenic agent	K2, K5
CO5	Explicate the extra chromosomal inheritance; methods of genetic transfer	K2, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Genetics

Unit 1: Mendelian Principles – Dominance, Segregation, independent assortment, deviation from mendelian inheritance; Concept of gene – Allele, multiple alleles, pseudoallele, complementation test; Extensions of mendelian principles – epistasis, codominance, incomplete dominance, gene interactions, genomic imprinting, penetrance and expressivity; phenocopy.

Unit 2: Linkage and crossing over, sex linkage, sex limited and sex influenced characters; Gene mapping methods - Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

Unit 3: Human chromosomes; sex determination and sex linked inheritance; Simple Mendelian traits in man; Pedigree analysis, Lod score for linkage testing, karyotype, genetic disorders (Sickle cell anemia, Down's, Klienfelter's and Turner's syndrome); Quantitative genetics - Polygenic inheritance, heritability and its measurements

Unit 4: Mutation – types: spontaneous and induced mutations; Point mutation and chromosomal mutations; ploidy and their genetic implications; Molecular basis of mutations – base substitution, (numerical and structural alterations of chromosomes), frame shift mutation and mismatch; Mutagenesis and mutagenic agents. Detection of mutagen - Ames test

Unit 5: Extra chromosomal inheritance - Inheritance of mitochondrial and chloroplast genes, maternal inheritance (kappa particles); Microbial genetics: Plasmids – F, R & Col plasmids; Methods of genetic transfer – transformation, conjugation, transduction and sexduction; mapping genes by interrupted and uninterrupted mating; site specific recombination, Holliday model

Text books:

Gardner E.J., Simmons, M.J. and Snustad, D. P. (2006) Principles of Genetics, 8th edition, Wiley India Pvt. Ltd., New Delhi.

Verma, P.S. and Agarwal, V.K. 2010. Genetics. 21st Edn. S. Chand Publishing, New Delhi

References:

Brown, T. 2011. Introduction to Genetics: A molecular approach, Garland Science, USA.

Klug, W.S., Cummings, M. R., Spencer, C. A. and Palladino, M.A. 2016. Genetics, X Edn. Pearson Education India, New Delhi.
Pierce.A.B. 2014. Genetics: Conceptual approach, IV Edn. W. H. Freeman and company, UK.
Strickberger, 2015. Genetics, IV Edn. Pearson Education India, New Delhi.

Course designer: Dr. A. Surendran

Course contents and lecture schedule

Units	TOPIC	Hrs.
Unit 1		
1.1	Mendelian Principles – Dominance, Segregation, Independent assortment, Deviation from mendelian inheritance	04
1.2	Concept of gene – Allele, Multiple alleles, Pseudoallele,	02
1.3	Complementation test	01
1.4	Extensions of mendelian principles – epistasis, co-dominance, incomplete dominance	04
1.5	Gene interactions, genomic imprinting, penetrance, expressivity, Phenocopy	06
Unit 2		
2.1	Linkage and crossing over	04
2.2	Sex linkage, Sex limited and sex influenced characters	06
2.3	Linkage maps, tetrad analysis, mapping with molecular markers	03
2.4	Mapping by using somatic cell hybrids	02
2.5	Development of mapping population in plants	02
Unit 3		
3.1	Sex determination and sex linked inheritance	04
3.2	Simple Mendelian traits in man	03
3.3	Pedigree analysis; Lod score for linkage testing	02
3.4	Karyotype	02
3.5	Genetic disorders, Polygenic inheritance, heritability and its measurements	02
Unit 4		
4.1	Mutation – types: spontaneous and induced mutations	03
4.2	Point mutation and chromosomal mutations	02
4.3	Molecular basis of mutations	03
4.4	Mutagenesis and mutagenic agents	03
Unit 5		
5.1	Extra chromosomal inheritance: mitochondrial & chloroplast	02
5.2	Plasmids – F, R & Col plasmids	02
5.3	Methods of genetic transfer	03
5.4	Mapping genes by interrupted and uninterrupted mating	03
5.5	Site specific recombination	02
5.6	Holliday model	02

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Programme Code PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CE21B	**Developmental Biology**	Elective 2	4	1		4

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

Preamble

This course provides basic knowledge to the students regarding the concepts and process of animal development. Enrich the knowledge to comprehend the regulatory mechanism of developmental process.

Prerequisite

Terminology about the embryonic development process will make to easy understanding and enrich the knowledge to this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Explain the concept of developmental biology and fertilization process	K1, K2
CO2	Describe the early developmental stages with leading to formation of gastrulation	K2, K4
CO3	Elucidate the embryonic axis and pattern formation with organ development	K1, K3
CO4	Understand the knowledge on metamorphosis and regeneration	K2, K5
CO5	Explicate the congenital malformations and teratogenesis; stem cells – classification, types and applications	K2, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Developmental Biology

Unit 1: Definitions and concepts of developmental biology - Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; Differentiation of germ cells and gametogenesis; types of sperms and eggs, egg envelops and vitellogenesis; Fertilization – capacitation, egg recognition, gametic fusion, prevention of polyspermy, activation of egg metabolism

Unit 2: Cleavage - salient features, planes of cleavage, patterns of cleavage and factors affecting cleavage; Blastulation - types of blastula; implantation, Gastrulation - salient features, metabolic and molecular changes during gastrulation and formation of germinal layers in fish and chick and fate of germinal layers

Unit 3: Neurulation and development of brain, & eye (ectodermal origin), kidney (endodermal origin) and limb (mesodermal origin) in mammals; Cell aggregation and differentiation in dictyostelium; axes and pattern formation and role of maternal genes in the development of *Drosophila*; Vulva formation in *Caenorhabditis elegans*

Unit 4: Metamorphosis - Morphological, physiological, biochemical changes and hormonal regulation in insect and amphibian metamorphosis; Regeneration – types, mechanism of regeneration in zebrafish and factors influencing regeneration

Unit 5: Programmed rearrangements in genes, chromatin diminution, endoreplication cycles, gene amplification, genome imprinting, congenital malformations and teratogenesis, epigenetic regulation; senescence; stem cells – classification, types and applications

Reference Books:

1. Balinsky, B.I. and Fabion, B.S. 2012. An introduction to Embryology. Saunders Ltd., USA
2. Gilbert, S.F. and K. Knisely. 2009. Developmental Biology, Sinauer Associates Inc.
3. Wolpert,L., Tickle, C. and Arias, A.M. 2002. Principles of Development. Oxford University Press, UK.

Course designer(s): Dr. N. Arun Nagendran and Dr.C.Balachandran

Course contents and lecture schedule

Units	TOPIC	Hrs.
Unit 1		
1.1	concepts of developmental biology - Potency, Commitment, Specification, Induction, Competence	3
1.2	Morphogenetic gradients	1
1.3	Differentiation of germ cells and gametogenesis	3
1.4	Fertilization and its process	3
1.5	Prevention of polyspermy, activation of egg metabolism	2
Unit 2		
2.1	Cleavage - salient features, planes of cleavage, patterns of cleavage and factors affecting cleavage;	3
2.2	Blastulation - types of blastula; implantation,	2
2.3	Gastrulation - salient features, metabolic and molecular changes during gastrulation	2
2.4	formation of germinal layers in fish and chick and fate of germinal layers	3
Unit 3		
3.1	Neurulation and development of ectodermal, endodermal and mesodermal origin in mammals	3
3.2	Cell aggregation and differentiation in dictyostelium	3
3.3	Axes and pattern formation and role of maternal genes in the development of *Drosophila*	3
3.4	Vulva formation in *Caenorhabditis elegans*	2
Unit 4		
4.1	Metamorphosis - Morphological, physiological, biochemical changes and hormonal regulation in	4

	insect and amphibian metamorphosis	
4.2	Regeneration – types, mechanism of regeneration in zebrafish and factors influencing regeneration	4
Unit 5		
5.1	Programmed rearrangements in genes and chromatin diminution	3
5.2	Endoreplication cycles and gene amplification,	2
5.3	Genome imprinting	3
5.4	Congenital malformations and Teratogenesis,	4
5.5	Epigenetic regulation and senescence	2
5.6	stem cells – classification, types and applications	3

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Programme Code PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CL21	Lab in Genetic Engineering	Core Lab	-	-	5	3

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

Preamble

This course will give hands on experience about various methods involved in microbial genetics and its application.

Prerequisite

Basic idea in microbial genetics will be an optional to get complete knowledge about its advanced methodologies.

