SYLLABUS FOR THE BATCH FROM YEAR 2025 TO 2026

FOR

Certificate Course in Artificial Intelligence in Human Genetics

(Credit Based Evaluation and Grading System)

Semester: I

EXAMINATIONS: 2025-2026

Certificate Course in Artificial Intelligence in Human Genetics (6 Months duration)

Program Outcomes:

- **AI Applications in Genomics –** Learn how AI enhances genetic screening, diagnosis, biomarker discovery, and gene therapy.
- **Technical Skills in AI-Driven Drug Discovery –** Gain insights into AI's role in pharmacogenomics, drug repurposing, and clinical decision support systems.
- **Ethical and Regulatory Considerations –** Explore bioethical principles, genetic privacy regulations, and the implications of AI in genomic medicine.
- **Genetic Counseling and AI** – Develop knowledge of genetic risk assessment, AI-assisted counseling, and ethical challenges in AI-driven genetic diagnosis.

Name of the Department: Human Genetics

In collaboration with

Directorate of Open & Distance Learning and Online Studies

GURU NANAK DEV UNIVERSITY AMRITSAR

Certificate Course in Artificial Intelligence in Human Genetics (SEMESTER SYSTEM) Offered by Department of Human Genetics in Collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University Amritsar

Programme Eligibility

- +2 biology with atleast 45%marks in aggregate (40% for SC/ST candidates)
- Any student doing Bachelor Degree, Master Degree, Ph.D. from GNDU.
- Working Professionals in Health Sectors/Pharma/IT etc.

SEMESTER-I

Paper Code	Subject	Marks			Credits
		Internal Assessment	End Term	Total	
ODAIHG111T	Artificial Intelligence in Human Health and Diseases	30	70	100	4
ODAIHG112T	Artificial Intelligence in Genetic Screening, Diagnosis and Drug Development	30	70	100	4
ODAIHG113T	Artificial Intelligence in Gene Therapy and Gene Editing	30	70	100	4
ODAIHG114T	Artificial Intelligence and Ethical Considerations in Human Genetics	30	70	100	4
Total Marks & Credits		**120**	**280**	**400**	**16**

Certificate Course in Artificial Intelligence in Human Genetics (SEMESTER SYSTEM) Offered by Department of Human Genetics in Collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University Amritsar

Subject Name: Artificial Intelligence in Human Health and Diseases

Subject Code: ODAIHG111T

(Semester–I)

Time: 03 Hours **Max.Marks:100Marks**

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section A

Structure of Nucleic acids and Protein; Gene expression and regulation, Genetic variations: SNPs, Mutations, copy number variations.

Section B

DNA Sequencing technologies: traditional and Next generation sequencing (NGS), Role of Artificial Intelligence (AI) in NGS, Role of AI in functional genomics and multi-omics.

Section C

Artificial Intelligence based diagnosis/screening for different diseases, biomarkers discovery and prediction of disease susceptibility.

Section D

Artificial Intelligence in prophylaxis, management and treatment of diseases, vaccine development: conventional to Artificial Intelligence approach.

Recommended Books:

1. Gardner, E.J. (2011). Human Genetics. Viva Books Pvt. Ltd., India.
2. Lodish, H., Baltimore, D., Berk, A., Zipursky, S.L., Matsudaira, P. and Daniell, J. (2007). Molecular Cell Biology. W.H. Freeman and Co., San Fransisco.
3. Strachan, T. and Read, A. (2010). Human Molecular Genetics. Garland Publishers, London.

Web Links:

10.1007/s44163-023-00049-5
10.1007/s12652-021-03612-z
10.1016/j.annonc.2023.10.125
10.1016/j.cels.2021.06.006
10.3390/cells10040787
10.1016/j.trecan.2024.12.001
10.1016/j.mimet.2024.106998
10.3390/biom14050568
10.1002/cpmb.59
10.1517/17460441.2012.660145

Certificate Course in Artificial Intelligence in Human Genetics (SEMESTER SYSTEM) Offered by Department of Human Genetics in Collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University Amritsar

Subject Name: Artificial Intelligence in Genetic Screening, Diagnosis and Drug Development
Subject Code: ODAIHG112T
(Semester–I)

Time: 03 Hours **Max.Marks:100Marks**
Internal Assessment: 30 Marks
End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
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Section A

Types of genetic screening: Reproductive, Predictive, Diagnostic, Carrier, Direct-to-Consumer, AI in Newborn Screening, Prenatal Testing & Carrier Screening

Section B

Overview of Drug discovery pipeline, Basics of Pharmacogenomics, Pharmacogenomic testing.

