

Syllabus

Certificate Course on Molecular Techniques/Genomics

ORBITO ASIA DIAGNOSTICS

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Coimbatore- 641 045 Tamil Nadu, India
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Affiliated to



BHARATHIAR UNIVERSITY

(A state University, Accredited with “A” Grade by NAAC,
Ranked 13th among Indian Universities by MHRD- NIRF,
World Ranking: Times – 801 – 1000, Shanghai – 901 -1000,
URAP -982)

Coimbatore – 641 046, Tamil Nadu, India

2022 – 2023 Onwards

About Us:

Orbito Asia Diagnostics is a comprehensive healthcare facility for imaging and diagnostic facilities, under one roof with NABL, NABH & ISO accreditation. We are one of the largest COVID RT PCR testing laboratory with the capacity of >25000 tests per day with fully automated robotic liquid handling systems. It prides of housing the latest infrastructure, the best possible medical facilities, accompanied with the most competitive prices and thorough individual care so that the customer can have the diagnostic tests done at the most efficient and cost effective means at a single point by our experienced and certified doctors and friendly supportive staff. We strive to provide ultimate diagnostic services to our clients with accurate results, highest quality imaging and comprehensive health check-up services with complete care, courtesy and compassion to our customers. Orbito Asia provides diagnostic solutions that improve patient health and ensure consumer safety. Orbito Asia is determined to continue to play a pioneering role by innovating and designing the diagnostics of the future to address the major challenges for public health. Orbito Asia offers more than 300 different tests and special profiles in pathology and diagnostic and scan services. With more than 20 collection centres across the state, our diagnostic services are unsurpassed. We believe one of the most important facets of being an outstanding reference laboratory is the quality assurance we provide in every result.

Program Highlights:

- This certification course of 3 months is designed to fulfil the need for highly skilled and trained technical person in Molecular techniques and Bioinformatics applications for the enhancement in diagnostic and research purposes.
- This practical enhanced curriculum is delivered through lectures by the renowned faculty of Bharathiar University and various enhanced in-house practical techniques.
- Regular theory and practical sessions will be conducted along with seminars carried out by Ph.D.'s and Research scholars from Molecular Division.
- Experiential learning at Orbito Asia Diagnostics and case studies conducted by experienced technical staffs helps the students deepen their knowledge about Molecular techniques and Bioinformatics applications carried out in the laboratory and pharmacy based industries.
- The course is associated with department of Biotechnology – Bharathiar University for guest lectures and higher end Practicals using their advanced facility with the help of the distinguished faculty members of the department.

Eligibility:

- B.Sc/M.Sc (Molecular biology, Microbiology, Biochemistry and Allied sciences)
- B.Tech/M.Tech (Biotechnology and Allied science)
- MBBS/MD
- Candidates working in a clinical lab, hospital, academic/research institution, Pharmaceutical, Food industry and any health sector with an interest to learn Enhanced Molecular Genomics with Bioinformatics application with a minimum graduation degree.

Year	Subject Code	Title of the Course	Hours/ Week
2022 -2023 onwards	22MOLTECHG	Molecular Techniques/Genomics	25

Program Educational Objectives (PEOs):

This objective of this programme is to develop qualified molecular biologists with the following competencies.

PEO 1: To prepare competent graduates for careers in molecular and genetic related fields for clinical applications

PEO 2: To provide a scientific foundation for expertise in the field of genetics and protein modelling.