Course outcomes

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

#	Course Outcome	Level
CO1	Explain the methods involved in isolation of mutant strains	K1
CO2	Demonstration of transformation and conjugation in bacterial system	K2, K3
CO3	Elaborate the isolation of plasmid DNA and genomic DNA from bacteria; separation by electrophoresis	K3, K4
CO4	Demonstrate the restriction digestion of DNA and PCR reaction	K4, K5
CO5	Demonstrate the separation of proteins by SDS PAGE and western blotting	K4

Mapping of COs with POs

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

S-Strong M-Medium L-low

Title of the paper: Lab in Genetic Engineering

1. Isolation of auxotroph
2. Selection of Rec A^+ and Rec A^- strains
3. Isolation of Z^- *E. coli* strains
4. Isolation of streptomycin resistant mutants using gradient plate technique
5. Demonstration of transformation in bacteria
6. Demonstration of uninterrupted conjugation in bacteria
7. Isolation of Plasmid by alkaline lysis method - A miniprep procedure
8. Isolation of DNA from bacteria
9. Restriction digestion of DNA (Single and double)
10. Cloning of DNA fragment into plasmids
11. Separation of DNA by Agarose gel electrophoresis
12. Separation of proteins by native and SDS PAGE.
13. Identification of specific proteins by Western Blotting
14. Demonstration of PCR reaction

Course designer(s):

Mr. S. Kulandaivel

Dr. N. Arun Nagendran

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Programme Code PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CL22	Lab in Plant and Animal biotechnology	Core Lab	-	-	5	3

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

Preamble

The course will provide knowledge on the hands on activities, projects and technical skills in the field of biotechnology.

Prerequisite

Students should take introduction to AFNR followed by principles of agricultural Science - Animal Science will make to easy understanding steps to this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Acquire the knowledge on basic principles and preparation of plant tissue culture media.	**K1, K3**
CO2	Depict the principle and types of plant tissue culture.	**K4, K5**
CO3	Perceive knowledge on preparation of animal tissue media.	**K4, K5**
CO4	Depict the principle and protocol for animal cell culture	**K2, K3**

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Title of the paper: Lab in Plant and animal biotechnology

1. Preparation of media for tissue culture
2. Preparation of explants
3. Callus culture
4. Morphogenesis of root and shoot system
5. Isolation of protoplast from leaves
6. Protoplasmic fusion by PEG.
7. Culture of anther/ovule
8. Induction of algal pigmentation by different light intensity.
9. Synthetic seed preparation
10. Microscopic observation of developmental stages of mosquitoe/chicken
11. Preparation of media for animal cell culture
12. Suspension cell culture
13. Testing the viability of the cells
14. Soft agar assay for stem cell culture

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Biotechnology
(For those joined on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
PBT19C31	Immunology and Immunotechnology	Core - 7	4	1		4

L - Lecture T - Tutorial P – Practical

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

Preamble:

The course will provide the knowledge on the types and mechanism of immune systems, immune reactions and antibody engineering.

Prerequisite:

Knowledge about the types and mechanism of immune system will make to easy understanding steps to this course.

Course outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Acquire knowledge on types and structure of immune systems and diversity of antibody.	**K1**
CO2	Elucidate cytokine and compliment based activation and regulation of immune mechanisms.	**K2, K3**
CO3	Perceive knowledge on Immunodeficiencies.	**K1, K3**
CO4	Depict principles in diagnosis, HLA typing and tumor immunology.	**K4,K5**
CO5	Describe antibody engineering and uses of immunohistochemistry.	**K3, K5**

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	**Continuous Assessment**		**End of Semester Marks**
	I Internal Marks	**II Internal Marks**	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Immunology and Immunotechnology

Unit 1. Types of immunity – innate and adaptive, humoral and cell-mediated immunity; lymphoid organs – primary and secondary; cells of the immune system; immunogens and antigens – characteristics, classes of antigens; MHC - Structure and regulation of its expression; Role of APCs and TCR in antigen processing and presentation; Maturation, activation and differentiation of B and T cells; Regulation of B cell development and immune response; Antibody – structure, types & functions; Generation of antibody diversity

Unit 2. Immune effector mechanisms: Cytokines – types and receptors; Complement – Components, their functions and activation; Biological consequences of complement activation and regulation; General properties of effector T cells, Cytotoxic T cells, and NK cells; ADCC and its assessment - Leukocyte migration; Hypersensitivity – Types (I - IV).

Unit 3. Immunodeficiencies – Primary and Secondary; Autoimmunity – organ specific and systemic diseases; Mechanism for induction of autoimmunity; Immunological basis of graft rejection, clinical manifestation of graft rejection; Histocompatibility testing - HLA typing - HLA 1 and 2, cross matching, serological, cellular and genomic typing; Immunosuppressive therapy; Tumor Immunology - tumor antigens, classification, immune responses to tumors, immune therapy to cancer

Unit 4. Ag-Ab interactions; Agglutination based assays – WIDAL, VDRL, blood grouping, CRP; precipitation based assay – Ig quantification by SRID, double immunodiffusion, immunoelectrophoresis; Effector cell assays – PFC, lymphocyte stimulation test, CM lympholysis, ELISA, RIA, ELISPOT

Unit 5. Hybridoma technology - murine monoclonal antibody production and enrichment, Human monoclonal antibodies, T cell hybridomas; Abzymes; antibody engineering; Chimeric and humanized antibodies and their applications; Immunoconjugates – immunotoxins and immunotargeting; FACS, immunohistochemistry

Text books:

1. Coleman R.M., Lombard M.F., Sicard R.E and Rencricca N.J.,Fundamental Immunology,(1994), 3rd ed., Wm.C.Brown Publishers, Iowa.
2. Goldsby R.A., Kindt T.J and Osborne B.A. 2003. Kuby Immunology, V Edn. W.H. Freeman and Co., New York.

Reference Books:

1 .Abbas A.K and Lichtman A.H. 2003. Cellular and Molecular Immunology,V Edn., Saunder's Publishers, Philadelphia.
2. Abbas A.K and Lichtman A.H. 2004. Basic Immunology, II Edn., Elsevier Inc., New Delhi.
Benjamini E., Sunshine G and Leskowitz S. 1996. Immunology: A Short Course, III Edn., Wiley-Liss Inc, New York.
3. Rao C.V., Immunology – A Text Book, (2006), Narosa Publishing House, New Delhi.
Roitt I.M and Delver P.J. 2005. Essential Immunology, X Edn., Blackwell Publications, London.
5. Roitt M., Brostoff and Male D.K., Immunology, (1996), 4th ed., Times Mirror InternationalPub. Ltd., UK.
6. Stites D.P., Terr A.I and Parslow T.G., Basic and Clinical Immunology, (1994), Prentice Hall Publishing, UK.

Course designer(s)
Dr. C. Binu Ramesh
Dr. A. Surendran

Course contents and lecture schedule

Units	Topic	Lecture hrs.	Mode of Teaching
Unit I			
1.1	Types of immunity – innate and adaptive, humoral and cell-mediated immunity.	3	
1.2	lymphoid organs – primary and secondary; cells of the immune system; immunogens and antigens – characteristics, classes of antigens; MHC - Structure and regulation of its expression;	5	
1.3	Role of APCs and TCR in antigen processing and presentation; Maturation, activation and differentiation of B and T cells; Regulation of B cell development and immune response.	5	
1.4	Antibody – structure, types & functions; Generation of antibody diversity.	5	

Unit II			
2.1	Immune effector mechanisms: Cytokines – types and receptors.	3	
2.2	Complement – Components, their functions and activation	3	
2.3	Biological consequences of complement activation and regulation; General properties of effector T cells, Cytotoxic T cells, and NK cells.	5	
2.4	ADCC and its assessment - Leukocyte migration; Hypersensitivity – Types (I - IV).	6	
Unit- III			
3.1	Immunodeficiencies – Primary and Secondary; Autoimmunity – organ specific and systemic diseases; Mechanism for induction of autoimmunity.	4	
3.2	Immunological basis of graft rejection, clinical manifestation of graft rejection	4	
3.3	Histocompatibility testing - HLA typing - HLA 1 and 2, cross matching, serological, cellular and genomic typing; Immunosuppressive therapy.	5	
3.4	Immunosuppressive therapy; Tumor Immunology - tumor antigens, classification, immune responses to tumors, immune therapy to cancer.	5	
Unit IV			
4.1	Ag-Ab interactions.	3	
4.2	Agglutination based assays – WIDAL, VDRL, blood grouping, CRP.	3	
4.3	precipitation based assay – Ig quantification by SRID, double immunodiffusion, immunoelectrophoresis.	4	
4.4	Effector cell assays – PFC, lymphocyte stimulation test, CM lympholysis.	3	
4.5	ELISA, RIA, ELISPOT	2	
Unit V			
5.1	Hybridoma technology - murine monoclonal antibody production and enrichment, Human monoclonal antibodies, T cell hybridomas; Abzymes.	3	
5.2	Antibody engineering; Chimeric and humanized antibodies and their applications; Immunoconjugates – immunotoxins and immunotargeting; FACS, immunohistochemistry.	4	

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C32	Forensic Science and Bioinfomatics	Core - 8	4	1		4

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

Preamble

The course will endow the knowledge to understand the basics of investigation procedures for physical, chemical and biological samples by applying computational tools.

Prerequisite

Basic knowledge about forensic science, bioterrorism and tools involved in bioinformatics will enable to get idea about this course.

