

Indian Statistical Institute



POSTGRADUATE DIPLOMA IN
STATISTICAL AND COMPUTATIONAL GENOMICS
(PGDSCG)

Students' Brochure

Effective from the Academic Year 2026–2027

POSTGRADUATE DIPLOMA IN STATISTICAL AND COMPUTATIONAL GENOMICS

Contents

General Information	3
1. Scope	3
2. Eligibility	3
3. Selection	3
4. Course Structure	4
5. Examination Scores	4
6. Satisfactory Conduct	6
7. Promotion	7
8. Final Result	7
9. Award of Certificate	8
10. Prizes and Medals	8
11. Class Teacher	8
12. Attendance	8
13. Hostel Facilities	8
14. Library Rules	8
15. Change of Rules	8
16. Syllabi of Courses	9
SEMESTER-I	9
1.1 Statistics:	9
1.2 Molecular Biology and Human Genetics:	9
1.3 Physiology and Pharmacology:	10
1.4 Introduction to Computational Biology:	11
1.5 Genomics in Biomedical Research	11
SEMESTER-II	12
2.1 Statistics in Biomedical Research	12
2.2 Machine Learning in Biomedical Research	13
2.3 Genomics and Pharmacogenomics	14
2.4 Project work:	15

POSTGRADUATE DIPLOMA IN STATISTICAL AND COMPUTATIONAL GENOMICS

This one-year (two semester) post graduate diploma program is offered at the Indian Statistical Institute, Kolkata

General Information

1. Scope

India is one of the emerging markets for biomedical genomics. Given the diversity of the Indian population and the increasing genomic interest in the country, the Government of India has launched the GenomeINDIA project, which comprises a consortium of 20 academic and research institutes. This postgraduate diploma course aims to equip participants with computational skills in genomics and to strengthen the key statistical competencies required for genomic studies. Owing to the distinctive nature of the program, candidates will receive training in computational biology, including machine learning with a particular emphasis on statistical genomics, aligning with the core academic mission of the Indian Statistical Institute. The course is structured so that students without a biology background are first introduced to foundational biological concepts, while those without a computational background are initially familiarized with essential computational principles before progressing to advanced computation-aided genomic data analysis.

The expected outcome of this industry-oriented program is to develop competencies relevant to both academia and industry in statistical and biomedical genomics, a rapidly growing field. Students with academic aspirations will have opportunities to pursue doctoral studies, whereas those with industry-oriented goals will be able to pursue careers in research and development. The mandatory project, conducted in collaboration with healthcare companies and medical colleges, will provide hands-on experience in addressing real-world problems pertinent to both industry and academia.

2. Eligibility

To be eligible for admission, candidates must have any of the following qualifications:

- a) an M.Sc. / M.S. in any branch of science or an equivalent qualification;
- b) a B.Tech / B.E. in any branch of Engineering, Technology;
- c) an M.B.B.S. / B. Pharm. degree.

Professionals currently working in the biomedical genomics, biotechnology, healthcare, or related industries who meet the above eligibility criteria are strongly encouraged to apply.

3. Selection

Selection is based on performance in the written test and interview. Past academic records may also be taken into consideration. An all-India admission test will be conducted, and a notification for it will be published along with other admission notifications on the ISI admission website. The written test has two major compulsory components:

1. Part-I will include questions from fundamental statistics, basic sciences and analytical reasoning.
2. Part-II has two groups in which the candidate must answer questions from any one group but not both-
 - a. Group A: Questions from molecular biology, genetics, cell biology, biochemistry, physiology, pharmacology, immunology, and statistics. Group A should be attended by students with biology equivalent degree holders.
 - b. Group B: Questions from mathematics, computer science and statistics. Group B should be attended by students with non-biology equivalent degree holders.

The test structure and syllabus will be determined by the Selection Test Committee and published on the ISI admission site. Based on the performance in the written tests, a candidate will be called for an interview. If a candidate fails to appear in the interview, his/her candidature will be cancelled.

