UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A ++' GRADE' UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(26/Jan./Adp./133)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the syllabi and courses of studies for **Post Graduate Programme** in **Human Genetics** under **NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Human Genetics	Semester-I	December 2025, 2026 and 2027
	Semester-II	May 2026, 2027 and 2028
	Semester-III	December 2026, 2027 and 2028
	Semester-IV	May 2027, 2028 and 2029

One Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Human Genetics	Semester-I	December 2026, 2027 and 2028
	Semester-II	May 2027, 2028 and 2029

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/26/13736-750
Dated: 21/11/2026

Copy for information and necessary action to:

1. Dean, Faculty of Life Science
2. Convener, Board of Studies in Human Genetics
3. Director, CITES&M, University of Jammu for directing the concerned to upload the notification on University Website
4. All members of the Board of Studies
5. Joint Registrar (Evaluation/P.G. Exam.)
6. Programmer, Computer Section, Examination Wing

20/11/26

Joint Registrar (Academic)

20/11/26

SYLLABI FRAMEWORK PG PROGRAMME HUMAN GENETICS(1YEAR)

PG Syllabi 2025

S.No.	Course No.	Course Title	No. of Credits	Credits Level	Credit Points	Course Type Core/Elective/Any other	Marks Theory	Marks Practical	Nature of Course Global	Nature of Course National	Nature of Course Regional	Nature of Course Skill	SWAYAM/ MOOC	Vocational Course	Research Project/ Summer Internship/ Dissertation
1.	P1HGTC101	Medical Genetics & Genomics	4	6.5	26	Core	-	50	✓	✓	✓	✓			
2.	P1HGTC102	Population & Evolutionary Genetics	4	6.5	26	Core	100	-	✓	✓	✓				
3.	P1HGTC103	Basics of Bioinformatics & Biostatistics	2	6.5	13	Core	100	-	✓	✓		✓			
4.	P1HGTC104	Fundamentals of Clinical Genetics	4	6.5	26	Core	100		✓	✓	✓	✓			
5.	P1HGPC105	Practical based on P1HGTC101	2	6.5	13	Core	100	-	✓	✓	✓	✓			
6.	P1HGPC106	Practical based on P1HGTC102	2	6.5	13	Core	100	-	✓	✓	✓	✓			
7.	P1HGPC107	Practical based on P1HGTC103	2	6.5	13	Core	-	50	✓	✓	✓	✓			
8.	P1HGTE108	Stem cell Technology	2*	6.5	13	Elective	-	50	✓	✓	✓	✓			
9.	P1HGTE109	Cancer Biology	2	6.5	13	Elective	-	50	✓	✓	✓	✓			
10.	P1HGPE110	Practical Based on P1HGTE107	2*	6.5	13	Elective	-	50	✓	✓	✓	✓			
11.	P1HGPE111	Practical Based on P1HGTE108	2	6.5	13	Elective	-	-	✓	✓	✓	✓			
12.	P1HGTC201	Essentials of Genetic Counselling	4	6.5	26	Core	100	-	✓	✓	✓	✓			
13.	P1HGTC202	Fundamentals of Immunology	4	6.5	26	Core	100	-	✓	✓					
14.	P1HGPC203	Practical based on P1HGTC201	1+1	6.5	13	Core	-	50	✓	✓	✓	✓			
15.	P1HGPC204	Practical based on P1HGTC202	2	6.5	13	Core	-	100	✓	✓	✓	✓			
16.	P1HGTE205	Basics of Artificial Intelligence	2*	6.5	13	Elective	50	-	✓	✓		✓			
17.	P1HGTE206	Bioethics and IPR	2	6.5	13	Elective	50	-	✓	✓	✓				
18.	P1HGRC207	**Research Project + Presentation/Dissertation**	16	6.5	104	Core	-	-	-	-	-	-	✓		Research Project/ Dissertation

COURSE STRUCTURE FOR PG PROGRAM HUMAN GENETICS (1 YEAR)

COURSE CODE	COURSE NAME	CREDITS
CREDIT FRAMEWORK FOR SEMESTER-I		
Major Core [14 (T) + 6 (P)]		
P1HGTC101	Medical Genetics & Genomics	4
P1HGTC102	Population & Evolutionary Genetics	4
P1HGTC103	Basics of Bioinformatics & Biostatistics	2
P1HGTC104	Fundamentals of Clinical Genetics	4
P1HGPC105	Practical based on P1HGTC101	2
P1HGPC106	Practical based on P1HGTC102	2
P1HGPC107	Practical based on P1HGTC103	2
Total Credits		**20**
Major Elective (any one* 2T+2P)		
P1HGTE108	Stem Cell Technology	2*
P1HGTE109	Cancer Biology	2
P1HGPE110	Practical Based on P1HGTE108	2*
P1HGPE111	Practical Based on P1HGTE109	2
TOTAL CREDITS (MAJOR ELECTIVE)		**4**

