Course Code	Course Name	Credits
	TRANSFORMATIVE STRATEGIES IN DRUG DISCOVERY: INTEGRATING MODERN PRE-CLINICAL RESEARCH WITH HEAVY METAL AND CHEMICAL TOXICITY ANALYSIS	**2**

Category: Value added Course

a. Preamble

- This course introduces zebrafish (*Danio rerio*) as a versatile vertebrate model in preclinical research, covering its applications in drug discovery, behavioral studies, and toxicology.
- Students will gain theoretical knowledge and hands-on experience in zebrafish care, system maintenance, behavioral assessment, infection control, and toxicological analysis.
- The course also includes exposure to laboratory instrumentation and murine dissection techniques relevant to biomedical and toxicological studies.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the significance of zebrafish as a model organism in preclinical and toxicological research.	K2
CO2	Demonstrate the routine care, maintenance, and housing practices for zebrafish under laboratory conditions.	K3
CO3	Analyze zebrafish behavioral patterns and biological responses under different environmental and experimental conditions.	K4
CO4	Operate basic laboratory instruments used in chemical and heavy metal toxicity studies, including chromatographic and spectroscopic tools.	K4
CO5	Evaluate toxicological outcomes in zebrafish and mice by interpreting behavioral, physiological, and organ-specific responses to chemical exposure.	K5

c. Course Syllabus **Total: 30 Periods**

ZEBRAFISH AS A MODEL IN PRECLINICAL RESEARCH **10**

Introduction to zebrafish as a model organism; Comparative anatomy and genetic similarity with humans; Applications in biomedical and preclinical drug research; Role in anti-cancer drug discovery; Advantages in high-throughput screening; Ethical considerations; System setup and housing parameters; Feeding protocols; System maintenance and water quality standards.

ZEBRAFISH BEHAVIORAL AND BIOLOGICAL STUDIES **10**

Behavioral phenotyping; Anxiety, social interaction, and locomotor assays; Behavioral response to pharmacological agents; Sex differentiation techniques; Biological sampling from system water; Health assessment and visual inspection; Demo-based observation of behavior in system and study tanks; Analysis of feeding patterns; Importance of sex-based variation in study design.

TOXICOLOGICAL AND LABORATORY TECHNIQUES **10**

Overview of chemical and heavy metal toxicology; Similarity of toxicological responses in zebrafish and humans; Common infections in zebrafish (protozoan, bacterial, fungal, viral); Control measures and quarantine protocols; Introduction to chromatographic and spectroscopic techniques (HPLC, AAS); Hands-on with software for toxicology analysis; Dissection of mouse for organ identification; Outline of organ-specific toxicity endpoints.

d. Activities

- Practical training in zebrafish care, housing, feeding, and water quality management.
- Demonstration and analysis of zebrafish behavioral patterns under laboratory conditions.
- Hands-on sessions in chemical and heavy metal toxicity assessment using zebrafish.
- Operation of laboratory instruments such as AAS and chromatography systems for toxicological studies.
- Live demonstration of murine dissection to identify major organs and relate them to toxicity studies.

e. Learning Resources

Textbooks

1. Monte Westerfield, *The Zebrafish Book: A Guide for the Laboratory Use of Zebrafish (Danio rerio)*, University of Oregon Press (5th ed.), 2007.
2. Patricia McGrath (Ed.), *Zebrafish: Methods for Assessing Drug Safety and Toxicity*, John Wiley & Sons, 2012. ISBN-13: 978-0-470-42513-8.

Reference Books

1. Carole Wilson & David Chu, *The Laboratory Zebrafish*, 2nd Edition, CRC Press / Taylor & Francis, 2025. ISBN-13: 978-0-367-62807-9
2. Charles A. Lessman & Ethan A. Carver (Eds.), *Zebrafish: Topics in Reproduction, Toxicology and Development*, Nova Science Publishers, 2014. ISBN-13: 978-1-63117-558-9.

f. CO-PO-PSO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	H	M	–	–	–	L	M	–	L	–	M	H	M
CO2	–	–	M	M	H	–	–	–	–	–	M	H	H
CO3	–	H	M	H	M	M	–	–	L	–	M	M	H
CO4	–	M	–	H	H	–	–	–	–	–	M	M	H
CO5	–	H	M	H	H	H	M	–	–	–	H	M	H

g. SDG Mapping

SDG	Target(s) Addressed	Alignment with Course
Goal 3: Good Health and Well-being	**Target 3.9**: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.	The course trains students in assessing chemical and heavy metal toxicity using zebrafish and murine models, supporting efforts to reduce exposure-related health risks.
Goal 3: Good Health and Well-being	**Target 3.b**: Support the research and development of vaccines and medicines for communicable and non-communicable diseases, particularly for developing countries.	Through zebrafish-based preclinical studies, students are introduced to tools and techniques that support early-stage drug discovery and safety evaluation.
Goal 4: Quality Education	**Target 4.4**: By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship.	The course provides hands-on experience in animal handling, behavioral studies, toxicological screening, and instrumentation, equipping students with job-ready technical skills in life sciences and biotechnology.