4. Course Structure

The total duration of the PG Diploma program is one year, which includes two regular semesters, including six-month project dissertation. The first semester has five courses. The second semester has three courses and one project. Each course carries 100 marks, and the project carries 200 marks. There is a study break of one week before the final examination in each semester. The first semester will commence in July, and the second semester will commence in January of the following year.

Course ID	Name of the course	Marks
<u>Semester-I</u> (500 marks)		
PGDSCG-1.1	Statistics	100
PGDSCG-1.2	Molecular Biology and Human Genetics	100
PGDSCG-1.3	Physiology and Pharmacology	100
PGDSCG-1.4	Introduction to Computational Biology	100
PGDSCG-1.5	Genomics in Biomedical Research	100
<u>Semester-II</u> (500 marks)		
PGDSCG-2.1	Statistics in Biomedical Research	100
PGDSCG-2.2	ML in Biomedical Research	100
PGDSCG-2.3	Genomics and Pharmacogenomics	100
PGDSCG-2.4	Project	200

5. Examination Scores

This program has two examinations, namely mid-semester and semester (final) examinations. The composite score in a course is a weighted average of the scores in the mid-semester and semester examinations, home-assignments, practical record book, etc. (announced at the beginning of the semester). The weights are announced beforehand by the Dean of Studies, or the In-Charge, Students' Academic Affairs, or the Class Teacher, in consultation with the teacher concerned. The minimum composite score to pass a course is 35%

Back-paper examination

If the composite score of a student in a course is above 35% but falls short of 45%, she/he will have one option to take a back-paper examination to improve the score to a maximum of 45%. This is called an optional back-paper. However, a student with a composite score of less than 35% in any course must take a back-paper examination to improve the score to a maximum of 45%. Such a back-paper is called a compulsory back-paper. At most one back paper examination is allowed in each course. Moreover, a student can take at most two back-paper examinations in the first semester and at most one in the second semester. The decision to allow a student to appear for the back-paper examination is taken by the appropriate Teachers' Committee. The back-paper examination covers the entire syllabus of the course. When a student takes a back-paper examination, his/her final score in that course is the higher of the back-paper score and the earlier composite score, subject to a maximum of 45%. If a student takes more than the allotted quota of back-paper examinations in a given academic year, then at the end of that academic year, the student should decide which of the optional back-paper examination scores should be disregarded. In such a case, the marks of those particular courses will be reverted to their original scores.

Compensatory Paper Examination

A student who gets less than 35% in at most one course even after the back-paper examination in any semester, but 60% or more on average in the other courses in that semester, is allowed to appear for a compensatory paper examination. A student would be allowed to appear in at most one compensatory paper in the entire program. The maximum marks obtainable in a compensatory paper would be 35%. In the second semester, a student would have to choose between the compensatory paper examination and the possibility of repeating the program. He/she would not be allowed to take both. The student must inform the Dean of Studies/Associate Dean/Students' Academic Affairs In-charge in writing in advance regarding his/her choice. A student would have to discontinue the program if he/she scores less than 35% in the compensatory paper in any semester.

Supplementary Examination

If a student misses an examination due to medical or family emergencies, he/she can appear in the supplementary examination. Supplementary examinations will be held for mid-semester, back-paper, and compensatory examinations within a month of the examination. The student should submit a written application with all supporting documents to the Dean of Studies/Associate Dean/Students' Academic Affairs In-charge, duly forwarded by the Class Teacher, for appearing in the supplementary examination. On receipt of such an application from a student, the Dean of Studies/Associate Dean/Students' Academic Affairs In-charge will decide, in consultation with the relevant Teachers' Committee, on whether such an examination will be allowed. The supplementary semester examination for a course is held at the same time as the back-paper examination for the semester, and the student taking the supplementary semester examination in a course is not allowed to take any further back-paper examination in that course. The student can score at most 60% in the supplementary examinations to midsemester and semester examinations.