COURSE CODE	COURSE NAME	CREDITS
CREDIT FRAMEWORK FOR SEMESTER-II		
Major Core [8 (T) + 4 (P)]		
P1HGTC201	Essentials of Genetic Counselling	4
P1HGTC202	Fundamentals of Immunology	4
P1HGPC203	Practical based on P1HGTC201	2
P1HGPC204	Practical based on P1HGTC202	2
Total Credits		**12**
MAJOR ELECTIVE (ANY ONE* 2T)		
P1HGTE205	Basics of Artificial Intelligence	2*
P1HGTE206	Bioethics and IPR	2
Total Credits (Major Elective)		**2**
P1HGRC207	**Research Project + Presentation/Dissertation**	**16**
Total Credits Earned by the students (Sem I+ Sem II)		**54**

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SEMESTER-I
(Syllabi for the examinations to be held in the years Dec. 2026, 2027, 2028)

COURSE CODE	COURSE NAME	CREDITS
CREDIT FRAMEWORK FOR SEMESTER-I		
Major Core [14 (T) + 6 (P)]		
P1HGTC101	Medical Genetics & Genomics	4
P1HGTC102	Population & Evolutionary Genetics	4
P1HGTC103	Basics of Bioinformatics & Biostatistics	2
P1HGTC104	Fundamentals of Clinical Genetics	4
P1HGPC105	Practical based on **P1HGTC101**	2
P1HGPC106	Practical based on **P1HGTC102**	2
P1HGPC107	Practical based on **P1HGTC103**	2
Total Credits		**20**
Major Elective (any one* 2T+2P)		
P1HGTE108	Stem Cell Technology	2*
P1HGTE109	Cancer Biology	2
P1HGPE110	Practical Based on **P1HGTE108**	2*
P1HGPE111	Practical Based on **P1HGTE109**	2
TOTAL CREDITS (MAJOR ELECTIVE)		**4**
Semester Credits Total		**20+4=24**

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Semester	Course No.	Course Title	Credits	Assessment Scheme
I	P1HGTC101	Medical Genetics & Genomics	Theory: 04 Practical: 02 Total: 06	Minor Test I: 10+10 Minor Test II: 10+10 Major test: 60 Total: 100

COURSE OUTCOMES:

CO1: Students will be able to Illustrate an in-depth understanding of the spectrum and inheritance patterns of genetic diseases, including autosomal, sex-linked, mitochondrial, and multifactorial disorders.

CO2: Apply modern genomic technologies such as NGS, WGS, and WES for the detection, screening, and management of inherited and somatic genetic diseases.

CO3: Interpret and analyze principles of personalized medicine, including pharmacogenomics, nutrigenomics, and preventive genomics, in the context of clinical applications.

CO4: Evaluate the molecular basis of cancer by identifying oncogenes, tumor suppressor genes, and genomic alterations, and assess the role of oncogenomics in diagnostics and ethical clinical practices.

CO5: Examine emerging technologies in medical genetics, including synthetic biology, transcriptomics, metabolomics, and reproductive technologies, along with their ethical and intellectual property considerations.

UNIT I Inheritance of Genetic Diseases/Disorders **12hours**

1.1 Spectrum of genetic diseases (single gene, chromosomal, multifactorial, mitochondrial, somatic cell genetic diseases) and their patterns of inheritance.

1.2 Inheritance pattern of autosomal single gene disorders: Sickle cell anemia, Huntington disease, Cystic Fibrosis, Neurofibromatosis. Marfan syndrome

1.3 Inheritance pattern of sex-linked single gene disorders: Hemophilia, DMD & Fragile-X syndrome.

1.4 Inheritance pattern of mitochondrial diseases: Mitochondrial Myopathy, Diabetes mellitus and deafness (DAD), Leber's hereditary optic neuropathy (LHON), Myoclonic epilepsy with ragged red fibers (MERRF syndrome).