Course outcomes

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

#	Course Outcome	Level
CO1	Outline the development of forensic science in India to examine the crime scene	K1, K3
CO2	Distinguish examination of different samples for forensic investigation	K1, K2
CO3	Describe microbes and bioterrorism impact on forensic investigation procedures	K2
CO4	Elucidate the bioinformatic tools and databases for sequence alignment methods	K4, K5
CO5	Describe evolutionary analysis by various tools; predict the homology model for drug designing and docking analysis	K3, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Forensic Science and Bioinfomatics

Unit 1: Introduction to forensic Science –Development of Forensic science in India - Organization and functions of Forensic laboratory; Physical evidences - their classification and significance, Crime Scene examinations - documentation of crime scene- recognition, collection, preservation and transportation. Fundamentals of crime scene photography. Tool marks - identification - restoration of field off/erased marks.

Unit 2: Foot and tyre impressions - examination of foot and tyre prints. Finger prints - Finger print patterns and classification – Toxicology - classification and mode of action of poisons - narcotic drugs - alcoholic beverages - Examination of biological fluids - blood, seminal and saliva Examination of hair, bones, teeth and skull - Fundamentals of DNA typing.

Unit 3: Types and identification of microorganisms, bacteria and fungi of forensic significance, Techniques in forensic microbiology. Bioterrorism- Types of biological agents – Category A, B, C. Planning and response to bioterrorism – Preparedness, Biosurveillance, Biodefence. Epidemiology of Bioterrorism- Study of spore, powdered minerals and pollens of forensic importance, Use of pollen grains & spores in criminal or civil investigation

Unit 4: Introduction – Bioinformatics and databases – sequence, structure & domain, application and scope. Biological databases: Nucleotide sequence databases – protein databases – specialized sequence data bases. Data retrieval and analysis. Sequence alignment: Types - local and global alignment. Alignment methods – pair wise sequence alignment: FASTA and BLAST. Introduction to ORF and primer designing. Secondary structure prediction: GOR, Chou – Fasman.

Unit 5: Multiple sequence alignment – methods and softwares – Clustal W, Multalign – phylogenetic analysis. Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure. Drug designing and docking analysis. Sturcture visualization tool- RASMOL. micro RNA SnRNA analysis

Text books:

1. Attwood, T.K., Parry-Smith, D.J. and Phukan, S. 2011. Introduction to Bioinformatics. Pearson Education, Asia, New Delhi.
2. James, S.H., and Nordby, J.J. 2005. Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton.

Reference books:

1. Baxevanis, A.D. and Qullette, B.F.F. 2001. Bioinformatics - Practical guide to analyse genes and proteins. Willey International Science Publications. New York.
2. Bevel, T., and Gardner, R.M. 2008. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton.
3. Bosu, O. and Thukral, S.K. 2007. Bioinformatics – databases, tools and algorithms. Oxford University Press. UK.
4. Duncan, G.T., and M.I. Tracey, M.I. 1997. Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton .
5. Hepsyba, S.G.H. and Hemalatha, C.R. 2009. Basic Bioinformatics. MJP Publishers, Chennai.
6. Khan, I.A. 2007. Elementary Bioinformatics. Pharma Book Syndicate, Hyderabad.
7. Krawetz., S.A. and Womble, D.D. 2009. Introduction to Bioinformatics – A theoretical and Practical Approach. Human Press, New Jersey.
8. Lesk, M.A. 2011. Introduction to Bioinformatics. Oxford University Press. UK.
9. Mount, W. 2001. Bioinformatics - Sequence and Genome analysis. Cold Springer Harber Laboratory Press, New York.
10. Murthy, 2008. Bioinformatics, Himalayan Publishing House Pvt. Ltd., Mumbai.
11. Nanda, B.B., Tiwari, R.K. 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi.
12. Pevsner, 2009. Bioinformatics and Functional Genomics – The analysis of genes and proteins . II Edn. Wiley International Science Publications, New York.
13. Poklis. 1997. Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton.
14. Rajadurai, M. 2010. Bioinformatics – A practical approach, PBS Book Enterprises, nai
15. Roy, D. 2009. Bioinformtics. Narosa Publishing House, New Delhi.
16. Stekel, D. 2005. Microarray Bioinformatics. Cambridge University Press, UK.
17. Tilstone, W.J., M.L. Hastrup, M.L., and C. Hald, Fisher's, C. 2013.Techniques of Crime Scene Investigation, CRC Press, Boca Raton .
18. Twyman, R.H. 2003. Instant notes on Bioinformatics. Viva Books Ltd., New Delhi

Course designer(s)

Dr. M. Karthikeyan

Course contents and lecture schedule

Units	Topic	Lecture hrs.	Mode of Teaching
1.1	Introduction to forensic Science –Development of Forensic science in India - Organization and functions of Forensic laboratory	5	

1.2	Physical evidences - their classification and significance, Crime Scene examinations - documentation of crime scene- recognition, collection, preservation and transportation	5	
1.3	Fundamentals of crime scene photography. Tool marks - identification - restoration of field off/erased marks.	4	
2.1	Foot and tyre impressions - examination of foot and tyre prints	3	
2.2	Finger prints - Finger print patterns and classification – Toxicology - classification and mode of action of poisons - narcotic drugs - alcoholic beverages	6	
2.3	Examination of biological fluids - blood, seminal and saliva Examination of hair, bones, teeth and skull - Fundamentals of DNA typing	6	
3.1	Types and identification of microorganisms, bacteria and fungi of forensic significance, Techniques in forensic microbiology	6	
3.2	Bioterrorism- Types of biological agents – Category A, B, C. Planning and response to bioterrorism – Preparedness	5	
3.3	Biosurveillance, Biodefence	4	
3.4	Epidemiology of Bioterrorism- Study of spore, powdered minerals and pollens of forensic importance, Use of pollen grains & spores in criminal or civil investigation	5	
4.1	Introduction – Bioinformatics and databases – sequence, structure & domain, application and scope	3	
4.2	Biological databases: Nucleotide sequence databases – protein databases – specialized sequence data bases. Data retrieval and analysis	3	
4.3	Sequence alignment: Types - local and global alignment. Alignment methods – pair wise sequence alignment	3	
4.4	FASTA and BLAST. Introduction to ORF and primer designing. Secondary structure prediction: GOR, Chou –Fasman	3	
5.1	Multiple sequence alignment – methods and softwares – Clustal W, Multalign – phylogenetic analysis	3	
5.2	Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure	4	
5.3	Drug designing and docking analysis. Sturcture visualization tool-RASMOL	3	
5.4	micro RNA SnRNA analysis	5	

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Programme Code PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C33	Biostatistics and Mathematical Modelling	Core - 9	4	1		4

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

Preamble

This course provided the knowledge and perceptive to solve problems from the univariate to bivariate analysis. The students will learn to approach a research problem logically and will be able to do statistical analyses in research.

Prerequisite

Knowledge about the basic mathematics and computer operating system will make to easy understanding steps to this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Understanding the graphical representation of data and experimental design	K1
CO2	Depict the descriptive statistics with problem solving	K3, K4, K5
CO3	Examine the correlation and regression analysis	K3, K5
CO4	Explore the modelling concept and its classification	K3
CO5	Mathematical modelling through ordinary differential equations with regards to biological concept	K1, K2

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	**Continuous Assessment**		**End of Semester Marks**
	I Internal Marks	**II Internal Marks**	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Biostatistics and Mathematical Modelling

Unit 1: Definition – Descriptive and inferential statistic; population and sample in biological studies; variables – qualitative and quantitative; Representation of data – table, histogram, pie diagram, frequency curve and ogives; Basic concepts and principles in replication, randomization and control

Unit 2: Measures of central tendency -mean, median, mode; Measures of dispersion- range, quartile deviation, standard deviation, variance and standard error; Probability distribution (binominal, poisson and normal distribution); Confidence interval; Level of significance; Chi-square test and its application, goodness of fit.

Unit 3: Correlation - types, methods of correlation- graphic method, mathematical method, testing the significance of the coefficient of correlation; Regression analysis – equation, estimation of unknown value from known value; Analysis of variance and its application; Statistical softwares – SPSS and MS-Excel

Unit 4: Mathematical Modelling: Need, Techniques, Classifications and Simple Illustrations: Simple situations requiring mathematical modelling – The technique of mathematical modelling – Classification of mathematical models – Some characteristics of mathematical models. Mathematical Modelling through ordinary differential equations of first order: Populational growth models – growth of science and scientist – effects of immigration and emigration on population size.

Unit 5: Mathematical modelling through systems of ordinary differential equations of the first order: Prey – Predator models – Competitions models - A Simple epidemic model – A susceptible – Infected – Susceptible (SIS) model – SIS models with constant number of carriers – Simple Epidemic model with carriers – model with removal – model with removal and immigration.