PEO 3: Interpreting the detailed procedure of DNA, RNA, protein extraction and Amplification techniques

Program Outcomes (POs):

On completion of the certificate course on Enhanced Molecular techniques with Bioinformatics application, the participants will be able to

PO 1: Understand the basics of Molecular biology

PO 2: Provide a detailed knowledge of Blotting and electrophoresis techniques

PO 3: Provide theoretical knowledge of vector, molecular cloning and DNA sequencing

PO 4: Provides information about the types of PCR and rDNA technology

PO 5: Provide knowledge in Bioinformatics application

Assessment Criteria:

Sr. No.	Guidelines for Assessment
1.	A combination of theory and practical courses will be offered in this certificate course. The courses will be offered with 60% practical and 40% theory.
2.	Duration : 3 months
3.	Credit: 20
4.	Grade and examination pattern: Semester pattern (both internal and external) as per the Bharathiar University Examination norms
5.	Evaluation: As per the Bharathiar University Examination norms
6.	Certificate: Based on the report of the post – training assessment jointly conducted by Bharathiar University and Orbito Asia Diagnostics

Certificate Course on Molecular Techniques/Genomics

S.No	Subject 22MOLTECG	Hours		Exam		Total marks	Cr edi ts
		T	P	CIA	ESE		
Course Duration – 3 months							
Lecture							
Enhanced Molecular Genomics for Clinical application		90	-	50	50	100	6
1	Techniques in Molecular Biology						
2	Blotting, Probing, structural analysis and Electrophoresis Techniques						
3	Vector, molecular cloning, Probes, hybridization, Microarray, DNA sequencing						
4	Polymerase Chain Reaction (PCR), Restriction Fragment Length Polymorphism (RFLP), Recombinant DNA technology						
5	Bioinformatics						
Practical							
6	Extraction and quantification of DNA	105	50	50	100	7	
	Extraction and quantification of RNA						
	Extraction and quantification of protein						
	Agarose Gel Electrophoresis						
7	Western Blot	105	50	50	100	7	
	Polyacrylamide Gel Electrophoresis [PAGE]						
	PCR and RT-PCR						
	Biological database with reference to Expasy and NCBI						
	Sequence similarity searching using BLAST						
Total		90	210	150	150	300	20

CIA continuous Internal Assessment; **ESE** End Semester Examination

Year	Course Code	Title of the paper	L	T	P	C
2022 -2023 onwards	22MOLTECG 01	Enhanced Molecular Genomics for Clinical application	5	5	-	6

Course Objectives:

The main objectives of this course are to:

1. Make students understand the basics of Molecular techniques
2. Make students understand the Blotting and electrophoresis techniques
3. Inculcate theoretical knowledge of vector, molecular cloning and DNA sequencing
4. Provide an in-depth knowledge about the types of PCR and rDNA technology
5. Make students learn the Bioinformatics applications

Expected Course Outcomes:

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

1	Understand the basics of Molecular techniques	K1 & K2
2	Understand the Blotting and electrophoresis techniques	K1 & K2
3	Learn various types of vector, molecular cloning and DNA sequencing	K1 & K2
4	Knowledge about the types of PCR and rDNA technology	K1 & K2
5	Learn the Bioinformatics applications	K1 & K2

K1 – Remember; **K2** – Understand; **K3** – Perform; **K4** - Analyse

Subject code	22 MOLTECG 01	Enhanced Molecular Genomics for clinical application
Unit:1	Techniques in Molecular Biology	20 hours
Basic introduction ; The central dogma in molecular biology ; The genetic code ; Mutations ; Protein synthesis ; Molecular techniques ; Biotechnological applications ; Good laboratory practices ; Introduction of biomolecules extraction ; Classic analytic methods in molecular biology ; Nucleic acid extraction methods ; Protein extraction ; Quantification methods ; Trouble shooting ; Future directions		
Unit:2	Blotting, Probing, structural analysis and Electrophoresis Techniques	20 hours
Macromolecules ; Biomarkers ; Blotting techniques ; Types of probes ; Staining ; Primary structure ; Post translational modifications ; Glycosylation ; Proteins ; Monoclonal antibodies ; Truncation ; Introduction and overview of different types of electrophoresis ; Agarose Gel Electrophoresis ; Polyacrylamide Gel Electrophoresis (PAGE) ; Clinical applications		
Unit:3	Vector, molecular cloning, Probes, hybridization, Microarray, DNA sequencing	20 hours
Introduction ; Gene ; Genome ; Genetic code ; Gene expression ; Basics of gene mutations ; Types of vectors ; Ligation ; Types of cloning ; Primer design ; Clinical applications Probe labelling and signal detection ; Types of In Situ hybridization - advantages and disadvantages ; designing and producing a microarray ; Labelling techniques ; Genomics ; Gene expression analysis ; Genotyping ; Microarray database		
Unit:4	Polymerase Chain Reaction (PCR), Restriction Fragment Length Polymorphism (RFLP), Recombinant DNA technology	20 hours
Introduction ; Principle ; Process of DNA replication ; Primers ; Primer sequence ; Different types of PCR Procedure ; Allele ; DNA fingerprinting ; Genome mapping ; Phylogenetics ; Polymorphism ; Restriction Endonucleases ; Restriction map ; RFLP probes ; Southern blot ;		