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UNIT II:Detection and Management of Genetic Diseases **12hours**

2.1 Detection of inherited genetic diseases by NGS: Whole genome sequencing (WGS), and whole exome sequencing (WES).

2.2 Reproductive Genomics: Screening and prenatal diagnosis of genetic disorders.

2.3 Cancer Theranostics: Diagnostic biomarkers and precision therapeutic agents.

2.4 Management & Treatment of genetic diseases.

UNIT III: Personalized medicine in clinical practice **12hours**

3.1 Introduction to pharmacogenomics, Variability in drug metabolism and side effects and methods of analysis in pharmacogenomics.

3.2 Personalizing the right dose: antipsychotics, antidepressants, antiepileptics, antidiabetics, cardiovascular drugs, NSAIDs, analgesic drugs and immunosuppresants, Nanotechnology in medicine.

3.3 Nutrigenomics: the relationship between human genome, human nutrition, and health.

3.4 Preventive genomics: Predictive risks, scores for complex disorders.

UNIT IV:Oncogenomics **12hours**

4.1 Oncogenes (e.g., MYC, KRAS, BCR-ABL) and tumor suppressor genes (e.g., TP53, RB1, BRCA1/2).

4.2 Hallmarks of cancer and genomic instability.

4.3 Major cancer genomics initiatives: TCGA, ICGC, COSMIC.

4.4 Use of genomic biomarkers for diagnosis and prognosis, ethical issues in cancer genomics.

UNIT V: Innovative Technologies in Medical Genetics **12hours**

5.1 Historical developments in Medical Genetics.

5.2 Assisted Reproductive Technologies, Somatic Cell Nuclear transplant & its applications.

5.3 Synthetic biology and its applications, Introduction to IPR.

5.4 Applications of Transcriptomics and Metabolomics in Medical Genetics.

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(Syllabi for the examinations to be held in the years Dec. 2026,2027, 2028)

Books Recommended:

1. Descartes, R. J., & Cheng, T. L. (2020). Thompson & Thompson genetics in medicine (9th ed.). Elsevier.
2. Wang, W., et al. (2022). Pharmacogenomics: Challenges and opportunities in therapeutic strategies. Academic Press.
3. Khoury, M. J., et al. (Eds.). (2021). Genomic and precision medicine: Ethics, challenges, and opportunities. Elsevier.
4. Baldwin, G., & Endy, D. (2023). Synthetic biology: A primer (2nd ed.). CRC Press.
5. Thakur, A., Thakur, P., & Suhag, D. (2025). Advancements in nanobiology characterization techniques and cutting-edge applications (1st ed.). Academic Press.
6. Cao, G., & Wang, W. (2011). Nanostructures and nanomaterials: Synthesis, properties (2nd ed.). Imperial College Press.
7. Saharan, V., & Pal, A. (2016). Chitosan-based nanomaterials in plant growth and protection. Springer Briefs in Nanoscience and Nanotechnology.

Scheme of Examination: The students shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

MCQ on LMS+ Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Test I (after 30 days)	20%	1:30 hour	10+10 (20)
Test II (after 30 days)	21-40%	1:30 hour	10+10 (20)
Major test (after 90 days)	100%	3 hours	60
Total			**100**
Practical's/ Research			
Internal Examination	100%	2 hours	25
External examination	100%	2 hours	25
Total			**50**

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Syllabi for the examinations to be held in the years Dec. 2026, 2027, 2028

Note:

1. **Test I and Test II**

   The Subjective Test of Test I and Test II would consists of three short answer type questions (05marks each). Students are required to answer any two questions. No preparatory holidays shall be provided for the Test I and Test II. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test IIonly once.

2. **Major test**

The Major test will comprise of two sections, Section- A and Section- B.

- Section A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each.
- Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). Students are required to attempt 01 question from each unit of section B.

In major test there should not be a gap of more than two days in between two tests.

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SEMESTER-I
(Syllabi for the examinations to be held in the years Dec. 2026, 2027, 2028)

Semester	Course No.	Course Title	Credits	Assessment Scheme
I	P1HGTC102	Population& Evolutionary Genetics	Theory: 04 Practical: 02 Total: 06	Minor Test I: 10+10 Minor Test II: 10+10 Major test: 60 Total: 100

COURSE OUTCOMES:

CO1: Students will understand the fundamental principles of biological evolution, including natural selection, speciation, and human evolutionary pathways.

CO2: Students will be able to learn the concepts and tools of phylogenetics, with emphasis on molecular phylogeny, comparative genomics, and the molecular clock.

CO3: Students will develop the skill to explain the genetic structure of populations, using models like Hardy-Weinberg Equilibrium and various genetic association study designs.

CO4: Students will explore the roles of mutation, selection, and genetic variation in shaping populations, including estimation techniques and adaptive mechanisms.