Text books:

1. Gurumani, N. 2004. An Introduction to Biostatistics. MJP publishers, Chennai.
2. Kapur, J.N. 2005. Mathematical Modelling. New Age International Publishers Ltd., New Delhi.
3. Khan., IA, Khanum, A. (2004) Fundamentals of Biostatistics second edition, Ukaaz publications, Hyderabad,

Reference Books:

1. Berg, H.V. 2011. Mathematical Models of Biological Systems Oxford University Press, New York
2. Britton, N.F. 2004. Essential Mathematical Biology. Springer-verlag, New Delhi
3. Daniel, W.W (2006) Biostatistics - A foundation for analysis in health sciences, John Wiley (Asia) & Sons, Singapore.
4. Green, D.G. 1990. Cellular automata models of crown-of-thorns outbreaks. In: Acanthaster and the coral reef: A Theoretical perspective. Springer-verlg, New York.
5. Gupta S.P. 1987. Statistical Methods. Sultan Chand & Sons Publishers, New Delhi
6. Khan., IA, Khanum, A. (2004) Fundamentals of Biostatistics second edition, Ukaaz publications, Hyderabad,
7. Mishra, B.K. and Satpathi, D.K. 2007. Mathematical Modeling – Applications, Issues and Analysis. Ane Books India, New Delhi.
8. Misra, B.N. and Misra, B. K. 1998. Introductory Practical Biostatistics. Naya Prakash, Calcutta.
9. Palanichamy, S. Manoharan, M. 1994. Statistical methods for Biologists, Palani Paramount Publications, Tamil Nadu.
10. Pillai, RSN and Bagavathi, V. 1989. Statistics Theory and Practice. S Chand & Company Ltd. New Delhi.
11. Renshaw, E. 1995. Modelling Biological Populations in Space and Time. Cambridge University Press. New York.
12. Rumbaugh, J., Blaha, M., Premerlani, W., Eddy, F. and Lorensen, W. 1991. Object oriented ecosystem modelling and Desingn. Printice-Hall, New Jershy.
13. Schefler, W.C. 1980. Statistics for the biological sciences. Addison-Wesley Publishing Company, New York.
14. Sokal, R.R. and Rohif, F.J. 1987. Introduction to Biostatistics. W.H. Freeman and company, New York.
15. Sundar Rao, P.S.S. and Righard, J. 2002. An Introduction to Biostatistics. III Edn. Prentice Hall of India, New Delhi.
16. Zar, J.H. 2007. Biostatistical Analysis, IV Edn., Pearson Education Inc., New York.

Course designer(s): Dr. D. Pandiaraja and
Dr. C. Balachandran

Course contents and lecture schedule

	TOPIC	Hrs.	MODE OF TEACHING
Unit 1			
1.1	Descriptive and inferential statistics	3	
1.2	Variables- qualitative and quantitative	1	
1.3	Representation of data	3	
1.4	Concepts and principles in replication, randomization and control	2	
Unit 2			
2.1	Mean, median and mode	3	
2.2	Measures of dispersion- range, quartile	2	
2.3	Deviation, standard deviation	3	
2.4	Variance, standard error, kurtosis	3	
2.5	Probability- binomial, poisson, distribution	4	
2.6	Confidence interval and Level of significance	2	
2.7	Chi square test and goodness of fit	3	
Unit 3			
3.1	Correlation - types, methods of correlation-	3	
3.2	Regression analysis – equation, estimation of unknown value from known value;	3	
3.3	Analysis of variance and its application	3	
3.4	Statistical softwares – SPSS	2	
3.5	MS-Excel	1	
Unit 4			
4.1	Outline on Mathematical Modelling, Classifications and Simple Illustrations:	2	
4.2	Characteristics features of mathematical models	2	
4.3	Mathematical Modelling through ordinary differential equations of first order: Populational growth models	2	
4.4	Growth of science and scientist	2	
4.5	Mathematical Modelling through ordinary differential equations: effects of immigration and emigration on population size.	3	
Unit 5			
5.1	Prey – Predator models	2	
5.2	Competitions models	1	
5.3	A Simple epidemic model	2	
5.4	A susceptible – Infected – Susceptible (SIS) model	2	
5.5	Simple Epidemic model with carriers	1	
5.6	model with removal – model with removal and immigration.	3	

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CE31A	Health care biotechnology	Elective-3	4	1		4

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

Preamble

This itinerary will deals about various genetic disorders, diagnostic methods, gene therapy strategies and applications of nanotechnology.

Prerequisite

Basics about various genetic disorders, available therapy and its applications may help to get overall knowledge about the course.

Course outcomes

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

#	Course Outcome	Level
CO1	Describe different types of genetic disorders	K1, K2
CO2	Determine the diagnosis of genetic diseases by carrier screening and prenatal testing	K2, K3
CO3	Explore the various types of gene therapy	K3, K4
CO4	Outline the production of pharmaceutical products for biological applications	K4, K5
CO5	Suggest the biomedical applications of nanoparticles	K3, K5

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

Mapping of COs with POs

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

S-strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Health care biotechnology

Unit 1: Genetic disorders: Types – Definition and examples for monogenetic disorder (autosomal dominant, autosomal recessive, sex linked, maternal inheritance, imprinted genetic disorders) multifactorial disorders; Characteristics and genetic causes of Huntington's disease, cystic fibrosis, haemophilia, mitochondrial genetic disorder, Prader-Willi syndrome, Alzheimer's disease.

Unit 2: Diagnosis of genetic diseases: Carrier screening, prenatal diagnosis (amniocentesis, CVS, chemicals, ultrasonic sound, preimplantation genetic diagnosis), newborn genetic screening, pre-symptomatic testing, biochemical testing, Karyotyping, FISH and SKY, genetic microarray, exome sequencing

Unit 3: Gene therapy: Gene therapy strategies – gene augmentation, targeted killing of specific cells, targeted mutation correction, targeted inhibition of gene expression at DNA and protein level; types of gene therapy; somatic cell gene therapy (kidney and pulmonary), germ line cell therapy, stem cell therapy

Unit 4: Pharmaceutical Products – production and applications of somatostatin, insulin, interferons, B-cell growth factors, tissue plasminagen activator, blood products.

Unit 5: Bionanotechnology: Introduction to bionanotechnology and nanoparticles, biomedical applications of nanoparticles - drug carriers-liposomes, nanoshells, micelles, dendrimers and hydrogels; functionalisation of nanomaterials and Targeted drug delivery; Imaging technique; quantum dots and magnetic nanoparticles, Implants: orthopaedic and vascular; Bionanosensors: nanocantilevers based on single stranded DNA.

Text books:

1. Balaji, S. 2010. Nanobiotechnology. MJ.P.Publications, New Delhi.
2. Kelly, E.B. 2013. Encyclopedia of human genetics and disease. ABC-CLIO/Greenwood, California.
3. Milunsky, A. And Milunsky, J..M. 2015. Genetic disorders and the Foetus: Diagnosis, prevention and treatment. Wiley-Blackwell Publsihers, USA.

Reference books:

1. Bhatia, M. 2010. Nanotechnology. Anmol Publications Pvt.Ltd.,, New delhi.
2. Chattopadhyay, K.K. and Banerjee, A.N. 2012. Introduction to Nanoscience and Nanotechnology. PHI Learning Pvt. Ltd., New Delhi.
3. David, N., Sabine, C. and Delnatte, Y.J. 1988. Genetically Engineered Human Therapeutic Drugs, Stockton Press, Mac Millan Publishers Ltd, USA.
4. Glick, B.K. and Pasternak, J.J. 2007. Molecular Biotechnology Principles and Applications of Recombinat DNA, III EDn. ASM Press, Washington, D.C.
5. Kumaresan, V. 2009. Biotechnology, Saras publications, Nagercoil.
6. Niemeyer, C.M. and Mirkin, C.A. 2006. Nanobiotechnology Concepts : Application and properties. Wiley, VCH Publishers.
7. Pasterneck, J.J. 2005. An introduction to Human Molecular Genetics. II Edn. Wiley-Blackwell Publsihers, USA.
8. Poole, Jr. C.P. and Owens, F.J. 2009. Introduction to Nanotechnology. Wiley India Pvt. Ltd., New Delhi.
9. Primrose, S.B. and Twyman, R.M. 2009. Principles of Gene manipulation and Genomics, VII Edn., Blackwell publishing, UK.
10. Tuan Vo Dinh, 2007. Nanotechnology in Biology and Medicine: Method, Devices and Applications. CRC Press, USA
11. Verlinsky, Y. and Kuliev, A. 2004. An Atlas of preimplantation genetic diagnosis: An illustrated textbook and reference for clinician. II Edn. CRC Press, USA
12. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz , J.A. and Weiner, A. M. 1998. Molecular Biology of the Gene, IV Edn. The Benjamin Cummings Publishing Company Inc., Tokyo.

