ADVANCED PG DIPLOMA (FULL-TIME) IN LIFE SCIENCE TECHNOLOGIES

CURRICULUM & SYLLABUS

2017 – 2018

FACULTY OF ENGINEERING AND TECHNOLOGY

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

SRM NAGAR, KATTANKULATHUR – 603 203

ADVANCED PG DIPLOMA (FULL TIME) IN LIFE SCIENCE TECHNOLOGIES

Curriculum and Syllabus 2017-18

(Applicable for students admitted from the academic year 2017-18)

Course Code	Course Name	L	T	P	C
Semester – I					
PGDALS11	Genomics	3			3
PGDALS12	Proteomics	3			3
PGDALS13	Biochemical Techniques	3			3
PGDALS14	Training in laboratory techniques			12	6
	Project Work (Commencement from 1st semester)			10	
Total		9		22	15
Total Contact Hours : 31					
Semester – II					
PGDALS21	Project Work			32	16
Total				32	21(16+5)
Total Contact Hours : 32					
Total credits to be earned for the award of Advanced P.G. Diploma degree : 36					

Legend:

L: Lecture hours per week

T: Tutorial hours per week

P: Practical hours per week

C: Credit

SEMESTER - I

PGDALS11	**GENOMICS**	L	T	P	C
	Total Contact hours - 45	3			3
	Prerequisite				
	Nil				

PURPOSE	
This course imparts the basic and advanced knowledge on genome organization across life, Next or third generation sequencing methods to study genome, transcriptome or exome of eukaryotic or prokaryotic organisms and different applications of genomics.	
INSTRUCTIONAL OBJECTIVES	
1	To know about the basics of genome organization and their functional elements across life
2	To get knowledge on the differences in the genes/genomes of different species of life
3	To learn about Next or Third generation sequencing technologies and their application in genome, transcriptome and exome analysis
4	To get knowledge on applications of genomics in various fields.

Unit I: Genome organization **(7 hours)**

Introduction, genome organization in eukaryotes and prokaryotes, genetic elements and their control on gene expression. Constitutive and inducible gene expression. Correlation between mRNA and protein abundance, functional genomic analysis using forward genetics and reverse genetics.

Unit II: Comparative genomics **(7 hours)**

Genome size, gene content, gene order, Orthologs and paralogs. Comparative genomics of bacteria and horizontal gene transfer. Comparative genomics of mitochondrial genomes, plastids and nuclear genomes of eukaryotes.Applications of comparative genomics.

Unit III: Next Generation Sequencing and genome analysis (12 hours)

Principles of NGS platforms, Strategy in choosing NGS methods in biological study.Strategy for the preparation of DNA and RNA samples for Next generation sequencing. Sequencing data types, quality assessment of NGS data. Genome assembly-tools and challenges. Exome sequencing and analysis.

Unit IV: Transcriptome analysis (12 hours)

Introduction to transcriptome and gene expression studies with RNA. Analysis of gene expression – Semi quantitative RT PCR, quantitative PCR (real time PCR), RNA Sequencing using NGS methods. Transcriptome assembly and expression analysis. Small RNA sequencing and analysis. Gene expression analysis using Microarrays.

Unit V: Applications of genomics (7 hours)

Introduction, applications of genomics in understanding basis of monogenic and polygenic disorders. Pharmacogenomics. Application of genomics in healthcare and agriculture.Applications of genomics in understanding the prokaryotes.

REFERENCES

1. Primrose. S.B., Twayman. R.M., "*Principles of Gene Manipulation and Genomics*" 7thedition, Blackwell publishing. 2006.
2. Pevsner. J., "*Bioinformatics and Functional Genomics*", 2ndedition, Wiley-Blackwell. 2009.
3. Mount. D, "*Bioinformatics: Sequence and Genome Analysis*", 2ndEdition, Cold Spring Harbor Laboratory Press, New York. 2004.