CO5: Students will analyze the effects of inbreeding, genetic drift, and migration, including calculations of inbreeding coefficients and implications for genetic health and diversity

Unit I: Evolutionary Biology **12hours**

1.1 Biological Evolution and Theories of Evolution

1.2 Natural selection: Evidences and modes of Natural selection, sexual selection.

1.3 Speciation: types of speciation, evolutionary processes causing speciation

1.4 Evolution of Modern Humans.

Unit II: Phylogenetics **12hours**

2.1 Concepts and applications of Phylogenetics

2.2 Molecular phylogeny: Phylogenetic tree construction

2.3 Molecular clock

2.4 Comparative Genomics.

Unit III: Population Genetics **12hours**

3.1 Genetic constitution of a population, calculation of allele and genotype frequencies.

3.2 Types of genetic association studies: Case control, Cross-sectional, GWAS, quantitative trait association studies.

3.3 Hardy-Weinberg Equilibrium Principle: Assumptions of HWE, Testing of HWE in the population, HWE for two and multiple alleles of an autosomal gene.

3.4 Impact of recurrent and non-recurrent mutations in HWE population.

Unit IV: Genetic Dynamics: Mutation, Selection, and Variation **12hours**

4.1 Mutation pressure and estimates of mutation rates.

4.2 Selection coefficient and fitness, Selection against recessive/ dominant/partial dominant/overdominant genes, heterozygote advantage

4.3 Phenotypic variation and spatial variation.

4.4 Adaptive landscape, gene pool & genetic fitness, Bayes theorem.

Unit V: Inbreeding, Genetic Drift, and Migration: Impacts on Populations **12hours**

5.1 Consanguinity and inbreeding.

5.2 Inbreeding coefficient of a population and individual through path analysis.

5.3 Biological consequences of inbreeding, genetic load and its measurements.

5.4 Effect of migration and genetic drift on gene frequencies.

Recommended Books:

1. Cohn, R. D., Scherer, S. W., &Hamosh, A. (Eds.). (2023). *Thompson & Thompson genetics and genomics in medicine* (9th ed.). Elsevier.
2. Rastogi, V. B. (2023). *Organic evolution: Evolutionary biology* (15th ed.). Medtech Science Press.
3. Hamilton, M. B. (2021). *Population genetics* (2nd ed.). Wiley-Blackwell.
4. Knopik, V. S., Neiderhiser, J. M., DeFries, J. C., & Plomin, R. (2016). *Behavioral genetics* (7th ed.). Worth Publishers.
5. Hedrick, P. W. (2011). *Genetics of population* (4th ed.). Jones and Bartlett Publishers.

6. Hartl, D. L., & Clark, A. G. (2007). *Principles of population genetics* (4th ed.). Sinauer Associates.
7. Relethford, J. H. (2012). *Human population genetics*. Wiley-Blackwell.
8. Doudna, J. (2017). *A crack in creation: The new power to control evolution*. Vintage Digital.

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Test I (after 30 days)	20%	1:30 hour	10+10 (20)
Test II (after 30 days)	21-40%	1:30 hour	10+10 (20)
Major test (after 90 days)	100%	3 hours	60
Total			**100**
Practicals/ Research			
Internal Examination	100%	2 hours	25
External examination	100%	2 hours	25
Total			**50**

Note:

1. **Test I and Test II**

   The Subjective Test of Test I and Test II would consists of three short answer type questions (05marks each). Students are required to answer any two questions. No preparatory holidays shall be provided for the Test I and Test II. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test IIonly once.

2. **Major test**

The Major test will comprise of two sections, Section- A and Section- B.

- Section A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each.
- Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). Students are required to attempt 01 question from each unit of section B.

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Semester	Course No.	Course Title	Credits	Assessment Scheme
I	P1HGTC103	Basics of Bioinformatics & Biostatistics	Theory: 02 Practical: 02 Total: 04	Minor Test I: 5+5 Minor Test II: 5+5 Major test: 30 Total: 50

COURSE OUTCOMES:

CO1: Students will gain knowledge about the foundational concepts in descriptive and inferential statistics, including measures of central tendency, probability distributions, hypothesis testing, and regression analysis relevant to biological data.

CO2: Familiarize students with core bioinformatics resources, including primary and secondary nucleotide and protein sequence databases, and their classification systems.

CO3: Students will get a comprehensive overview of genome projects (e.g., Human Genome Project, Genome India Project), genome mapping and sequencing techniques, and their applications in modern biology.