For the back-paper or the compensatory papers, the maximum the student can score in the supplementary examination is 45% or 35%, respectively.

6. Satisfactory Conduct

A student is also required to maintain satisfactory conduct as a necessary condition for taking semester examinations, for promotion, and the award of a diploma. Failing to follow the examination guidelines, copying in the examination, rowdiness, other breaches of discipline of the Institute, unlawful/unethical behaviour, and the like are regarded as unsatisfactory conduct. Violation of such nature is likely to attract punishments such as withholding promotion/award of diploma, and/or expulsion from the Institute.

Ragging is banned in the Institute. If any incident of ragging comes to the notice of the authorities, the concerned student shall be given liberty to explain, and if his/her explanation is not found to be satisfactory, he/she may be expelled from the institute. The punishment may also take the shape of

- i) suspension from the Institute for a limited period,
- ii) suspension from the classes for a limited period,
- iii) withholding other benefits,
- iv) withholding results,
- v) suspension or expulsion from the hostel, and the likes.

Local laws governing ragging are also applicable to the students at the Institute.

Guidelines during examinations

The students are required to abide by the following guidelines during the examinations:

- i) Students are required to take their seats according to the seating arrangement displayed. If any student takes a seat not allotted to him/her, he/she may be asked by the invigilator to hand over the answer script (i.e., discontinue the examination) and leave the examination hall.
- ii) Students are not allowed to carry inside the examination hall any mobile phone with them, even in switched-off mode. Calculators, books, and notes will be allowed inside the examination hall only if these are so allowed by the teacher(s) concerned (i.e., the teacher(s) of the course), or if the question paper is an open-note/open-book one. Even in such cases, these articles cannot be shared.
- iii) No student is allowed to leave the examination hall without permission from the invigilator(s). Further, students cannot leave the examination hall during the first 30 minutes of any examination. Under no circumstances can two or more students writing the same paper go outside together.
- iv) Students should ensure that the main answer booklet and any extra loose sheets bear the signature of the invigilator with the date. Any discrepancy should be brought to the notice of the invigilator immediately. The presence of any unsigned or undated sheet in the answer script will render it (i.e., the unsigned or undated sheet) cancelled, and this may lead to charges of violation of the examination rules.

- v) Any student caught cheating or violating examination rules will get a 'Zero' in that examination. If the offence is in a back-paper examination, the student will get 'Zero' in the back-paper. (The other conditions for promotion, as mentioned below, will continue to hold. The decisions regarding promotion and final result are arrived at after taking into account the violation, if any, of the satisfactory conduct by the student, as described in this section.

7. Promotion

A student is considered for promotion to the second semester of the program only when his/her conduct has been satisfactory. Subject to the above condition, a student is promoted from first semester to the second semester if i) the number of composite scores less than 45% is at most two, and ii) no composite score in a course is less than 35%. Otherwise, a student is not promoted to the second semester, and he/she is asked to discontinue the program.

8. Final Result

At the end of the second semester, the overall average of the percentage composite scores in all the courses taken in the two-semester program is computed for each student. The student is awarded the post-graduate diploma in one of the following categories according to the criteria he/she satisfies, provided that, in the second semester, if

- i) he/she does not have a composite score of less than 35% in any course and
- ii) his/her conduct is satisfactory.

Postgraduate Diploma in Statistical & Computational Genomics passed in First Division with Distinction, if

- i) the overall average score is at least 75%, and
- ii) the composite score in at most one course is less than 45%.

Postgraduate Diploma in Statistical & Computational Genomics, passed in First Division, if

- i) the overall average score is at least 60%,
- ii) the composite score in at most one course is less than 45%, and
- iii) not obtained First Division with Distinction.

