

<b>COURSE TITLE</b>	<b>PHARMACOGENOMICS</b>
<b>COURSE CODE</b>	<b>01CB0701</b>
<b>COURSE CREDITS</b>	<b>4</b>

**Objective:**

- 1 To enable students to apply pharmacogenomic principles and bioinformatics tools to analyze genetic variations influencing drug response, and evaluate the role of pharmacogenomics in personalized medicine.

**Course Outcomes:** After completion of this course, student will be able to:

- 1 Apply fundamental pharmacogenomics concepts to interpret how genetic variations influence individual responses to drug therapy.
- 2 Analyze the role of pharmacogenomics in advancing personalized medicine by examining genetic influences on pharmacokinetics and pharmacodynamics.
- 3 Utilize appropriate bioinformatics tools and databases to retrieve, interpret, and visualize pharmacogenomic data.
- 4 Assess the impact of specific genetic polymorphisms on drug metabolism and identify their clinical significance in treatment decisions.
- 5 Evaluate the practical challenges and limitations in the clinical integration of pharmacogenomics, and propose strategies or innovations to address them and shape future directions in the field.

**Pre-requisite of course:**Introductory Bioinformatics Skills

**Teaching and Examination Scheme**

<b>Theory Hours</b>	<b>Tutorial Hours</b>	<b>Practical Hours</b>	<b>ESE</b>	<b>IA</b>	<b>CSE</b>	<b>Viva</b>	<b>Term Work</b>
3	0	2	50	30	20	25	25

<b>Contents : Unit</b>	<b>Topics</b>	<b>Contact Hours</b>
1	<b>Introduction to Pharmacogenomics</b> Overview of Pharmacogenomics: Definition, Scope, and Importance, Genetic Variation and Drug Response, Pharmacokinetics and Pharmacodynamics, Role of Pharmacogenomics in Personalized Medicine, Ethical and Regulatory Considerations in Pharmacogenomics	9
2	<b>Pharmacogenetics and Drug Metabolism</b> Gene Variability in Drug Metabolism, Genetic Polymorphisms Affecting Drug Response, Genotyping and Phenotyping Approaches, Drug Transporters and their Genetic Regulation, Adverse Drug Reactions and Genetic Factors	9

<b>Contents : Unit</b>	<b>Topics</b>	<b>Contact Hours</b>
3	<b>Pharmacogenomic Databases</b> Databases: PharmGKB, dbSNP, 1000 Genomes Project, Computational Approaches for Genetic Variant Analysis, Application of AI and Machine Learning in Drug Response Prediction, OMIM, ClinVar	8
4	<b>Clinical Applications of Pharmacogenomics</b> Pharmacogenomics in Diseases, Role of Pharmacogenomics in Disorders, Case Studies of FDA-approved Pharmacogenomic Drugs, Challenges and Future Trends in Clinical Implementation	8
5	<b>Pharmacogenomics and Precision Medicine</b> Personalized Therapy and its Clinical Impact, Pharmacogenomic Testing in Clinical Practice, Development of Pharmacogenomic Guidelines, Pharmacoeconomics and Cost-effectiveness Analysis, Future Perspectives	8
<b>Total Hours</b>		<b>42</b>

#### Suggested List of Experiments:

<b>Contents : Unit</b>	<b>Topics</b>	<b>Contact Hours</b>
1	<b>Experiment 1</b> Apply search strategies to retrieve clinically relevant pharmacogenomic data from the PharmGKB database for specific genes or drugs.	2
2	<b>Experiment 2</b> Analyze genetic variant information using the dbSNP database and interpret its relevance to pharmacogenomic traits.	2
3	<b>Experiment 3</b> Interpret population-specific allele frequencies and genetic diversity using data from the 1000 Genomes Project.	2
4	<b>Experiment 4</b> Identify and evaluate genetic polymorphisms in drug-metabolizing enzyme genes and correlate them with altered drug response.	2
5	<b>Experiment 5</b> Construct and analyze phylogenetic trees to study evolutionary relationships among drug-metabolizing enzymes.	2
6	<b>Experiment 6</b> Predict and assess drug-like properties using cheminformatics tools for potential pharmacogenomic candidates.	2
7	<b>Experiment 7</b> Model and compare 3D protein structures of wild-type and variant forms to assess structural impacts of polymorphisms.	2
8	<b>Experiment 8</b> Using computational tools, predict and interpret the functional consequences of nonsynonymous SNPs on protein function.	2

### Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
9	<b>Experiment 9</b> Analyze protein structures to identify active sites, binding pockets, tunnels, and cavities relevant to drug interaction.	2
10	<b>Experiment 10</b> Perform and evaluate molecular docking simulations to assess the binding efficiency of drugs with their target proteins.	2
11	<b>Experiment 11</b> Visualize and interpret gene-drug interactions using network and pathway-based visualization tools.	2
12	<b>Experiment 12</b> Process, annotate, and analyze pharmacogenomic NGS datasets to identify clinically actionable genetic variants.	2
13	<b>Experiment 13</b> Analyze transcriptomic data to determine differential expression of pharmacogenes under drug-treated vs. control conditions.	2
14	<b>Experiment 14</b> Develop and apply AI/ML models to classify drugs based on structural features and predict potential pharmacogenomic properties.	2
<b>Total Hours</b>		<b>28</b>

### Textbook :

- 1 Pharmacogenomics: Challenges and Opportunities in Therapeutic Implementation, Yui-Wing Francis Lam et al., Elsevier, 2018
- 2 Principles of Pharmacogenetics and Pharmacogenomics , Russ B. Altman et al., Cambridge University Press, 2012
- 3 Pharmacogenomics in Drug Discovery and Development , Qing Yan, Humana New York, 2022

### References:

- 1 Molecular genetic testing and the future of clinical genomics., Molecular genetic testing and the future of clinical genomics., Katsanis, S. H., & Katsanis, N. , Nature Reviews Genetics, 2013
- 2 Pharmacogenomics in the clinic, Pharmacogenomics in the clinic, Relling, M. V., & Evans, W. E. , Nature, 2015
- 3 Pharmacogenomics: driving personalized medicine, Pharmacogenomics: driving personalized medicine, Sadee, W., Wang, D., Hartmann, K., & Toland, A. E. , Pharmacological reviews, 2023
- 4 Pharmacogenetics: From bench to byte - An update of guidelines, Pharmacogenetics: From bench to byte - An update of guidelines, Swen, J. J., et al. , Clinical Pharmacology & Therapeutics, 2011
- 5 Genomics and drug response, Genomics and drug response, Wang, L., McLeod, H. L., & Weinshilboum, R. M, New England Journal of Medicine, 2011

### References:

- 6 Pharmacogenomics: Principles and Clinical Applications, Pharmacogenomics: Principles and Clinical Applications, Cavallari, L. H., & Lam, Y. W. F. (Eds.), McGraw-Hill Education, 2019
- 7 Pharmacogenetics, pharmacogenomics, and individualized medicine, Pharmacogenetics, pharmacogenomics, and individualized medicine, Ma, Q., & Lu, A. Y. H. , Pharmacological Reviews, 2011
- 8 The role of pharmacogenomics in precision medicine, The role of pharmacogenomics in precision medicine, Lee, W. H., et al. , Expert Review of Precision Medicine and Drug Development, 2020

### Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
0.00	0.00	35.00	35.00	30.00	0.00

### Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by blackboard, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

### Supplementary Resources:

- 1 <https://www.pharmgkb.org/>
- 2 <https://www.ncbi.nlm.nih.gov/>