Unit I: Bioinformatics and Biological Databases **10hours**

1.1 **Introduction to Bioinformatics-** Role of the internet in modern biological research; Scope and applications of bioinformatics in life sciences; Overview and classification of biological databases: Primary databases, Secondary databases, Composite database

1.2 **Nucleotide Sequence Databases-** Structure, content, and access to major nucleotide databases: GenBank (NCBI), EMBL-EBI Nucleotide Sequence Database, DDBJ (DNA Data Bank of Japan).

1.3 **Protein Sequence Databases-** Key repositories for protein sequence information; SWISS-PROT, TrEMBL, UniProt, PROSITE and Pfam, OWL.

1.4 **Structural Databases and Classification Systems-** Resources for macromolecular 3D structures: Protein Data Bank (PDB), Molecular Modelling Database (MMDB), Nucleic Acid Database (NDB); Structural classification systems: SCOP (Structural Classification of Proteins), CATH (Class, Architecture, Topology, Homologous superfamily)

Unit II: Statistical Methods and Inference **10hours**

2.1 Descriptive Statistics and Probability Fundamentals- Measures of central tendency: Mean, median, and mode; Measures of dispersion: Range, variance, standard deviation; Fundamentals of probability: Definitions, types (classical, empirical, and subjective); Combinatorics: Permutations and combinations; basic probability computations.

2.2 Probability Distributions and Statistical Hypotheses- Theoretical probability distributions: Binomial, Poisson, and Normal; Introduction to hypothesis testing: Null and alternative hypotheses; Statistical errors: Type I and Type II errors

2.3 Inferential Statistical Techniques- Tests of significance: *t*-test (independent and paired), chi-square test; Analysis of variance (ANOVA): One-way and two-way ANOVA.

2.4 Correlation and Regression Analysis- Simple correlation: Concepts, calculation, and interpretation; Simple linear regression: Estimation of parameters, model interpretation; Application and limitations in predictive analysis.

UNIT III: Information Retrieval and Computational Analysis of Biological Databases

10hour

3.1 Data Retrieval Systems- SRS (Sequence Retrieval System) for flat-file databases, ENTREZ (NCBI) global search platform, LinkDB for pathway and link-based data retrieval.

3.2 Sequence Analysis and Submission Tools- Sequence similarity tools: BLAST, FASTA, CLUSTALW; Sequence submission: BankIt, Sequin, Webin, SAKURA

3.3 Genomics and the Human Genome Project- Overview of the Human Genome Project, latest advancements: T2T consortium, Human Pangenome Reference Consortium (HPRC), Genome India Project (GIP). Genome sequencing and mapping techniques, Applications of genome maps, Telomere-to-Telomere (T2T) Consortium, Human Pangenome Reference Consortium (HPRC), Genome India Project (GIP), European Reference Genome Atlas (ERGA), Earth BioGenome Project (EBP), Human Heredity and Health in Africa (H3Africa).

3.4 Genome and Phylogenetic Analysis- Sequence assembly and genome annotation, Phylogenetic analysis methods; Comparative genomics: COGs and HomoloGene (NCBI

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Books Recommended:

1. Lesk, A. M. (2019). *Introduction to bioinformatics* (5th ed.). Oxford University Press
2. Ghosh, Z., & Mallick, B. (2008). *Bioinformatics: Principles and applications* (1st ed.). Oxford University Press.
3. Rastogi, S. C., Rastogi, P., & Mendiratta, N. (2022). *Bioinformatics: Methods and applications – Genomics, proteomics and drug discovery* (5th ed.). PHI Learning Pvt. Ltd
4. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis.Cold Spring Harbor, NY: Cold Spring Harbor.
5. Baxevanis, A. D., & Ouellette, B. F. F. (2005). *Bioinformatics: A practical guide to the analysis of genes and proteins* (3rd ed.). Wiley-Interscience
6. Pevsner, J. (2015).Bioinformatics and Functional Genomics. Hoboken, NJ.: Wiley- Blackwell.
7. Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.
8. Lesk, A. M. (2019). *Introduction to protein science: Architecture, function, and genomics* (3rd ed.). Oxford University Press.
9. Attwood, T. K., & Parry-Smith, D. J. (2009). *Introduction to bioinformatics* (2nd ed.). Pearson Education Limited
10. Information Resources Management Association. (Ed.). (2024). *Research anthology on bioinformatics, genomics, and computational biology* (Vols. 1-3). IGI Global.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

MCQ on LMS+ Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Test I (after 30 days)	20%	1 hour	05+05 (10)
Test II (after 30 days)	21-40%	1 hour	05+05 (10)
Major test (after 90 days)	100%	2.5 hours	30
Total			**50**
Practical/Research			
Internal Examination	100%	2hours	25
External Examination	100%	2hours	25
Total			**50**

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Note:

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate must attempt one question from each unit of 10 marks each.