Postgraduate Diploma in Statistical & Computational Genomics, passed in Second Division, if

- i) the overall average score is at least 45%,
- ii) the composite score in at most two courses is less than 45%, and
- iii) not obtained First Division with Distinction or First Division.

All other students are considered to have failed. A student who fails but obtains at least 35% average score in the second semester, and has satisfactory conduct, is allowed to repeat the program in the following year, provided that he/she has not taken the option of a compensatory paper examination in the second semester. A student is not given more than one chance to repeat.

9. Award of Certificate

A student passing the Diploma is given a certificate which includes i) the list of all courses taken along with the respective composite scores, and ii) the category (First Division with Distinction /First Division/Second Division) of his/her final result. The certificate is awarded in the Annual Convocation of the Institute following the semester II examinations

10. Prizes and Medals

Students are awarded prizes in the form of book awards for good academic performances in each semester as decided by the Teachers' Committee.

11. Class Teacher

One of the instructors of a class is designated as the Class Teacher. Students are required to meet their Class Teacher periodically to get their academic performance reviewed and to discuss their problems regarding courses.

12. Attendance

Every student is expected to attend all the classes. If he/she is absent, he/she must apply for leave to the Dean of Studies or the Academic Coordinator. Failing to do so may result in disciplinary action.

13. Hostel Facilities

Hostel accommodation will not be provided by ISI, Kolkata. Students may be required to arrange their own accommodation for the duration of the course.

14. Library Rules

A student is allowed to use the reading room facilities in the library and is allowed access to the stacks. Students will have to pay a security deposit in order to avail themselves of the borrowing facility. The amount of the security deposit will be specified at the time of admission to the course. A student can borrow at most four books at a time. A fine is charged if any book is not returned by the due date stamped on the issue-slip. The library rules and other details are available in the library of the Centre to which the student is admitted.

15. Change of Rules

The Institute reserves the right to make changes in the above rules, course structure, and the curriculum as and when needed.

16. Syllabi of Courses

SEMESTER-I

1.1 Statistics: (Demonstrations and assignments will be done in R/Python)

- a. Introducing statistics using R / Python [4 L]
- b. Study design and participant recruitment for genomic association study, and estimation of genomic risk for a disease [2 L]
- c. Data description- qualitative, quantitative; structure of genomic data for association study with and without covariates [2 L]
- d. Basic probability, probability distributions and their properties [6 L]
- e. Measures of central tendency, dispersion, skewness and kurtosis [6 L]
- f. Correlation, linear regression, regression diagnostics [6 L]
- g. Measures and tests of association between attributes [4 L]
- h. Estimation of parameters: Method of moments, Method of maximum likelihood [4 L]
- i. Confidence interval [2 L]
- j. Hypothesis testing [10 L]
 - i. Formulation of hypothesis, level of significance, and power of a statistical test of hypothesis
 - ii. Two sample tests, test for equality of means, variances, and proportions, paired t-test
 - iii. Testing equality of multiple mean values (ANOVA)
 - iv. Non-parametric tests
- k. Sample size calculation for testing of equality of proportions and equality of means [2 L]
- l. Multiple hypothesis testing corrections [2 L]

References:

1. *Introductory Statistics with R (Statistics and Computing)* by Peter Dalgaard; Springer.
2. *Fundamentals of Descriptive Statistics* by Zealure Holcomb; Routledge.
3. *Statistics* by David Freedman, Robert Pisani, and Roger Purves; W W Norton & Co Inc.
4. *Biostatistics: A Foundation for Analysis in the Health Sciences* by Wayne W. Daniel, Chad L. Cross; John Wiley & Sons Inc.
5. *Fundamentals of Statistics Vol-I & II* by A.M. Gun, M.K. Gupta and B. Dasgupta; World Press.
6. *Introductory Biostatistics* by Chap T. Le; Wiley.

