SYLLABUS

Ph.D.

BIOTECHNOLOGY

NATIONAL INSTITUTE OF PHARMACEUTICAL EDUCATION AND RESEARCH GUWAHATI
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Ph.D. Syllabus

BIOTECHNOLOGY

Course No.	Course Name	Credits
	Semester-I	
BT-710	**Advanced Techniques in Biotechnology**	2
BT-720	**Principles of Drug Discovery and Development**	2
***CS-701**	**Research Methodology** (Compulsory)	2

Course No.	Course Name	Credits
	Semester-II	
BT-730	**Molecular Oncology and Therapeutics**	2
BT-740	**Metabolic Disorders**	2
***CS- 801**	**Research and Publication Ethics** (Compulsory)	2

***Detailed Syllabus is available at Page No. 39-40**

Ph.D. Syllabus
SEMESTER - I

BT-710 :- Advanced Techniques in Biotechnology (2 Credits)

1. **Genetic Manipulation In Cells** – Mammalian gene manipulation techniques and its applications.
2. **Advanced Microscopic Techniques** – Fluorescence and Near IR Imaging, Confocal, Flow Cytometry, AFM, SEM and TEM.
3. **Genomics And Transcriptomics** – Next generation sequencing, data analysis and it's applications.
4. **Proteomics** – Advances in proteomics, data analysis and its application in biomarker discovery.
5. **Metabolomics and Lipidomics**– Approaches and its applications.
6. **In vivo Imaging** – Fluorescence and Micro – CT imaging.
7. **Advances In Assay Development** – Bead based assays and Multiplexing assay development.

Book Suggestion:

1. Green and Sambrook. Molecular Cloning: A Laboratory Manual (Fourth Edition).
2. Melanie Kappelmann-Fenzl. Next Generation Sequencing and Data Analysis. ISBN-13 : 978-3030624897.
3. Ron Wehrens, Reza Salek. Metabolomics- Practical Guide to Design and Analysis. 2021. ISBN 9781032242637.
4. Simon R. Cherry, Ramsey D. Badawi, Jinyi Qi. Essentials of In Vivo Biomedical Imaging. 2015. ISBN 9781439898741.

BT- 720 :- Principles of Drug Discovery and Development (2 Credits)

1. **A general introduction and historical perspective on drug discovery and development:** General introduction to drug discovery research and development, history of drug discovery research and development, Examples of few drug discovery in old days and recent times, Small molecules vs Biopharmaceuticals, different stages of drug discovery and development.
2. **Target identification and validation:** Concept of target, different approaches to identify drug targets, Target validation, Single target versus multi-targets approaches, Off target and adverse effects, Drug repurposing.
3. **In-silico drug designing:** Basics of structural bioinformatics, Role of Bioinformatics in drug design, Target understanding at molecular level, lead optimization and in-silico validation, Structure- and ligand-based drug design, Molecular docking and docking algorithms, de-novo ligand design and molecular dynamics simulation.
4. **Drug Screening:** Understanding protein-protein, protein-small molecule interaction study, Role of Structural Biology in Drug Discovery, Cell-free and cell-based assays, exploiting cell biology to design assay platforms, High-throughput screening, Introduction to High Content Screening, Designing and development of disease model.
5. **Medicinal Chemistry, Pharmacology and Drug Development:** Small molecules as drugs, Lipinski rule five, hit identification to lead development process,

Chemistry Manufacturing and Control (CMC), Pre-clinical study, Clinical study, IND, NDA.

6. **Drug Repurposing:** Drug discovery via drug repurposing, Strategies of drug repurposing, Approaches and methodologies of drug repurposing, Examples of Repositioned drugs in different diseases, Opportunities and challenges, Regulatory and intellectual property issues.

Book Suggestion

1. Madhu Dikshit. Drug Discovery and Development. Springer Nature
2. Benjamin E Blass. Basic Pringles of Drug Discovery and Development. Academic Press; 2nd edition (March, 2021).

BT-730 : - Molecular Oncology and Therapeutics (2 Credits)

1. **Cancer:** Different cell types and their cancer, rare cancers. Carcinogens and DNA damage. Cancer registry.
2. **Genes and Cancer Cell Signalling:** Tumor heterogeneity, Cellular oncogene, Tumor suppressor genes, Growth factor receptors and cancers.
3. **Tumor Metabolism:** Warburg effect, cancer cell metabolic homeostasis.
4. **Metastasis and Angiogenesis:** Seed and Soil Hypothesis, Tumor microenvironment, Metastasis. Tumor Angiogenesis.
5. **Tumor Immunology:** Introduction, immune evasion of cancer cells, TAM, CAF, cancers of the immune cells and their molecular mechanism.
6. **Biological Models in Cancer Research:** Cell Lines, Tumor Organoid Models, Small Rodent Models, Zebrafish Models, Drosophila Models, other animal models.
7. **Cancer Therapy and Resistance:** Chemotherapy, Natural anticancer, Radiation Therapy, Immune Therapy, Gene therapy, Antibody based therapies, Personalized medicine, Drug resistant cancers.
8. **Cancer Stem Cells:** Cancer stem cells and relapse, Cancer therapy associated health complications.

Book Suggestion

1. Francesco Pezzella, MahvashTavassoli, and David J. Kerr. Oxford Textbook of Cancer Biology. 2019. ISBN-13: 9780198779452.
2. Kleinsmith. Principles of Cancer Biology. 2016. ISBN-13: 978-9332577480.
3. Lauren Pecorino. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. 5th Edition. 2021. ISBN-13 : 978-0198833024.
4. Vincent T. DeVita Jr., Theodore S. Lawrence, Steven A. Rosenberg. Cancer: Principles and Practice of Oncology Primer of Molecular Biology in Cancer. 3rd edition. 2020. ISBN-13 : 978-1975149116.