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(Syllabi for the examinations to be held in the years Dec. 2026, 2027, 2028)

Semester	Course No.	Course Title	Credits	Assessment Scheme
I	P1HGTC104	Fundamentals of Clinical Genetics	Theory: 04	Minor Test I: 10+10 Minor Test II: 10+10 Major test: 60 Total: 100

COURSE OUTCOMES:

CO1: Students will understand the interplay between genetic and environmental factors in the development of clinical disorders and assess genetic risk using tools like polygenic risk scores.

CO2: Students will recognize the genetic basis, inheritance patterns, and clinical features of monogenic and multifactorial disorders, including both autosomal and X-linked conditions.

CO3: Students will analyze complex diseases with polygenic and environmental components, such as cardiovascular, neurodegenerative, and psychiatric disorders, to inform diagnosis and management.

CO4: Students will be ableto explore the role of dermatoglyphics in identifying genetic disorders and its clinical applications.

CO5: Students will understand the diagnosis and genetic basis of congenital anomalies and the use of emerging reproductive technologies.

UNIT I: Genetics, Environment & Disease **12hours**

1.1 Genetic and Environmental determinants of Clinical Disorders.

1.2 Clinical utilization of presymptomatic and predisposition testing for genetic diseases and malignancy.

1.3 Nature and Nurture: Disentangling the effects of genes and environment.

1.4 Risk of recurrence, empiric risks and polygenic risk scores.

UNIT II Monogenic/Unifactorial Genetic Disorders **12hours**

2.1 Introduction to monogenic genetic diseases.

2.2 Common Autosomal Disorders: Thalassemia, cystic fibrosis, lysosomal storage diseases, Neurofibromatosis, Achondroplasia.

2.3 Common X-linked Disorders: Hemophilia, DMD, G-6-PD Deficiency.

2.4 Disorders with multiple modes of inheritance: Retinitis Pigmentosa, Alport Syndrome, Prelingual deafness.

UNIT III: Polygenic/Multifactorial Disorders **12hours**

3.1 Introduction to complex genetic disorders.

3.2 Coronary Artery Disease and MIYA (Myocardial Infarction in young adults).

3.3 Inflammatory Bowel Disease (IBD): Crohn's Disease and Ulcerative Colitis.

3.4 Neurodegenerative & Psychiatric disorders: Parkinson, Alzheimer's, Schizophrenia &bipolar disorder.

UNIT IV: Dermatoglyphics in Clinical Genetics **12hours**

4.1Introduction to dermatoglyphics

4.2Classification and pattern types

4.3Dermatoglyphics in clinical disorders- Down's syndrome, Turner's syndrome, Klinefelter's syndrome and Cri du chat syndrome.

4.4Clinical applications, Advantages and Limitations.

UNIT V: Clinical and Genetic Approaches to Congenital Disorders **12hours**

5.1Clinical Approach to Children with Congenital Anomalies: Down syndrome, Achondroplasia, Marfan syndrome.

5.2 Dysmorphology and Clinical Teratology.

5.3 Ring chromosome and related genetic disorders.

5.4 Reprogenetics- Germinal Choice Technology.

Books Recommended:

1. Pyeritz, R. E., Korf, B. R., & Grody, W. W. (Eds.). (2024). Emery and Rimoin's principles and practice of medical genetics and genomics (8th ed.). Academic Press.
2. Turnpenny, P. D., Ellard, S., & Cleaver, R. (2021). Emery's elements of medical genetics and genomics (16th ed.). Elsevier.
3. D. Peter Snustad and Michael J. Simmons. Principles of Genetics. 6th edition. John Wiley & Sons, Inc., 2011.

4. Kingston, H. M. (2002). *ABC of clinical genetics* (3rd ed.). BMJ Books.
5. Human Heredity: Principles and Issues by Micheal R. Cummings; 11th edition, Cengage Learning, 2016.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

MCQ on LMS+ Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Test I (after 30 days)	20%	1:30 hour	10+10 (20)
Test II (after 30 days)	21-40%	1:30 hour	10+10 (20)
Major test (after 90 days)	100%	3 hours	60
Total			**100**

Note:

1. **Test I and Test II**

   The Subjective Test of Test I and Test II would consists of three short answer type questions (05marks each). Students are required to answer any two questions. No preparatory holidays shall be provided for the Test I and Test II. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test IIonly once.