1.2 Molecular Biology and Human Genetics:

- a. Core concepts: cell structure; molecular and cell biology [4 L]

- b. Cell division (mitosis, meiosis) [4 L]
- c. Central dogma: DNA, RNA, protein [6 L]
- d. Replication, transcription, and translation [6 L]
- e. Control of gene expression in prokaryotes & eukaryotes [6 L]
- f. Polymorphism, allele, and estimation of allele frequency [4 L]
- g. Mendelian inheritance [4 L]
- h. Sex-linked inheritance [2 L]
- i. Extension and modifications of Mendelian genetics [8 L]
- j. Hardy Weinberg equilibrium [2 L]
- k. Recombination and Linkage [4 L]

References:

1. *Instant Notes on Molecular Biology* by P C Turner, A C McLenan, A D Bates and M R H White; Bios Scientific Publishers Ltd
2. *Molecular Biology of the Cell* by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts & Peter Walter; Garland Science.
3. *iGenetics* by Russell, Peter J; Pearson Education India
4. *Lewin Gene XII* by Jocelyn Krebs, Elliott Goldstein, Stephen Kilpatrick; Jones and Bartlett Publishers, Inc
5. *Principles of Genetics* by Gardner, Simmons, Snustad; Wiley.
6. *Genetics: A Conceptual Approach* by Benjamin A. Pierce; W H Freeman & Co

1.3 Physiology and Pharmacology:

- a. Systems physiology [25 L]
 - i. Core Concepts in Systems Physiology
 - ii. Blood and Hemodynamics
 - iii. Cardiovascular system
 - iv. Excretory (Renal) system
 - v. Nervous system
 - vi. Gastrointestinal system
 - vii. Reproductive system
- b. The importance of pharmacology in the study of pathophysiological processes. [8 L]
- c. Pharmacokinetics [4 L]
- d. Pharmacodynamics [4 L]
- e. Basics of receptor biology [3 L]
- f. Drug, agonist, and antagonist [3 L]
- g. Adverse drug effect [3 L]

References:

1. *The Pharmacological basis of Therapeutics* by Goodman and Gilman; McGraw-Hill.
2. *Basic and Clinical Pharmacology* by B.G Katzung; McGraw-Hill.

3. *Textbook of Pharmacology* by Seth and Seth; Elsevier.
4. *Textbook of Medical Physiology* by A.C. Guyton, John E. Hall; W.B. Saunders Co.
5. Best & Taylor's *Physiological Basis of Medical Practice* by O. P. Tandon & Y. Tripathi; Wolters Kluwer.
6. Ganong's *Review of Medical Physiology* by Barrett Kim; McGraw Hill.

1.4 Introduction to Computational Biology:

- a. Introduction to Linux [20 L]
 - i. Basic commands [6 L]
 - ii. Editors (VI, EMACS) [4 L]
 - iii. Shell scripting [10 L]
- b. Basics of Python programming [20 L]
 - i. Understanding IDEs: Jupyter Notebook
 - ii. Understanding variables and data types
 - iii. Strings and booleans
 - iv. Lists, tuples, sets, and dictionaries
 - v. Operators
 - vi. Control Flow: Conditions and Loops
 - vii. Working with libraries: NumPy, Pandas, Matplotlib, Seaborn, SciPy
 - viii. Functions in Python
- c. DNA and protein sequence alignment: pairwise and multiple [4 L]
- d. Introduction to biological databases [4 L]
- e. Introduction to emerging computational need in the healthcare domain [2 L]

References:

1. *Linux for Beginners: An Introduction to the Linux Operating System and Command Line* by Jason Cannon; Createspace Independent Pub.
2. *Python Data Science Handbook* by Jake Vanderplas; O'Reilly.
3. *Python for Data Analysis* by Wes McKinney; O'Reilly.
4. *Bioinformatics: Sequence and Genome Analysis* by David Mount; Cold Spring Harbor Laboratory.