SEMESTER – I

PGDALS12	**PROTEOMICS**	L	T	P	C
	Total Contact hours - 45	3			3
	Prerequisite				
	Nil				

PURPOSE

This course imparts the advanced knowledge on large-scale study of proteins which are vital parts of living organisms with many functions. To study protein expression and Protein-protein interaction, sample preparation and separation, Mass spectrometry and MALDI-TOF techniques and its applications in various fields.

INSTRUCTIONAL OBJECTIVES

1	It is an introductory course where students get a basic knowledge on techniques of proteome research.
2	To learn about complex peptide mixture analysis in the proteomes of different sources and its mode of action and function
3	To study individual proteins or group of proteins and its associated post-translational modifications, which techniques to apply depending on the protein of interest
4	To update knowledge about proteomic research work in the team, together with chemists, biochemists and biophysicists, in solving the complex biological and biochemical processes.

Unit I: Introduction to proteomics **(7 hours)**

Overview of protein structure; Protein localization and compartmentalization; Relationship between protein structure and function; Protein-protein interactions and identification; Proteome and proteomics; Types of Proteomics- Structural proteomics, Functional proteomics; Extraction and separation of Proteins from Biological Samples, protein quantification techniques

Unit II: Gel-based proteomics (12 hours)

Two dimensional gel electrophoresis (2-DE); Staining procedures to visualize 2-D gels; Tools for analysis of gels; 2-D Fluorescence Difference Gel Electrophoresis (DIGE); Blue native PAGE (BN-PAGE); Modifications in gel-electrophoresis technique; Molecular scanner; Application of 2-DE and DIGE techniques in biological systems; Merits and demerits of gel-based proteomic techniques

Unit III: Gel-free proteomics (7 hours)

Stable Isotope Labeling by Amino acids in Cell culture (SILAC); Isotope Coded Affinity Tag (ICAT); Isobaric Tagging for Relative and Absolute Quantitation (iTRAQ); Proteolytic labeling with [^{18}O]-water; Merits and demerits of gel-free quantitative proteomic techniques

Unit IV: Mass spectrometry based proteomics (12 hours)

Principles of Mass spectroscopy, Sample preparation, Sample ionization, Mass analysis, Types of mass spectrometers, Peptide fragmentation, Peptide mass fingerprinting database searching. Amino acid sequence database searching, MALDI-TOF - sample preparation, types of matrices, fragmentationpatterns and data analysis

Unit V:Applications of Proteomics Analysis (7 hours)

Drugdevelopment and toxicology, Pharmaceutical applications, Glycobiology and proteomics, Clinical proteomics- biomarker and therapeutic target screening;Metaproteomics and human health

References

1. Introduction to Proteomics: Tools for the New Biology, 2nd Edition by Daniel C. Liebler, Humana Press, 2007
2. Principles of Proteomics, 2nd Edition by Richard Twyman, Garland Science, 2013
3. Introduction to Proteomics: Principles and applications by Nawin Mishra, Wiley & Sons, 2010

SEMESTER - I

PGDALS13	**BIOCHEMICAL TECHNIQUES**	L	T	P	C
	Total Contact hours - 45	3			3
	Prerequisite				
	Nil				

PURPOSE	
This course provides an understanding of the core principles and topics of routinely used biochemical techniques and their experimental basis in any research lab, and to enable students to acquire a specialized knowledge and its applications in various fields	
INSTRUCTIONAL OBJECTIVES	
1	It is an introductory course where students get a basic knowledge on biochemical techniques of basic research lab
2	The course aims to develop students understanding of major areas of widely used and advanced scientific methods – spectroscopic tools, electrophoretic, chromatographic and microscopic techniques
3	By the end of the course students should understand the principles and limitations of spectroscopic tools, electrophoretic, chromatographic and microscopic techniques

Unit I: Basic Techniques **(5 hours)**

Buffers; Methods of cell disintegration; Enzyme assays and controls; Detergents and membrane proteins; Dialysis, Ultrafiltration and other membrane techniques; centrifugation

Unit II: Electrophoresis, Blotting and PCR **(8 hours)**

Factors affecting electrophoresis. Electrophoretic techniques- Slab, Capillary, pulsed field, and immuno-electrophoresis. Blotting techniques: western, southern and northern blotting: principle and methodology. PCR-conventional, reverse-transcriptase, real-time PCR and Digital PCR. Primer designing and sequence analysis. Taq-man, MGB and molecular beacons.