2. **Major test**

The Major test will comprise of two sections, Section- A and Section- B.

- Section A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each.
- Section B will have 06 questions of 12 marks each to be set from the last three units (02 from each unit). Students are required to attempt 01 question from each unit of section B.

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SEMESTER-I
(Syllabi for the examinations to be held in the years Dec. 2026, 2027, 2028)

Semester	Course No.	Course Title	Credits	Assessment Scheme
I	P1HGTE108	Stem Cell Technology	Theory: 02 Practical: 02 Total: 04	Minor Test I: 5+5 Minor Test II: 5+5 Major test: 30 Total:50

COURSE OUTCOMES:

CO1: Students will be able to learn the fundamental concepts of stem cell biology, including stemness, types of stem cells, their sources, and laboratory techniques for isolation, characterization, and maintenance.

CO2: Students will explore the therapeutic potential and applications of mesenchymal and induced pluripotent stem cells (iPSCs) in regenerative medicine and disease modeling.

CO3: Students will acquire understanding of the ethical, legal, and regulatory frameworks governing stem cell research, including national and international guidelines and the role of biobanks in clinical and research settings.

UNIT I: Introduction to Stem Cells **10hours**

1.1 Introduction to stem cells and basis of stemness

1.2 Types of stem cells: Embryonic stem cells, adult stem cells, hematopoietic stem cells, mesenchymal stem cells, cancer stem cells, induced pluripotent stem cells, Placental cell and umbilical cord stem cells, adipocyte derived stem cells

1.3 Isolation, characterization, and maintenance of embryonic stem cells.

1.4 Serum and feeder free culture of human embryonic stem cells, cryopreservation of embryos.

UNIT II: Mesenchymal & Induced Pluripotent Stem Cells **10hours**

2.1 Introduction to mesenchymal stem cells, isolation, and characterization.

2.2 Differentiation of mesenchymal stem cells into various lineages.

2.3 Introduction to iPSC technology; Reprogramming iPSCs: integration and non-integration methods;

2.4 Advantages and disadvantages of iPSCs.

UNIT III: Stem Cell Applications & Ethical Issues **10hours**

3.1 Existing and potential clinical use of stem cells.

3.2 Application of stem cells to regenerative medicine.

3.3 Biobanks &Controversies in stem cell research, current controversies surrounding stem cell research.

3.4 Ethical and regulatory issues associated with stem cell research: National and International guidelines.

Books Recommended:

1. Lanza, R., & Atala, A. (Eds.). (2025). *Essentials of stem cell biology* (4th ed.). Elsevier Science.
2. Brand-Saberi, B. (Ed.). (2020). *Essential current concepts in stem cell biology*. Springer Nature.
3. Deb, K. D., &Totey, S. M. (Eds.). (2011). *Stem cell basics and application*. Tata McGraw-Hill Pvt. Ltd.
4. Chiu, A. Y., & Rao, M. (Eds.). (2011). *Human embryonic stem cells*. Humana Press.
5. Sell, S. (Ed.). (2010). *Stem cells handbook*. Humana Press.
6. Marshak, D. R., Gardner, R. L., & Gottlieb, D. I. (2001). *Stem cell biology*.
7. Lanza, R., Gearhart, J., & Hogan, B. (Eds.). *Essentials of stem cell biology*.

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Test II (after 30 days)	21-40%	1 hour	05+05 (10)
Major test (after 90 days)	100%	2.5 hours	30
Total			**50**
Practical/Research			
Internal Examination	100%	2hours	25
External Examination	100%	2hours	25
Total			**50**

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SEMESTER-I

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Note:

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate must attempt one question from each unit of 10 marks each.

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SEMESTER-I
Syllabi for the examinations to be held in the years Dec. 2026, 2027, 2028

Semester	Course No.	Course Title	Credits	Assessment Scheme
I	P1HGTE109	Cancer Biology	Theory: 02 Practical: 02 Total: 04	Minor Test I: 5+5 Minor Test II: 5+5 Major test: 30 Total:50

COURSE OUTCOMES:

CO1: Students will acquire foundational knowledge of cancer biology, including cancer types, stages, and hallmark characteristics, with emphasis on molecular and cellular mechanisms of oncogenesis.

CO2: Students will be able to analyze genetic, epigenetic, and environmental factors contributing to cancer development, including tumor suppressor genes, oncogenes, chromosomal instability, and the tumor microenvironment.