BT- 740 :- Metabolic Disorders (2 Credits)

1. **Introduction:** General principles of metabolic disorders and focuses on pathways, enzyme mechanisms, and diseases associated with defects in metabolism.
2. **Metabolic Pathways:** Pathways related to carbohydrate, protein and fat metabolism, Urea cycle, Fatty acid oxidation, Citric acid cycle.
3. **Disorders related to Cellular Metabolism:** Carbohydrate disorder, protein disorder, fat disorder, amino acid disorder, Urea cycle disorder, Organic acid disorder, Glycogen storage disease.
4. **Metabolic syndrome:** Definition, risk factors, causes and complication. Prevention and treatment of metabolic syndrome**.**
5. **Type 2 diabetes and obesity:** Insulin signalling and resistance, Metabolic consequences of type 2 diabetes, Adipose biology, Leptin signalling pathway, GLP1, Newer therapy.
6. **Cardiovascular diseases and heart failure:** Energy metabolism in heart, Dyslipidemia, hypertension and associated cardiac disorder, recent therapy for cardiac disorders.

Book Suggestion

1. Goodman & Gilman's: The Pharmacological Basis of Therapeutics, 13e
2. Paramjit S Tappia, S K Bhullar, Niranjan S Dhalla. Biochemistry of Cardiovascular Dysfunction in Obesity. Springer Nature Switzerland AG. 2020.
3. Enid Gilbert-Barness, Lewis A. Barness, Philip M. Farrell. Metabolic Disease: Foundations of Clinical Management, Genetics, and Pathology. (2nd Edition). IOS Press, Amsterdam.

(Syllabus for Compulsory Courses)

Semester-I

CS- 701 :- Research Methodology (2 Credits)

Unit 1: **Objectives and types of research**: Motivation and objectives, research methods vs methodology. Types of research – descriptive vs analytical, applied vs fundamental, quantitative vs qualitative, conceptual vs empirical. Introduction to drug discovery & development research, objectives, flowchart from discovery to post-marketing research, overview of research methodology in various areas of drug discovery and development research.

Unit 2: **Research formulation and Literature review**– Defining and formulating the research problem, selecting the problem, the necessity of defining the problem, the importance of literature review in defining a problem, Literature review - primary and secondary sources, reviews, monographs, patents, research databases, web as a source, searching the web, critical appraisal of literature, identifying gap areas from literature review and research databases, and development of a working hypothesis.

Unit 3: **Research design and methods**: Research design – basic principles, need of research design, features of good design, important concepts relating to research design, observation and facts, laws and theories, prediction and explanation, research databases, development of models, developing a research plan – exploration, description, diagnosis, and experimentation.

Unit 4: **Execution of the research, data collection and analysis**: Aspects of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statistical packages (GraphPad Prism, SPSS for Student t-test, ANOVA, etc), hypothesis testing, generalization, and interpretation.

Unit 5: **Safety measures in the laboratory: Handling of hazardous chemicals, incompatible chemicals, flammable solvents, toxic chemicals and forms of toxic materials.** Approaches for prevention and management of fire, electrical, chemical, biological, and gaseous hazards, good laboratory practices. General safety rules, waste minimization approaches and safety practices for disposal of chemical waste, biologicals and other laboratory waste.

(Syllabus for Compulsory Courses)

Semester-II

CS- 801 :- Research and Publication Ethics (2 Credits)

Unit 1: **Research Ethics:**

a) Ethics – ethical issues, ethical committees (human & animal)
b) Ethics with respect to science and research
c) Intellectual honesty and research integrity
d) Scientific misconducts: Falsification, Fabrication, and Plagiarism
e) What is plagiarism? Similarity report software like iThenticate/ Turnitin/ Urkund.
f) Redundant publications: duplicate and overlapping publications, salami-slicing
g) Selective reporting, and misrepresentation of data

Unit 2: **Publication Ethics:**

a) Publication ethics: definition, introduction, and importance.
b) Best practices / standards-setting initiatives and guidelines: COPE, WAME, etc.
c) Conflicts of interest
d) Publication and Research misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
e) Violation of publication ethics, authorship, and contributorship
f) Identification of publication misconduct, complaints, and appeals
g) Predatory publishers and journals.
h) Journal finder/journal suggestion tools.

Unit 3: **IPR and scholarly publishing**:

Intellectual Property Rights (IPR) and patent law, commercialization, copyright, royalty, trade-related aspects of intellectual property rights (TRIPS)

Unit 4: **Report and thesis writing:**

a) Structure and components of scientific reports, types of reports, technical reports, and thesis.
b) Thesis writing – different steps and software tools (Word processing, etc) in the design and preparation of the thesis, layout, structure (chapter plan), and language of typical reports, Illustrations and tables, bibliography, referencing, and footnotes.
c) Oral presentation – planning, software tools, creating and making an effective presentation, use of visual aids, the importance of effective communication
d) Writing a research proposal and research grant
e) Scholarly publishing – IMRaD concept and design of research paper, citation and acknowledgment, reproducibility, and accountability.
f) Graphical Abstract and Artwork preparation

Unit 5: **Databases and Research Metrics**

a) Indexing databases: PubMed, Embase, etc.
b) Citation databases: Web of Science, Scopus, etc.
c) Impact Factor of the journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score, *etc*.
d) Metrics: h index, g index, i10 index, altmetrics