Course desiner(s):

Dr. N. Arun Nagendran

Mr. S. Kulandaivel

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Genetic disorders: Types – Definition and examples for monogenetic disorder (autosomal dominant, autosomal recessive, sex linked, maternal inheritance, imprinted genetic disorders) multifactorial disorders	6
1.2	Characteristics and genetic causes of Huntington's disease, cystic fibrosis, haemophilia, mitochondrial genetic disorder, Prader-Willi syndrome, Alzheimer's disease	6

Unit II		
2.1	Diagnosis of genetic diseases: Carrier screening, prenatal diagnosis (amniocentesis, CVS, chemicals, ultrasonic sound, preimplantation genetic diagnosis)	4
2.2	Newborn genetic screening, pre-symptomatic testing, biochemical testing	3
2.3	Karyotyping, FISH and SKY	6
2.4	Genetic microarray, exome sequencing	4
Unit- III		
3.1	Gene therapy: Gene therapy strategies – gene augmentation	3
3.2	Targeted killing of specific cells, targeted mutation correction, targeted inhibition of gene expression at DNA and protein level	4
3.3	Types of gene therapy; somatic cell gene therapy (kidney and pulmonary), germ line cell therapy	4
3.4	Stem cell therapy	3
Unit IV		
4.1	Pharmaceutical Products – production and applications of somatostatin, insulin, interferons	2
4.2	B-cell growth factors, tissue plasminagen activator, blood products	3
Unit V		
5.1	Bionanotechnology: Introduction to bionanotechnology and nanoparticles	4
5.2	Biomedical applications of nanoparticles - drug carriers-liposomes, nanoshells, micelles, dendrimers and hydrogels	4
5.3	Functionalisation of nanomaterials and Targeted drug delivery; Imaging technique	4
5.4	Quantum dots and magnetic nanoparticles, Implants: orthopaedic and vascular	4
5.5	Bionanosensors: nanocantilevers based on single stranded DNA	3

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Course Code	Course Title	Category	L	T	P	Credit
PBT19CE31B	Food processing technology	Elective-3	4	1		4

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

Preamble

This course will enable to understand the basic principles of different food processing mechanism and its mode of preparation.

Prerequisite

Basics about the importance of different food processing, storage and maintenance will enable to understand the course.

Course outcomes

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

#	Course Outcome	Level
CO1	Explore the processing of multi grains	**K1**
CO2	Explain the manufacturing process of different bakery products and fresh fruit juices	**K5**
CO3	Explore the various types of milk product production	**K2, K3**
CO4	Outline the production and processing mechanism involved in meat products	**K2, K4**
CO5	Illustrate the production of fish products	**K5**

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Food processing technology

Unit 1: Drying of grains; Processing of rice and rice products; Milling of wheat and production of wheat products, including flour and semolina; Milling, processing and production of corn, oat, sorghum, ragi products; Processing of tea and coffee

Unit 2: Manufacture of bread, cake and biscuits; Manufacture of bread rolls, sweet yeast dough products, pies and pastries, doughnuts, chocolates and candies; Analysis of bakery products; Preparation of juice, jam, jelly, squash, marmalade, pickles, and sauce; Storage and handling of fresh fruits and vegetables; Preservation of fruits, vegetable and fruit juice

Unit 3: Varieties of milk; Manufacture of milk products evaporated milk, powder milk, condensed milk, cream butter, cheese, yogurt, ice cream, ghee.
Spoilage and preservation of milk

Unit 4: Meat processing - curing and smoking; Fermented meat products (meat sausages & sauces); Frozen meat & meat storage; Processing of poultry meat and eggs; Spoilage and control.

Unit 5: Fish products - production of fish meal, fish protein concentrate, fish liver oil and fish sauce; Spoilage of Fish; Methods of Preservation of fish: Canning, Freezing, Drying, Salting, Smoking and Curing.

Text books:

1. Bhatti, S and Varma, U. 1995. Fruit and Vegetable Processing. CBS Publishers and distributors, New Delhi
2. Chakraverty A and De DS. 1981. Post-harvest Technology of Cereals, Pulses and Oilseeds. Oxford & IBH.
3. Matz. S.A., 1991. Bakery technology and Engineering, Springer,New York.
4. Potter, N.N. and J.H. Hotchkiss. 1995. Food Science, V Edn. Springer, New York

Reference books:

1. Cruesss W.V. 2000. Commercial Fruit and Vegetable Products. Agrobios
2. Harper, J,M. 1981. Extrusion of Food, Vol 2. CRC Press. Florida.
3. Jongen, W. 2002. Fruit and vegetable processing, I Edn. Woodhead Publishing. Elsevier, Amsterdam
4. Srivastava R.P and Sanjeev Kumar. 1994. Fruit and Vegetable Preservation. Principles and Practices. International Book Dist. Mumbai.
5. Thompson A.K. 1996. Post Harvest Technology of Fruits and Vegetables. Blackwell.
6. Verma L.R and Joshi V.K. 2000. Post Harvest Technology of Fruits and Vegetables. Vols. I-II. Indus Publishing Company, New Delhi.

Course designer(s):

Dr. N. Arun Nagendran Mr. S. Kulandaivel

Course contents and lecture schedule

Units	Topic	Lecture hrs.
Unit I		
1.1	Drying of grains; Processing of rice and rice products	3
1.2	Milling of wheat and production of wheat products, including flour and semolina	5
1.3	Milling, processing and production of corn, oat, sorghum, ragi products; Processing of tea and coffee	5
Unit II		
2.1	Manufacture of bread, cake and biscuits	3
2.2	Manufacture of bread rolls, sweet yeast dough products, pies and pastries, doughnuts, chocolates and candies. Analysis of bakery products	5
2.3	Preparation of juice, jam, jelly, squash, marmalade, pickles, and sauce	6
2.4	Storage and handling of fresh fruits and vegetables; Preservation of fruits, vegetable and fruit juice	3
Unit- III		
3.1	Varieties of milk	2
3.2	Manufacture of milk products evaporated milk, powder milk, condensed milk	3
3.3	Cream butter, cheese, yogurt, ice cream, ghee	3
	Spoilage and preservation of milk	4
Unit IV		
4.1	Meat processing - curing and smoking	3
4.2	Fermented meat products (meat sausages & sauces); Frozen meat & meat storage	5
4.3	Processing of poultry meat and eggs; Spoilage and control	3
Unit V		
5.1	Fish products - production of fish meal, fish protein concentrate, fish liver oil and fish sauce	4
5.2	Spoilage of Fish; Methods of Preservation of fish	3
5.3	Canning, Freezing, Drying, Salting, Smoking and Curing	3

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CL31	Lab in Immunology & Immunotechnology				5	3

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

Preamble

The course will provide knowledge on the hands on activities, projects and technical skills in the field of immunotechnology.

Prerequisite

Students should take introduction to immune response , types of immunity and electrophoresis will make to easy understanding steps to this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Acquire the knowledge on preparation of soluble antigens and its preservation.	**K1, K3**
CO2	Depict the principle of Isolation and enumeration of lymphocytes from human blood.	**K4, K5**
CO3	Perceive the knowledge on direct agglutination to determine ABO blood grouping.	**K2, K4**
CO4	Demonstrate the Immunoelectrophoretic techniques.	**K3, K5**

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Title of the paper: Lab in Immunology & Immunotechnology

1. Preparation of soluble antigen – human serum
2. Preparation of cellular (particulate) antigen - bacterial antigen
3. Separation and preservation of serum / complements.
4. Determination of differential leukocyte count.
5. Isolation and enumeration of lymphocytes from human blood.
6. Determination of lymphocyte viability by trypan blue exclusion test.
7. Identification and enumeration of human T – lymphocyte using E – rosette technique
8. Direct agglutination to determine ABO blood grouping
9. Visualization and study of Lymphoid Organs from mice and Chicken (Model)
10. Immunization protocols
11. Routes of antigen administration.
12. Demonstration of natural resistance to infection by bacterial killing of serum factors.
13. Electrophoretic separation of serum proteins.
14. Immunoelectrophoretic technique
15. Agarose Ouchterlony double immunodiffusion.
16. Mancini single radial immunodiffusion.
17. Haemagglutination titration assay.
18. Immunodiagnosis – Pregnancy test, HIV/ WIDAL

Reference books:

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

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Programme Code PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CL32	Lab in Bioinformatics and biostatistics	Lab			5	3

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

Preamble

The course will provide knowledge on the hands on activities, projects and technical skills in the field of bioinformatics.