1.5 Genomics in Biomedical Research (Demonstrations and assignments will be done using Linux, R/Python):

- a. Introduction to next-generation sequencing [2 L]
- b. Sequencing Technologies: Principles, processes, and limitations of different platforms [3 L]
- c. RNA-sequencing: methods and data Analysis [20 L]
 - i. Introduction to RNA-sequencing
 - ii. Experimental design
 - iii. Quality control (QC)
 - iv. File formats
 - v. Alignment and mapping

- vi. Quantification
- vii. Differential expression analysis
- viii. Functional enrichment
- ix. Visualization
- x. Introduction to single cell sequencing and analysis of single-cell RNA-seq data
- d. Exome-sequencing: Methods and Data Analysis [15 L]
 - i. Introduction to exome sequencing
 - ii. Experimental design
 - iii. Target Enrichment
 - iv. Data analysis: Pre-processing, alignment, variant calling, variant filtering and annotation
 - v. Methods to assess clinical significance of identified variants
 - vi. Ethical considerations
- e. Whole Genome Sequencing: Methods and Data Analysis [10 L]
 - i. Introduction to whole genome sequencing
 - ii. Experimental design
 - iii. Sample preparation
 - iv. Library preparation
 - v. Data analysis: Pre-processing, alignment, variant calling, variant filtering and annotation

References:

1. *Genomes* by T. A. Brown; CRC Press.
2. *Principles of Computational Genomics* by Paolo Provero; Chapman & Hall.
3. *Computational Genome Analysis: An Introduction* by Richard C. Deonier, Simon Tavare, Michael S. Waterman; Springer.
4. *Computational Exome and Genome Analysis* by Peter N Robinson, Rosario M Piro, Marten Jager; Chapman and Hall/CRC.
5. *Learning Computational Genomics with Python: Tools, Pipelines, and Machine Learning* by Praise D Debby; Amazon Digital Services LLC.

SEMESTER-II

2.1 Statistics in Biomedical Research (Demonstration and assignments will be done in R/Python):

- a. Epidemiology of communicable and non-communicable diseases [25 L]
 - i. Causal relationships in health and disease
 - ii. Measures of disease frequency
 - iii. Cross-Sectional, cohort, and case-control study designs
 - iv. Randomized trials
 - v. Misclassification, confounding and effect modification
 - vi. Screening and diagnosis
- b. Survival analysis [15 L]

- i. Survival function
- ii. Hazard function
- iii. Censoring
- iv. Kaplan-Meier (KM) estimator
- v. Log-rank test
- vi. Cox proportional hazards model
- c. Regression [10 L]
 - i. Simple and multiple linear regression, R^2 and adjusted R^2
 - ii. Logistic regression, AIC and BIC.

References

1. *Statistics in Medicine* by Robert H Riffenburgh & Daniel L. Gillen; Academic Press
2. *Survival models and data analysis* by Elandt-Johnson, R.E. Johnson, N.L.; John Wiley & sons.
3. *Analysis of survival data* by Cox, D.R. and Oakes, D; Chapman & Hall.
4. *Applied Linear Statistical Models* by M. Kutner, C.J. Nachtsheim, J. Neter, W. Li; McGraw-Hill/Irwin.

2.2 Machine Learning in Biomedical Research (Demonstrations and assignments will be done using Python/R):

- a. Introduction to Machine learning (ML) [4 L]
 - i. Definition, scope, and types of ML: supervised, unsupervised, semi-supervised, reinforcement
 - ii. ML workflow: data preprocessing, feature engineering, model selection, evaluation; Applications in computational biology, genomics, medical imaging.
- b. Understanding and Preparing Biomedical Data [4 L]
 - i. Statistical perspective on data and features, increasing complexity of biomedical datasets, and approaches to visualization
 - ii. Data preprocessing: cleaning, imputation, and transformation
 - iii. Handling categorical and mixed-type data
 - iv. Outlier detection and treatment
- c. Classification & Regression [16 L]
 - i. Naïve Bayes' classification, k-nearest neighbors, decision trees, Random Forest
 - ii. Performance measures: Precision, Recall, Sensitivity, Specificity, F1-Score, AUROC
 - iii. LASSO, Ridge, Elastic Net
 - iv. Case studies in biomedical research.
- d. Dimensionality Reduction [10 L]
 - i. Feature selection, different criterion functions
 - ii. Principal components analysis (PCA)
 - iii. Fisher's linear discriminant analysis.
- e. Unsupervised Learning [10 L]