Recombinant DNA ; Methods ; choice of host organism ; Choice of Vector ; Transformation ; Transfection ; Transduction ; Screening ; Applications		
Unit:5	Bioinformatics	20 hours
Introduction ; Database ; Genomics ; Next-generation sequencing technology ; Proteomics ; Transcriptomics ; Sequence alignment and database ; Applications		
Total theory hours		100 hours
References		
<p>1.Molecular cell Biology, by Darnell, Lodish, Baltimore, Scientific American Books, Inc., 1994</p> <p>2.Karp's Cell and Molecular Biology: Concepts and Experiments, 8th Edition. Gerald Karp, Janet Iwasa Wallace Marshall.2015</p> <p>3.Cell biology D E SadavaCBS Publishers & Distributors, 2009</p> <p>4. Gene Cloning, an introduction – T. A. Brown, Chapman and Hall, 3rd Edition, 1995.</p> <p>5. Gardner et al (1991). Principles of Genetics. John Wiley.</p> <p>6. Hartl. D.L. A primer of population genetics. III edition, Sinauer associates inc. Sunderland, 2000</p> <p>7. Human genetics, A. Gardner, R. T. Howell and T. Davies, Published by VinodVasishtha for Viva Books private limited, 2008.</p> <p>8. The science of Genetics by Alan G. Atherly, Jack. R, Girton, Jhon. F, Mc Donald. Sounders college publishers.</p> <p>9. Primrose. S.B., Twyman R.M. (2014) Principles of Gene Manipulation and Genomics,7th Edition, Blackwell Science Limited.</p> <p>10. Primrose .S.B (1994) Molecular Biotechnology., Blackwell Scientific Publishers, Oxford.</p> <p>11. Alberts. B., Johnson. A.D., Lewis. J., Morgan. D (2014) Molecular Biology of the Cell.</p> <p>12. Brown, T. A. (2006). Genomes (3rd ed.). New York: Garland Science Pub.</p> <p>13. Old, R. W., Primrose, S. B., &Twyman, R. M. (2001). Principles of Gene Manipulation: an Introduction to Genetic Engineering. Oxford: Blackwell Scientific Publications.</p> <p>14. S.C. Rastogi et al. Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery) Kindle Edition.</p>		

Mapping with Programme Outcomes

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

***S- Strong; M – Medium; L- Low**

Year	Course Code	Title of the paper	L	T	P	C
2022 -2023 onwards	22MOLTECG P01	Practical - I	-	-	3	7

Course Objectives:

The main objectives of this course are to:

1. Make students to understand how to extract and quantify DNA from samples.
2. Make students to understand how to extract and quantify RNA from samples.
3. Make students to understand how to extract and quantify Proteins from samples.
4. Inculcate in-depth knowledge about agarose gel electrophoresis

Expected Course Outcomes:

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

1.	Understand how to extract and quantify DNA from samples	K3 & K4
2.	Understand how to extract and quantify RNA from samples.	K3 & K4
3.	Understand how to extract and quantify Proteins from samples	K3 & K4
4.	In-depth knowledge about agarose gel electrophoresis	K3 & K4