Prerequite

Students should take introduction to basics in computer, internet, biotools and statistics will make to easy understanding steps to this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Acquire the knowledge on Retrieval of nucleotide sequence data and protein sequence data.	**K1**
CO2	Depict the sequence alignments	**K2, K3**
CO3	Perceive the knowledge on Retrieving PDB sequence data and analysis of secondary structure.	**K1, K2**
CO4	Demonstrate the Bioengineering using DOCK – ADAM	**K4, K5**
CO5	Evaluating mean, median, mode, standard deviation and its interpretation and Fitting the Regression lines for the given data	**K4, K5**

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

Mapping of COs with POs

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

Title of the paper: Lab in Bioinformatics and biostatistics

1. Retrieval of nucleotide sequence data and protein sequence data.
2. Pair-wise sequence alignment by using BLASTn and BLASTp.
3. Multiple sequence alignment by using ClustalW.
4. Primer designing using free internet software.
5. Phylogenetic analysis of protein and nucleic acid by using MEGA-4.
6. Retrieving PDB sequence data and analysis of secondary structure
7. Protein prediction – nep cutter and pep cutter
8. Homology modeling of a protein using SPDBV.
9. Gene profiling
10. Bioengineering using DOCK – ADAM
11. Graphical representation of data
12. Evaluating mean, median, mode, standard deviation and its interpretation
13. Test of significance using Z test, t test, Chi square test
14. Non parametric test: Mann Whitney, Kruskal Wallis
15. ANOVA
16. Finding the Correlation coefficient for the given data
17. Fitting the Regression lines for the given data
18. Note:
19. Wherever necessary/possible, Statistical practicals will be conducted using MS-Excel, SPSS

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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19C41	Bioprocess technology	Core – 10	4	1		4

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

Preamble

This course is to provide students with an extensive and concise knowledge about bioprocess principles and strategies to optimize the production of byproducts from industrial important microbial strains. In addition to this students will understand the fundamental concepts of fermentation; aerobic and anaerobic fermentation, production of biotechnologically important products, exopolymers and steps involved in upstream and downstream processes

Prerequisite

Knowledge about the sterilization technique involved in bioprocess and downstream process will help to appreciative move to this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Screening industrial important microbe and its preservation technique	K3, K4
CO2	Describe the comprehension of types of fermentor, fermentation and sterilization	K1, K3
CO3	Apply the perception of growth kinetic patterns; Cell and enzyme immobilization and its application	K3, K5
CO4	Acquire the knowledge on production and assay of biologically important materials	K1, K3
CO5	Apply the concept of downstream processing; instrumentation technique	K3, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Bioprocess Technology

Unit 1: Introduction to Bioprocess engineering; Isolation of productive strains; screening - primary and secondary screening; strain improvement – mutation, protoplast fusion and recombinant DNA techniques; Preservation techniques - serial sub-culture, mineral oil, freeze drying, N_2 storage, Storage of fungi - soil culture, silica gel culture and water storage; fermentation media – carbon and nitrogen sources, media formulation – Packet-Burmen design and Box Wilson design

Unit 2: Types of fermentation - solid state fermentation and submerged fermentation; types of substrates; methods of fermentation - batch, continuous and fed batch system; Types and design of fermentors - batch, CSTF, air lift, tower, bubble column, fluidized bed fermentor; auxiliary equipments; sterilization – batch sterilization, continuous sterilization (media and fermentor), sterilization of air, sterilization kinetics of cell death

Unit 3: Material balance in biological system; energy balance in biological system; growth kinetics in batch and continuous cultures; maintenance requirement; mass transfer and heat transfer; production kinetics in fed batch culture; feed of concentrated media, feed of dilute substrate; Cell and enzyme immobilization and its applications

Unit 4: Inoculum development, production, recovery and assay of antibiotics (penicillin, streptomycin) and Vitamins (cyanocobalamine, riboflavin), amino acids (glutamic acid, phenylalanine), and organic acids (citric acid, vinegar) and enzymes (amylase, protease), alcoholic beverages (alcohol and wine)

Unit 5: Downstream processing – release of intracellular compounds – physical and chemical methods; methods of recovery - filtration, centrifugation, precipitation, liquid-liquid extraction, chromatography, dialysis, reverse osmosis, drying, crystallization, lyophilization

Text books:

1. Crueger, W. and Crueger, A. 2005. Biotechnology: A Test Book of Industrial Microbiology, II Edn., Panima Publishing corporation, New Delhi.
2. Kalaichelvan, P.T. and Arul Pandi, I. 2007. Bioprocess Technology, MJP publishers, Chennai.
3. Patel, A.H., 1996, Text Book of Industrial Microbiology, MacMillan India Ltd., New Delhi

Reference Books:

1. Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.
2. Casida, J.F. 2010. Industrial Microbiology, New Age International India Pvt. Ltd., New Delhi.
3. Cruger, W., Cruger, A. and Brock, T.D. 1991. Biotechnology, A Text book of Industrial Microbiology
4. Demain A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology & Biotechnology. ASM press.
5. El-Mansi, E.M.T., Bryce, C.F.A., Dahhou, D., Sanchez, S., Demain, A.L. and Allman, A.R. 2012. Fermentation Microbiology and Biotechnology. III Edn., CRC Press, London.
6. Flickinger, M.C. and Drew, S.W. 1999. Encyclopaedia of Bioprocess Technology Fermentation, Biocatalysis and Bioseperation Vol. V., John Wiley and Sons Publications.
7. Glazer, A.N. and Nikaido, H. 1995. Microbial Biotechnology – Fundamentals of Applied Microbiology. W.H. Freeman and Company. New York.
8. Peppler, H. and Pearman, D. 2008. Microbial Technology, II Edn. Vol.I, Academic Press, New York.
9. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New Delhi.
10. Stanbury, P.F, Whitaker, A. and Hall, S.J.1999. Principles of Fermentation technology, II Edn. Aditya Book (P) Ltd., New Delhi.
11. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. 2001. Industrial Microbiology: An Introduction, Blackwell Science, London.

Course designer(s): Mr. S. Kulandaivel

Course contents and lecture schedule

Unit	TOPIC	Hrs.
1.1	Introduction- isolation of productive strains	1
1.2	Primary and secondary screening	2
1.3	Strain improvement – mutation, protoplast fusion and	3

	recombinant DNA techniques	
1.4	Preservation techniques	1
1.5	Storage of fungi	1
1.6	Fermentation media	1
1.7	Media formulation-Placket-Burmen ad Box Wilson design	2
Unit 2		
	Types of fermentation- solid state and submerged	2
	Types of substrates	2
	Methods of fermentation	3
	Types and design of fermentors	3
	Sterilization- batch, continuous (media and fermentor) sterilization of air	3
	Sterilization kinetics of cell death	2
Unit 3		
	Material balance in biological system	2
	Energy balance in biological system	2
	Growth kinetics in batch and continuous cultures	1
	Production kinetics in fed batch culture	1
	Cell and enzyme immobilization-applications	3
Unit 4		
	Inoculums development, production, recovery and assay of antibiotics-penicillin	3
	Streptomycin	1
	Chloramphenical	1
	Vitamins (cyanogobalamine, beta carotene)	2
	Amino acids (glutamic acid, phenyalanine)	2
	Organic acids (citric acid, lactic acid)	2
	Enzymes (amylase, protease)	2
	alcoholic beverages (alcohol and wine)	2
Unit 5		
	Download processing	2
	Methods of recovery- filtration, centrifugation, precipitation	3
	Liquid-liquid extraction	2
	Chromatography	2
	Dialysis, reverse osmosis	3
	Drying, cyrstallization and Lyophilization	3

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Course Code	Course Title	Category	L	T	P	Credit
PBT19C42	Rural and entrepreneurial biotechnology	Core - 11	4	1		4

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

Preamble

The course provided baseline data about rural resource and helpful to entrepreneurs in getting a basic understanding on management of biotechnology business; integrate biotechnological principles to solve ecological problems

Prerequisite

Knowledge about the agro-based industry and raw material resource availability will assist to become successful entrepreneur

Course Outcomes

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

#	Course Outcome	Level
CO1	Acquire preparation procedure and uses to green/organic manures	K1, K3
CO2	Comprehend information to mushroom and spirulina cultivation	K2, K4
CO3	Describe the biofertilizer and biopesticide production	K3, K5
CO4	Enlist the function and services of biotech park with initiating government autonomous bodies.	K2, K4
CO5	Preparing project plan with cost analysis and marketing planing	K4, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Rural and entrepreneurial biotechnology

Unit 1: Organic farming – green manure, green leaf manure, farm yard manure, concentrated organic manure (oil cakes), panchagavya, Dasagavya, composting – vermicompost, coir compost, composting of poultry waste

Unit 2: Mushroom cultivation – edible and non-edible mushroom, Preparation of mother spawn, bed spawn, bed preparation, production technology (paddy straw mushroom, oyster mushroom, milky mushroom, button mushroom), post harvest technology; SCP – cultivation of spirulina, baker's yeast

Unit 3: Biofertilizers - mass production and mode of application of *Rhizobium, Azospirillum,* phosphate solublizers, iron chelators, AM;
Biopesticides large scale cultivation and mode of application of *Bacillus thuringiensis, Beauveria bassiana*, NPV, CPV

Unit 4: Biotech parks – concept, functions, facilities and services; initiatives of government, BCIL (Biotech Consortium of India Limited), CSIR, DBT, DST, NSTEDB (National Science and Technology Entrepreneurship Development Board); regulations and requirements

Unit 5: Market potential, production capacity, project costs, cost analysis and regulation for organic farming and commercial production of biofertilizer, biopesticides and enzymes

Text books:

1. Anonymous. 2007. Entrepreneurship development programme in biotechnology. Department of biotechnology of India.
2. Anonymous. Organic farming. TNAU agricultural portal, agritech.tnau.ac.in/org_ farm/orgfam_index.html.