- i. Basics of clustering, cluster validity indices
- ii. k-means clustering, hierarchical clustering
- iii. Case studies in biomedical research.
- f. Model Evaluation and Regularization [6 L]
 - i. Overfitting and underfitting, Bias-variance trade-off, Cross-validation techniques.

References

1. *Pattern Recognition and Machine Learning* by Christopher M. Bishop; Springer (2006).
2. *The Elements of Statistical Learning* by T. Hastie, R. Tibshirani, and J. H. Friedman; Springer (2009).
3. *Introduction to Machine Learning with Python* by Andreas C. Müller and Sarah Guido; O'Reilly (2016).
4. *Statistical Modeling and Machine Learning for Molecular Biology* By Alan Moses; Chapman & Hall.

2.3 Genomics and Pharmacogenomics (Demonstration and assignments will be done using Linux, R/Python):

- a. Genome Wide Association Study: Methods and Data Analysis [15 L]
 - i. Introduction to GWAS
 - ii. Quality control (QC) and data management
 - iii. Association Analysis
 - iv. Handling covariates and confounding factors
 - v. Haplotypes and imputation
 - vi. Meta-analysis of results from different studies
 - vii. Polygenic Risk Score
 - viii. Post-GWAS analysis and interpretation
 - ix. Translating findings to biological and clinical implications
- b. Methylome: Methods and Data Analysis [15 L]
 - i. Fundamentals of DNA methylation
 - ii. Biological roles & association with health and disease
 - iii. Methylome profiling techniques (whole-genome bisulfite sequencing, Reduced Representation Bisulfite Sequencing (RRBS), and methylation arrays).
 - iv. Methylation data analysis: Quality control (QC), file formats, alignment and mapping
 - v. Quantification
 - vi. Differential methylation analysis
 - vii. Data Interpretation
 - viii. Visualization
 - ix. Applications: Biomarker identification
- c. SNPs and their impact on clinical medicine and clinical outcomes [5 L]

- d. Biomarker discovery, turning biomarkers into drug targets [5 L]
- e. Molecular diagnostic methods in Pharmacogenomics [5 L]
- f. Applications of pharmacogenomics in the personalized medicine and healthcare industry [5 L]

References:

1. *Principles of pharmacogenomics and pharmacogenetics* by Russ B. Altman, David Flockhart, David B. Goldstein; Cambridge university press.
2. *Genomes* by T. A. Brown; CRC Press.
3. *Principles of Computational Genomics* by Paolo Provero; Chapman & Hall.
4. *Computational Genome Analysis: An Introduction* by Richard C. Deonier, Simon Tavare, Michael S. Waterman; Springer.
5. *Computational Exome and Genome Analysis* by Peter N Robinson, Rosario M Piro, Marten Jager; Chapman and Hall/CRC.
6. *Learning Computational Genomics with Python: Tools, Pipelines, and Machine Learning* by Praise D Debby; Amazon Digital Services LLC.

2.4 Project:

- a. Industrial talk: Lectures by leaders of the healthcare genomics industry.
- b. Interactions with clinicians: Lectures by clinicians.
- c. Project work: student needs to develop a scientific problem based on the lectures provided by the clinicians and industry experts within 1 month of Semester-II in consultation with the teachers/instructors. Students will work on the project work during the rest of the Semester-II.