



Centre for Interdisciplinary Research and Innovations (CIRI) University of Kashmir

SYLLABUS FOR Ph.D COURSE WORK (2022 onwards) and GE COURSES OFFERED BY CIRI

Paper	Code	Paper Name	Marks
Paper I	CIRI-Ph. D-01	Research Methodology	100
Paper II	CIRI-Ph. D-02	Recent Advances in the Field	100
Paper III	CIRI-Ph. D-03	Specialized Paper	100

The syllabus for the Specialized Paper is based on the research theme of the lab and Ph.D topic of the student. The syllabus is drafted by the concerned supervisor.

<u>Generic Electives</u>										
Sr. No.	Course Code	Course Title	Credit distribution			Total Credits	SEE	IA	Total Marks	Semester
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1	CIRI-01-GE	Epigenetics in Human Health and Diseases	2	0	0	2	40	10	50	Second
2	CIRI-02-GE	Advanced course on Green and Sustainable Chemistry	2	0	0	2	40	10	50	
4	CIRI-03-GE	Neurogenetics	2	0	0	2	40	10	50	Third
5	CIRI-04-GE	Fundamentals of Biological Mass Spectrometry	2	0	0	2	40	10	50	

CIRI-Ph. D-01: Research Methodology

Unit I: Research Ethics

Philosophy and ethics, Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP), Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data. Publication ethics: definition, introduction and importance, Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior, Violation of publication ethics, authorship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals.

Unit II: Bioinformatics and biostatistics

Next Genome sequencing and methods of analysis. Chromosome conformation capture and Chromatin immunoprecipitation coupled to sequencing (ChIP-seq). Sequence alignment-clustalw and omega. Introduction to statistics, Data types, mean, mode, median, sample variance and sample standard deviation. Data interpretation and analysis, precision and accuracy, Error analysis, least squares fitting, Linear and non-linear regression and correlation analysis, Hypothesis testing (T and F hypothesis testing), Test of significance, Chi-square goodness of fit tests. Significance of goodness of fit.

Unit III: Techniques-1

Electrophoresis: types, principles, and applications. Blotting techniques: types, principles, and applications. Determination of antigen antibody concentration by ELISA. Determination of dissociation constant and basic biochemical calculations. Mass spectrometry: principle, methods of ionization and applications of mass spectrometry. Principle and applications of bright-field and confocal microscopy.

Unit IV: Techniques-2

Chromatography principles and its types. Principle and applications of UV-visible absorption spectroscopy. Principle and applications of Fluorescence spectroscopy. Circular dichroism (far-UV, near-UV). Infrared spectroscopy. Raman spectroscopy and Dynamic light scattering. Basic of X-ray diffraction, Bragg's Law, X-ray crystallography, Cryogenic electron microscopy, Transmission electron microscopy, Scanning electron microscopy, Fundamentals of NMR spectroscopy and its applications.

CIRI-Ph.D-02: Recent Advances in the Field

Unit I: Recent Advances in Cell Biology

Introduction to cell biology concepts-from membranes to molecules. Transmembrane Transport: Pumps, Ion channels, receptor mediated endocytosis and role in diseases. Mitochondrial dysfunction in diseases. Retromer mediated transport and diseases.

Unit II: Recent Advances in Molecular Biology

Molecular biology- Introduction to molecular biology concepts-Biology of DNA, RNA and Proteins. Translation mechanism. Chromosome structure and Epigenetics. Genome editing: CRISPR-Cas9, base editing, TALENS. Mitochondrial genome editing.

Unit III: Chemical Biology

Introduction to chemical biology, chemical and structural properties of the biomolecules (DNA and proteins), Amino acids, protein structure, protein-protein and protein-ligand interactions, Enzymology- kinetics and mechanistic enzymology, introduction to Mass spectrometry, click chemistry and its application. Proteolysis Targeting Chimeras (PROTACs) as targeted therapy drugs, Peptide Nucleic Acids (PNAs).

Unit IV: Environment and Health

Introduction to environmental and climate change. Impact of environment on health-quality of air, water, and soil. Environmental degradation and modern diseases. Factors driving global warming-Agricultural, industrial, domestic etc. Policies and practices to control climate change-national and international. Plastic waste management, need for recycling, biodegradable and non-biodegradable plastics. Capturing and utilization of greenhouse gas for making useful polymers. Circular economy.