Reference books:

1. Alexander M. 1997. Introduction to soil microbiology, John Wiley & Sons, Inc, New York.
2. Benwart, G.J. 1987. Basic Food Microbiology, CBS Publishers & Distributors, New Delhi.
3. Deak, T. and Beuchat, L.R. 1996. Hand Book of Food Spoilage yeasts, CRC Press, New York.
4. Mehrotra, R.S. 1983. Plant Pathology, Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. Pandy, B.P. 1997. Plant Pathology (Pathogen & Plant Disease), S.Chand & Company Ltd., New Delhi.
6. Ray Chadhuri, S.P. 1977. A Manual of Virus Diseases of Tropical Plants, MacMillan Company of India Ltd., Delhi.
7. Rengaswami, G. and Rajagopalan, S. 1973. Bacterial Plant Pathology – Tamil Nadu Agriculture University, Coimbatore.
8. Subba Rao, N.S. 2000. Soil Microorganisms and Plant Growth, Third Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Course designer(s): Dr. N. Arun Nagendran and Mr. S. Kulandaivel

Course contents and lecture schedule

Units	TOPIC	Hrs.
Unit 1		
1.1	Organic farming – green manure, green leaf manure, farm yard manure, concentrated organic manure	4
1.2	Explain the panchagavya, Dasagavya,	4
1.3	composting – vermicompost, coir compost, composting of poultry waste	3
Unit 2		
2.1	Distinguish between the edible and non-edible mushroom	1
2.2	Preparation of mother spawn, bed spawn, bed	3
2.3	preparation, production technology (paddy straw mushroom, oyster mushroom, milky mushroom, button mushroom)	3
2.4	post harvest technology;	1
2.5	SCP – cultivation of spirulina, baker's yeast	3
Unit 3		
3.1	Biofertilizers – Rhizopium, Azospirillum	3
3.2	Phosphate solubilizers, iron chelators	3
3.3	VAM	2

3.4	Biopesticides – Bacillus thuringiensis	2
3.5	Beauveria bassiana	2
3.6	NPV,CPV	3
Unit 4		
4.1	Biotech parks – concept, functions, facilities and services;	2
4.2	initiatives of government, BCIL, CSIR, DBT, DST, NSTEDB	4
4.3	initiatives of government: Regulations and requirements	2
Unit 5		
5.1	Market potential and production capacity	2
5.2	project costs and cost analysis	3
5.3	regulation for organic farming	3
5.4	commercial production of biofertilizer, biopesticides and enzymes	4

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Course Code	Course Title	Category	L	T	P	Credit
PBT19CE41A	Environmental Biotechnology	Elective- 4	4	1		4

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

Preamble

The students will learn the biological means of removing the toxic pollutants from the water, air and soil in order to clean the environment. Also learn the biotechnological processes of solid waste management and reclamation of waste land.

Prerequisite

Knowledge about the basics of environmental concept and importance of green environment through biotech approach will facilitate to understand this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Explain the ecosystem concept and their impacts	K1,K2
CO2	Describe the stage wise waste treatment both water and solid	K2, K3
CO3	Examine the environmental toxic pollutants and its bioremediation	K4,K5
CO4	Apply the knowledge on nanotechnology in pollution abatement	K3, K5
CO5	Explore the awareness to EIA and its importance	K1, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	**Continuous Assessment**		**End of Semester Marks**
	I Internal Marks	**II Internal Marks**	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Environmental Biotechnology

Unit 1: Ecosystem and its components; Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factors; Energy flow, food chain, food web and trophic levels; types of pollution and their effects – land, water and air, global climate change and its impact.

Unit 2: Waste water treatment - Waste water collection, Physico-chemical properties of water; primary treatment – anaerobic digesters, secondary treatment – oxidation ponds, trickling filters, tertiary treatment – activated charcoal, chlorination
Solid waste management – sources, steps involved in solid waste management, solid waste disposal – open dumping, sanitary landfills, thermal treatment, biological treatment

Unit 3: Biotechnology for processing and waste management in pesticide, tannery, textile, dye and food industries; Biodegrdation of hydrocarbons, Bioleaching of copper and uranium; e-waste and hospital waste management. Bioremediation – types, biomechanism of metal chelation and detoxification; Bioenergy production (hydrogen production, biodiesel from algae); bioplastics

Unit 4: Application of nanotechnology in pollution abatement – photocatalyst oxidation (TiO_2 based nanoparticles), reduction (iron based nanoparticle), absorption (nanoclay), encapsulation (dendrimers), nanofiltration (nanosieve membranes); nanosensors, CO_2 capture, adsorption of toxic gases

Unit 5: EIA: Introduction, definition, Objectives, basic principles and classification; Strategic EIA (SEIA), Regional EIA, Sectoral EIA, Project Level EIA and Life Cycle Assessment, Project Cycle, Grouping of Environmental Impacts - direct impacts, indirect impacts, cumulative impacts and induced impacts; Significance of impacts - criteria/methodology to determine the significance of the identified impacts.

Text books:

1. Atlas, R.M., 2000. Microbiology Fundamentals and Applications, MacMillan Pub. Co., New York.

2. Jogdand, S.N.2010. Environmental Biotechnology, Himalaya Publishing House. New Delhi

Reference Books:

1. Allsopp, D., and J.Seal, 1986, Introduction to Biodeterioration, Edward Arnold Pub. London.
2. Chatterji, A.K. 2005.Introduction to Environmental Biotechnology.
3. Markandy, D.K and N. Rajvaidys. 2004. Environmental Biotechnology. APH Publishing Corporation, New Delhi.
4. Mohapatra, P.K. 2006. Text book of environmental biotechnology, I.K. International publishing house, New Delhi.
5. Norris, R.D. 1994, Handbook of Bioremediation, Lewis Publishers, London.
6. Prescott, L.M., Harley, J.P. and Helin, D.A. 2008. Microbiology, Fifth Edition, McGraw Hill, New Delhi.
7. Rajendran, P and Gunasekaran, P. 2006. Microbial Bioremediation. MJP Publishers, Chennai.
8. Stilling, P. 2009. Ecology – Theories and Applications. IV Edn., Pearson Education Inc. New Jersey.
9. Subba rao, N.S. 2001. Soil microbiology. Raju Primlani Publishing Pvt. Ltd., New Delhi.

Course designer(s): Dr. N. Arun Nagendran and Mr. S. Kulandaivel

Course contents and lecture schedule

Units	TOPIC	Hrs.
Unit 1		
1.1	Interactions between environment and biota	1
1.2	Concept of habitat and ecological niches	2
1.3	Energy flow, food chain, food web and tropic levels	2
1.4	Types of pollution and their effects- land, water, air	3
1.5	Global climate change and its impact	1
Unit 2		
2.1	Waste water treatment-primary treatment	2
2.2	Secondary treatment	2
2.3	Tertiary treatment	2
2.4	Solid waste management- steps	3
2.5	Solid waste disposal methods	3
Unit 3		
3.1	Bioprocessing and waste management in Pesticide, tannery, textile industries, dye and food industries	4
3.2	Biodegradation of hydrocarbons	2
3.3	Bioleaching of copper and uranium	2

3.4	e-waste and hospital waste management	2
3.5	Bioenergy production (hydrogen production, biodiesel from algae	3
3.6	Bioremediation – types, biomechanism of metal chelation and detoxification	3
3.7	Bioplastics	1
Unit 4		
4.1	Application of nanotechnology in pollution abatement – photocatalyst oxidation, reduction, absorption, encapsulation, nanofiltration	3
4.2	Nanosensors	1
4.3	CO_2 capture,	1
4.4	adsorption of toxic gases	2
Unit 5		
5.1	EIA: Basic principles and classification	2
5.2	Strategic EIA (SEIA), Regional EIA, Sectoral EIA, Project Level EIA and Life Cycle Assessment,	2
5.3	Grouping of Environmental Impacts - direct impacts, indirect impacts, cumulative impacts and induced impacts	3
5.4	Significance of impacts - criteria/methodology to determine the significance of the identified impacts.	2

Thiagarajar College (Autonomous):: Madurai – 625 009
Department of Biotechnology
(For those joined on or after June 2019)
Programme Code PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CE41B	Nanobiotechnology	Elective- 4	4	1		4

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

Preamble

After completion of this course, the students will be able to explain the methods of synthesize, characterization of nanoparticles. Also learn the nanomaterial applications.

Prerequisite

Basics about the importance of different types of nanomaterial and their uses will enable to understand the course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Explain the concept of nanoscience and their significance	K1,K2
CO2	Describe the nanoprocessess in nature (lotus effect, Colour patterns in butterflies, Adhesive pads in lizards)	K2, K3
CO3	Elucidate the nanoparticles synthesis and characterization	K4,K5
CO4	Expound the fabrication of nanomaterials- lithography and thin film deposition; Nanocomposities- significance and application	K3, K5
CO5	Enlist the health and environmental issues about nanoparticles	K1, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Blooms Taxonomy			
Category	Continuous Assessment		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge -K1	20%	20%	20%
Understand -K2	20%	20%	20%
Apply-K3	20%	20%	20%
Analyze-K4	20%	20%	20%
Evaluate-K5	20%	20%	20%
Total Marks	**60**	**60**	**150**

Title of the paper: Nanobiotechnology

Unit 1: Introduction to Nanoscience and basic concepts; Interaction of surface molecules and its chemical and physical properties; Nanoprocessess in nature - lotus effect, colour patterns in butterflies, adhesive pads in lizards; Different types of nanoparticles - metallic nanoparticles - Gold/silver, titanium based, non metallic nanoparticles - carbon and silicon based.