Unit III: Spectroscopy **(12 hours)**

Principle of spectroscopy. Concept of absorptions, transmission, scattering, phosphorescence, fluorescence, luminescence, diffraction spectra. Principle, instrumentation, working and application of – UV, visible and IR spectroscopy, spectro-fluorimetry, luminometry. Principle, instrumentation, working and application of- Nuclear Magnetic Resonance (NMR), electron spin resonance (ESR), matrix assisted LASER desorption/ionizationtime of flight-mass spectroscopy (MALDI-TOF MS). X-ray crystallography.

Unit IV: Chromatography **(12 hours)**

Basic Principles, Instrumentation, working and applications of partition chromatography (Paper), absorption chromatography (TLC, HPTLC, column), affinity chromatography, ion exchange chromatography, gel filtration chromatography, gas-liquid chromatography (GLC), high Pressure liquid chromatography (HPLC). Applications: GC-MS, HPLC-MS and LC-MS/MS.

Unit V: Microscopy Principles and Applications **(8 hours)**

Overview of current microscopy techniques, Fundamentals of Optics, Light-matter interactions, Confocal Microscopy, Multiphoton Microscopy, Labeling and Sample Preparation, Advanced Microscopy Techniques - Forster resonance energy transfer (FRET), fluorescence lifetime imaging (FLIM), super resolution techniques (STED, STORM, PALM, SIM), single-molecule techniques, Microscopy Applications.

References

1. Principles and Techniques of Practical Biochemistry (5th Ed.), Wilson, K., Walker, J. (eds.); Cambridge University Press, Cambridge, 2000
2. Biochemistry Laboratory: Modern Theory and Techniques (2nd Ed.), Rodney Boyer (eds.), Prentice Hall, 2012
3. An Introduction to Microscopy, Suzanne Bell, Keith Morris (eds.), CRC Press, 2009
4. Fundamentals of Light Microscopy and Electronic Imaging (2nd Ed.), Douglas B. Murphy, Michael W. Davidson (eds.), Wiley-Blackwell, 2013

SEMSTER – I

PGDALS14	**Training in laboratory techniques**	L	T	P	C
	Total Contact hours - 180			12	6
	Prerequisite				
	Nil				

PURPOSE	
This course imparts the training in laboratory techniques.	
INSTRUCTIONAL OBJECTIVES	
1	Hands-on training in laboratory techniques
2	To impart training to handle the instruments independently

List of Laboratory Techniques:

DNA Isolation & QC; RNA Isolation & QC; PCR; DNA Fragmentation; qPCR and DPCR; Protein Extraction & QC; SDS-PAGE; In-gel and In-solution Digestion; LC – MS/MS of digested protein; Western Blot; Tissue sectioning – Frozen sections by Cryostat; Slide Staining and Imaging; NGS Workflow; Microarray Workflow.

References

Laboratory training manual

Assessment process

Assessment tool	Weightage
Carrying out laboratory work, attendance, and submission of record, class tests, model examination, quizzes etc.	60%
End semester practical examination	40%

PROJECT WORK

Course Code	Course Name	L	T	P	C
PGDALS21	Project Work *(1st Semester)*			10	
	Project Work *(2nd Semester)*			32	21
PURPOSE					
To undertake research in an area related to the program of study					
INSTRUCTIONAL OBJECTIVES					
The student shall be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings which will facilitate development of a new/improved product, process for the benefit of the society.					

Advanced P.G Diploma projects should be socially relevant and research oriented ones. Each student is expected to do an individual project. The project work will commence in 1st semester and will be completed by the end of the 2nd semester. At the completion of the project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project. The method of assessment for the project work is shown in the following table:

Assessment	Tool	Weightage
End of 1st Semester	Review I	10%
During 2nd Semester	Review II	15%
	Review III	35%
End of 2nd Semester	Final viva voce examination	40%

Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.