Epigenetics in Human Health and Diseases

UNIT-I: Chromatin, Histones, Nucleosome, Nucleosome Structure, Euchromatin, Heterochromatin, Modulation of Chromatin Structure, ATP dependent chromatin remodeling, Histone modifications and the enzymes involved (Acetylation, Methylation, Phosphorylation and Ubiquitination), Genome wide analysis of histone modifications, Cross-talk between histone modifications, Histone Code hypothesis, Protein Domains that Bind Chromatin Modifications, Histone Modifications and Transcription, Histone H3K4 Methylation in transcription initiation, Histone H3K36 Methylation and transcription elongation. DNA repair in context of chromatin, Transcription Memory and Maintenance of Genome Integrity, DNA Methylation, Interplay of DNA methylation and histone modifications.

UNIT-II. Epigenetics, Chromatin Boundaries: *S. cerevisiae* Silencing, *S. pombe*, Centromeric Heterochromatin, RNAi-directed Silencing. Epigenetic reprogramming in mammals, Position effect variegation, dosage compensation, X chromosome inactivation. Epigenetic mechanisms regulating ES cell differentiation, Bivalent Chromatin Marks in maintaining stem cell pluripotency, Epigenetics and Human Diseases, Cancer, Neurological disorders (Parkinsons Disease, Alzheimer's Disease, Schizophrenia, Autism related disorders), Cardiovascular Diseases (Atherosclerosis, Hypertension), Autoimmune Disorders (Lupes, Rheumatoid Arthritis, multiple Sclerosis), Developmental Disorders (Angelman syndrome, Rett Syndrome), Epigenetics and NAFLD. Epigenetic Therapy

References:

- **Epigenetics by** David Allis, Marie-Laure Caparro, Thomas Jenuwein and Danny Reinberg, Cold Spring Harbor Laboratory Press.
- **The Epigenetics Revolution:** How Modern Biology Is Rewriting Our Understanding of Genetics, Disease, and Inheritance.

Course Code: CIRI-02-GE

Credits: 02

Advanced course on Green and Sustainable Chemistry

Unit I

Fundamentals Of Green Chemistry.

Environmental Protection Agency (EPA) 1970; 12 major environmental laws

Presidential Green Chemistry Challenge Awards (1996)

Twelve Principles of Green Chemistry

Atom economy and Life Cycle Assessment Environmental/Health/Safety of Organic Solvent, Use of renewable resources. Alternative solvents and reaction media.

Unit II

Catalysis for Green Chemistry: Topics chosen from General, Inorganic, Organic and Polymer Chemistry, Homogenous catalysis and Homogenous catalysis in environmentally benign solvents, Green Improvements to Polyolefin Synthesis, Polymers from Renewable Resources, CO₂ And Global Warming CO₂ capture and utilization, Renewable Energy Sources, Greener approach to polycarbonate synthesis, green synthesis of polyols: building blocks to polyurethane.

References:

1. "Green Chemistry: An Introductory Text, 2nd Edition" Mike Lancaster; RSC Paperbacks, Cambridge, UK.
2. Environmental Chemistry: Green Chemistry and Pollutants in Ecosystems" by Eric Lichtfouse and Didier Robert
3. Green Chemistry: Environmentally Benign Reactions" by V K Ahluwalia

Course Code: CIRI-03-GE

Credits: 02

Fundamentals of Biological Mass Spectrometry

Unit I:

Introduction to mass spectrometry, Construction of a mass spectrometer- ion sources, analyzers, detectors. Protein mass spectrometry-intact mass determination, denaturing and native state mass spectrometry Proteomics- top-down and bottom up, sample preparation and analysis analysis, quantitative proteomics, label free proteomics. Metabolomics- sample preparation and analysis

Unit II:

Basics of the integrated structural mass spectrometry

Hydrogen-Deuterium exchange coupled to mass spectrometry (HDX-MS)

Chemical crosslinking mass spectrometry (CXL-MS)

Limited proteolysis coupled to mass spectrometry (LIP-MS)

Ion mobility-mass spectrometry (IM-MS)

References:

4. Mass Spectrometry in Biophysics: Conformation and Dynamics of Biomolecules by Igor A. Kaltashov
5. Mass Spectrometry: Principles and Applications by Edmond de Hoffmann
6. Mass Spectrometry: A Textbook by Jurgen H. Gross
7. Mass Spectrometry in Structural Biology and Biophysics: Architecture, Dynamics, and Interaction of Biomolecules by Igor A. Kaltashov and Stephen J. Eyles

Course Code: CIRI-04-GE
Neurogenetics

Credits: 02

Unit I

Cell biology of a neuron and how genes define neuronal diversity.
Transgenes and their application in neurogenetic
Neurogenetic disorders- illustration of basic concepts in neurogenetics.
Genome-wide association studies in neurological disorders
From genes to mechanism – Parkinson's disease
From genes to mechanism – Dementias

Unit II

Genetic models of neurological diseases
M. musculus basic biology, genetics, and genetic tools for studying neurogenetics.
C. elegans model for neurogenetics research
Conserved circuit and genetic mechanisms between model organisms