Unit 2: Synthesis of nanoparticles - solid state, vapour state and solution based (mechanical ball milling, sol gel process, chemical vapor deposition); Characterization of nanoparticles - spectroscopic methods (UV-visible, FTIR, Raman spectroscopy, NMR), microscopic (AFM, Scanning and Transmission Electron microscopy), Structural (XRD), EDAX

Unit 3: Fabrication of nanomaterials: Lithography and Thin film deposition, high energy Arc discharge. Polymer nanoparticles, biomaterials, nanocomposities- Its Significance and application.

Unit 4: Biomedical applications of nanoparticles: drug carriers-liposomes, nanoshells, micelles, dendrimers and hydrogels; functionalisation of nanomaterials and Targeted drug delivery. Imaging technique; quantum dots and magnetic nanoparticles, Implants: orthopaedic and vascular; Bionanosensors: nanocantilevers based on single stranded DNA.

Unit 5: Health and environmental issues about nanoparticles. Nanotoxicology, Immune response to nanoparticles, Safety concerns about using nanotechnology. The National Personal Protective Technology Laboratory (NIOSH) Guidelines for working with nanomaterials.

Text books:

Balaji, S. 2010. Nanobiotechnology. MJ.P.Publications, New Delhi.

Tuan Vo Dinh, 2007. Nanotechnology in Biology and Medicine: Method, Devices and Applications. CRC Press

Reference Books:

Bhatia, M. 2010. Nanotechnology. Anmol Publications Pvt.Ltd.,, New delhi.

Chattopadhyay, K.K. and Banerjee, A.N. 2012. Introduction to Nanoscience and Nanotechnology. PHI Learning Pvt. Ltd., New Delhi.

Niemeyer, C.M. and Mirkin, C.A. 2006. Nanobiotechnology Concepts : Application and properties. Wiley, VCH Publishers.

Poole, Jr. C.P. and Owens, F.J. 2009. Introduction to Nanotechnology. Wiley India Pvt. Ltd., New Delhi.

Pradeep, T. 2011. Nano: The Essentials. Tata Mc Graw Education Private Ltd., New Delhi.

Ratner, M and Ratner, D. 2005. Nanotechnology: A Gentle Introduction to the Next Big Idea. Pearson education.Inc.

Course designer(s):

Dr. Poornima Kkani

Course contents and lecture schedule

Units	TOPIC	Hrs.
Unit 1		
1.1	Introduction to Nanoscience and basic concepts	1
1.2	Interaction of surface molecules- physical and chemical properties	2
1.3	Nanoprocessess in nature – lotus effect, Colour patterns in butterflies, Adhesive pads in lizards	2
1.4	Metallic nanoparticles (gold, silver,titanium)	3
1.5	Non metallic nanoparticles (carbon, silicon)	1
Unit 2		
2.1	Nanoparticles synthesis – solid state, Vapour state, Solution based	2
2.2	Characterization of nanoparticles- spectroscopic methods	2
2.3	Microscopic methods (AFM,SEM,TEM)	3
2.4	Structural characterization (XRD, EDAX)	2
Unit 3		
3.1	Fabrication of nanomaterials- lithography and thin film deposition	4
3.2	High energy arc discharge	2
3.3	Polymer nanoparticles	2
3.4	Biomaterials	2
3.5	Nanocomposities- significance and application	3
Unit 4		
4.1	Biomedical applications- drug carriers liposomes, nanoshells	3
4.2	Micelles, dendrimes and hydrogels	1
4.3	Functionalisation of nanomaterials	1
4.4	Targeted drug delivery	2

4.5	Imaging technique	1
4.6	Implants- orthopaedic and vascular	1
4.7	Bionanosensors	2
Unit 5		
5.1	Health and environmental issues about nanoparticles	2
5.2	Immune response to nanoparticles	2
5.3	Safety concerns about using nanotechnology	2
5.4	NIOSH guidelines for working with nanomaterial	2

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Department of Biotechnology
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Programme Code: PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CL41	Lab in Bioprocess Technology and environmental biotechnology	Lab			5	3

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

Preamble

This course is to provide students with an extensive and concise knowledge about bioprocess techniques with strategies to optimize the production of by-products from industrial important microbial strains. In addition to this students will learn the physico-chemical properties of water.

Prerequisite

General knowledge about the microbe screening methods, media preparation and sterilization will be useful to make the learning option of this course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Understanding of strain improvement and knowing the isolation and screening of industrially important microbes.	K2, K4
CO2	Assess power requirements in bioreactors, modeling of bioprocesses, traditional and new concepts in bioprocess monitoring, and the biological basis for industrial fermentations and cell cultures	K3, K5
CO3	Impart practical skills to the students to immobilize industrially important enzymes for fermentation processes.	K3, K4
CO4	Analyse the physico-chemical properties of water samples	K1, K3
CO5	Screening the microbes for biodegradation of dyes	K3, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Title of the paper: Lab in Bioprocess Technology and environmental biotechnology

1. Demonstration of fermentation using Kuhn's fermentation vessel.
2. Screening, production and assay of amylase from microbes
3. Screening, production and assay of protease from microbes
4. Screening, production and assay of citric acid from microbes
5. Screening of antibiotic producing microbes
6. Production and assay of glutamic acid from microbes
7. Production and estimation of alcohol
8. Production and quantitative analysis of wine
9. Bacterial cell /enzyme immobilization in sodium alginate gel
10. Cell disruption for endoenzymes by sonication
11. Enzyme purification by acetone precipitation
12. Estimation of biomass and substrate concentration in fermentation, determination of kinetic parameters (yield and productivity)
13. Physico chemical analysis of effluents – TS, TSS, TDS, Acidity, Alkalinity, BOD
14. Screening of biodegrading microbes from industrial effluents
15. Biodegradation of dyes using microbes
16. Microbial assessment of waste water – MPN method and microbial load analysis
17. Submission of environmental diary (activity based)

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Programme Code PBT

Course Code	Course Title	Category	L	T	P	Credit
PBT19CL42	Lab in rural and entrepreneur biotechnology	Lab			5	3

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

Preamble

The course provided baseline data about rural resource and helpful to entrepreneurs in getting a basic understanding on management of biotechnology business; integrate biotechnological principles to solve ecological problems.

Prerequisite

Knowledge about the agro-based industry and raw material resource availability will help to complete the course.

Course Outcomes

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

#	Course Outcome	Level
CO1	Prepare Panchakavya, Vermi and coir comPSO4st	K1, K3
CO2	Cultivate the spawn for mushroom cultivation and their production	K3, K5
CO3	Isolate the rhizopium for to produce biofertilizer	K3, K4
CO4	Isolate and identify the BT endospore	K2, K3
CO5	Drafting budget proposal for organic farming	K2, K5

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

Mapping of COs with POs

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

S-Strong M-Medium L-Low

Title of the paper: Lab in rural and entrepreneurial biotechnology

1. Preparation of panchakavya

2. Production of vermicompost
3. Production of coir compost
4. Production of poultry waste compost
5. Preparation of spawn for mushroom cultivation
6. Production of mushroom
7. Isolation of AM fungi/spore
8. Isolation and identification of BT endospore
9. Isolation of rhizopium
10. Isolation of phosphate solublizing bacteria
11. Cultivation of rhizopium
12. Drafting budget proposal for organic farming, commercial production of biofertilizer / biopesticide /enzymes

M.Sc., Biotechnology

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

Title of the paper	PO1	PO2	PO3	PO4	PO5
General Microbiology	5	7	7	8	8
Biochemistry	3	5	5	4	8
Cell and Molecular Biology	6	5	3	3	5
Bioinstrumentation	5	3	5	4	4
Clinical lab technology	5	9	6	7	6
Lab in General Microbiology & Cell biology	5	7	7	8	8
Lab in Biochemistry & molecular biology	2	4	6	13	3
Genetic engineering	3	11	10	6	9
Plant Biotechnology	4	7	9	9	8
Animal Biotechnology	5	5	8	15	12
Developmental Biology	5	5	9	3	2
Genetics	4	8	8	2	3
Lab in Genetic Engineering	3	10	11	15	6
Lab in Plant and Animal Biotechnology	7	2	5	9	4
Immunology &Immunotechnology	10	3	5	7	6
Forensic science and bioinformatics	7	8	9	15	6
Biostatistics and Mathematical Modelling	6	6	6	3	2
Health care biotechnology	6	6	11	2	10
Food processing technology	9	7	8	8	6
Lab in Immunology &Immunotechnology	9	3	2	9	4
Lab in Bioinformatics and Biostatistics	7	8	9	15	6
Bioprocess technology	4	3	9	3	7
Rural and entrepreneurial biotechnology	4	9	6	2	6
Project					
Environmental Biotechnology	5	3	9	4	6
Nanobiotechnology	5	8	8	4	7
Lab in Bioprocess technology	8	1	3	8	4
Lab in Rural and Entrepreneurial biotechnology	7	3	3	6	5