K1 – Remember; **K2** – Understand; **K3** – Perform; **K4** - Analyse

Subject code	22MOLTECG P01	Practical - I
Unit:1	Extraction and Quantification of DNA	25 hours
Planning and preparation of chemicals, To perform extraction and quantification procedure of DNA.		
Unit:2	Extraction and Quantification of RNA	25 hours
Planning and preparation of chemicals, To perform extraction and quantification procedure of RNA.		
Unit:3	Extraction and Quantification of Proteins	25 hours
Planning and preparation of chemicals, To perform extraction and quantification procedure of Proteins.		
Unit:4	Agarose Gel Electrophoresis	30 hours
Planning and preparation of chemicals, To perform Agarose gel electrophoresis using the extracted DNA samples.		
Total		105 hours
References		
<ol style="list-style-type: none"> 1. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in 2. Modern Biotechnology - M. Wink. Wiley, ed. 2, 2011. 2. Molecular and cellular Biology, Stephen L.Wolfe, Wadsworth Publishing Company, 1993 3. Molecular Biology LabFax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford, 1991 4. Electrophoresis in Practice: A Guide to Methods and Applications of DNA and Protein Separations, Fourth Edition; Dr. Reiner Westermeier,2004 		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	L	L	L	L
CO2	S	L	L	L	L
CO3	S	L	L	L	L
CO4	S	S	L	L	L

***S- Strong; M – Medium; L- Low**

Year	Course Code	Title of the paper	L	T	P	C
2022 -2023 onwards	22MOLTECG P02	Practical - II	-	-	3	7

Course Objectives:

The main objectives of this course are to:

1. Provide knowledge about how to perform western blotting and its application.
2. Provide knowledge about how to perform PAGE and its application.
3. Inculcate in-depth knowledge about PCR and RT-PCR.
4. Make students to understand how to analyse biological database.
5. Make students to understand how to find sequence similarity using BLAST tool.

Expected Course Outcomes:

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

1.	Perform western blotting and its application	K3 & K4
2.	Perform PAGE and its application.	K3 & K4
3.	Understand the uses of PCR and RT-PCR.	K3 & K4
4.	Understand how to analyse biological database	K3 & K4
5.	Understand how to find sequence similarity using BLAST tool.	K3 & K4

K1 – Remember; **K2** – Understand; **K3** – Perform; **K4** - Analyse

Subject code	22MOLTECG P02	Practical - II
Unit:1	Western Blot	20 hours
Planning and preparation of chemicals, To perform Western Blot using Protein samples.		
Unit:2	Polyacrylamide Gel Electrophoresis	20 hours
Planning and preparation of chemicals, Analysis of protein bands based on their charge and molecular mass.		
Unit:3	PCR and RT-PCR	20 hours
Planning and preparation of Master mix, Perform PCR and RT-PCR and Analysis of Amplification curves.		
Unit:4	Biological databases with reference to Expasy and NCBI	25 hours
Analysis of sequence database using Expasy and NCBI.		
Unit: 5	Sequence similarity searching using BLAST	20 hours
Comparison of similarity between sequences using BLAST tool.		
Total		105 hours
References		
<ol style="list-style-type: none"> 1. Western Blotting: Methods and Protocols: 1312 (Methods in Molecular Biology) by Biji T. Kurien (Editor), R. Hal Scofield (Editor) 2. SDS-Polyacrylamide Gel Electrophoresis (SDS-PAGE); Sean R.Gallagher; Current protocols essential laboratory techniques. 3. PCR - The Basics (Garland Science, 2nd Edition). McPherson. M. J. & Moller S. G. (2006). Taylor & Francis 4. Campbell, A.M. & Heyer, L.J. 2002 Discovering Genomics, Proteomics and Bioinformatics. Benjamin/Cummings. 5. Stuart M. Brown. Next-Generation DNA Sequencing Informatics, Second Edition. New York University School of Medicine (ISBN-13: 978- 1621921236). 6. Xinkun Wang. Next Generation Sequencing Data Analysis, CRC Press. (ISBN13: 9781482217889). 		

Mapping with Programme Outcomes

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

***S- Strong; M – Medium; L- Low**