Section C

AI in Drug Target Identification & Lead Optimization, AI-Based Drug Repurposing, Datasets for AI-driven Drug Discovery

Section D

Clinical Decision Support Systems (CDSS) for Pharmacogenomics, AI in Clinical Trials, Regulatory guidelines for AI-driven Pharmacogenomics

Web Links

doi: 10.1016/j.drudis.2020.10.010
doi: 10.1208/s12249-024-02901-y
doi: 10.1002/cpt.2387
doi.org/10.1016/j.ejphar.2024.177103
https://doi.org/10.1186/s13073-019-0689-8
https://doi.org/10.1016/j.ipha.2024.08.005

Certificate Course in Artificial Intelligence in Human Genetics (SEMESTER SYSTEM) Offered by Department of Human Genetics in Collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University Amritsar

Subject Name: Artificial Intelligence in Gene Therapy and Gene Editing
Subject Code: ODAIHG113T
(Semester–I)

Time: 03 Hours **Max. Marks:100 Marks**
Internal Assessment: 30 Marks
End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
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Section A

Basics of Gene Therapy, Somatic and Germline Gene Editing, Gene Editing Tools, Role of AI in Gene Editing

Section B

Stem Cells, Cancer Stem Cells, B stem cell therapy, Basics of Regenerative Medicine and Role of AI.

Section C

Basics of Cancer genomics, Cancer risk prediction and screening, Role of AI in cancer genomics and medicine

Section D

AI and emerging concepts in Human Genetics, Digital Twins, AI-Powered Rare Disease Genomics

Web Links:

Human genome editing: Science, ethics, and governance. National Academies Press.https://nap.nationalacademies.org/catalog/24623/human-genome-editing-science-ethics-and-governance
https://pmc.ncbi.nlm.nih.gov/articles/PMC10800897
https://pmc.ncbi.nlm.nih.gov/articles/PMC6373233/
https://www.sciencedirect.com/science/article/pii/S2949820124000249
https://www.sciencedirect.com/science/article/abs/pii/S1359644623001216

Certificate Course in Artificial Intelligence in Human Genetics (SEMESTER SYSTEM) Offered by Department of Human Genetics in Collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University Amritsar

Subject Name: Artificial Intelligence and Ethical Considerations in Human Genetics
Subject Code: ODAIHG114T
(Semester–I)

Time: 03 Hours **Max. Marks:100 Marks**
Internal Assessment: 30 Marks
End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

1. Question paper shall consist of **Four sections**.
2. Paper setter shall set **Eight questions** in all by selecting **Two questions** of equal marks from each section. However, a question may have sub-parts (not exceeding four sub-parts) and appropriate allocation of marks should be done for each sub-part.
3. Candidates shall attempt **Five questions** in all, by at least selecting **One question** from each section and the **5th question** may be attempted from any of the **Four sections**.
4. The question paper should be strictly according to the instructions mentioned above. In no case a question should be asked outside the syllabus.

Section A

Principles of Bioethics: Autonomy, Beneficence, Justice, Informed Consent, Privacy and Confidentiality

Section B

Introduction to Genetic Privacy, Legal frameworks governing genetic privacy (e.g., GDPR, HIPAA, GINA), Genetic discrimination in employment and insurance settings

Section C

Eugenics; Old versus Liberal, AI and Human Enhancement through liberal eugenics, Ethical Concerns

Section D

Genetic Counseling, Principles, Role of AI in genetic counseling, Ethical concerns with AI and disease risk estimation and genomic analysis

Web Links:

https://pubmed.ncbi.nlm.nih.gov/38344556/
https://pmc.ncbi.nlm.nih.gov/articles/PMC7923912/
https://pmc.ncbi.nlm.nih.gov/articles/PMC4233176/
https://www.tandfonline.com/doi/full/10.1080/14636778.2021.2007064
https://www.nature.com/articles/s41431-024-01782-w