CO3: Familiarize students with modern approaches to cancer diagnosis, treatment, and genetic counseling, including personalized therapies, immunotherapy, liquid biopsies, and polygenic risk assessment following established guidelines (e.g., MCC – Multidisciplinary Cancer Care Guidelines).

Unit I: Fundamentals of Cancer Biology **10hours**

1.1 Definition and overview of cancers, Hallmarks of cancer cells.

1.2 Types of Cancers: Benign vs. malignant tumors; Carcinomas Sarcomas, Leukemias, Lymphomas & Myelomas, Hematological & Solid, Inherited & Familial

1.3 Stages of Cancer Development: Initiation, promotion and progression & Clonal evolution.

1.4 Cancer risk factors: Lifestyle choices, environmental exposures, and genetic predisposition, molecular mechanisms of carcinogens & mutagens

Unit II: Molecular and Cellular Mechanisms of Cancer **10hours**

2.1 Molecular Basis of Cancer: Two-hit hypothesis, Tumor suppressor genes and Oncogenes; Chromosomal Instability in Oncogenesis.

2.2 The Tumor Microenvironment: Driving Cancer Progression.

2.3 Epigenetics in Cancer: DNA methylation, histone modifications, non-coding RNAs (ncRNAs) & chromatin remodelling.

2.4 Role of Cell Cycle in Carcinogenesis.

Unit III: Managing Cancer: From Heredity to Therapy **10hours**

3.1 Familial cancer syndromes: BRCA1/2 breast and Ovarian cancer syndromes; Lynch syndrome (HNPCC), Li-Fraumeni syndrome; Familial adenomatous polyposis (FAP).

3.2 Detection and Diagnosis: Biopsy techniquesand types; Imaging modalities, Tumor markers & monoclonal antibodies.

3.3 Cancer therapies: chemotherapy; Immunotherapy and targeted therapies (with special emphasis on CAR T Therapy) & Cancer vaccines.

3.4 Genetic Counselling and Polygenic risk assessment for cancer predisposition, Multidisciplinary Cancer Care (MCC) Guidelines.

Recommended Books:

1. Cohn, R. D., Scherer, S. W., &Hamosh, A. (Eds.). (2024). *Thompson & Thompson genetics and genomics in medicine* (9th ed.). Elsevier.
2. Weinberg, R. A. (2023). *The biology of cancer* (3rd ed.). W. W. Norton & Company.
3. Hesketh, R. (2023). *Introduction to cancer biology* (2nd ed.). Cambridge University Press.
4. Pecorino, L. (2021). *Molecular biology of cancer: Mechanisms, targets, and therapeutics* (5th ed.). Oxford University Press.
5. DeVita, V. T., Hellman, S., & Rosenberg, S. A. (2019). *Cancer: Principles and practice of oncology* (9th ed.). Wolters Kluwer Health.
6. Heim, S., & Mitelman, F. (Eds.). (2015). *Cancer cytogenetics: Chromosomal and molecular genetic aberrations of tumor cells* (4th ed.). Wiley-Blackwell.

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Scheme of Examination: The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

MCQ on LMS+ Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
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Test II (after 30 days)	21-40%	1 hour	05+05 (10)
Major test (after 90 days)	100%	2.5 hours	30
Total			**50**
Practical/Research			
Internal Examination	100%	2hours	25
External Examination	100%	2hours	25
Total			**50**

Note:

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate must attempt one question from each unit of 10 marks each.

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SEMESTER-II
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COURSE CODE	COURSE NAME	CREDITS
CREDIT FRAMEWORK FOR SEMESTER-II		
Major Core [8 (T) + 4 (P)]		
P1HGTC201	Essentials of Genetic Counselling	4
P1HGTC202	Fundamentals of Immunology	4
P1HGPC203	Practical based on **P1HGTC201**	2
P1HGPC204	Practical based on **P1HGTC202**	2
Total Credits		**12**
MAJOR ELECTIVE (ANY ONE* 2T)		
P1HGTE205	Basics of Artificial Intelligence	2*
P1HGTE206	Bioethics and IPR	2
Total Credits (Major Elective)		**2**
P1HGRC207	**Research Project + Presentation/Dissertation**	**16**
Semester Credits Total		**12+2+16= 30**

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Semester	Course No.	Course Title	Credits	Assessment Scheme
II	P1HGTC201	Essentials of Genetic Counseling	Theory: 04 Practical: 02 Total:06	Minor Test I: 10+10 Minor Test II: 10+10 Major test: 60 Total: 100

COURSE OUTCOMES:

CO1: Students will gain foundational knowledge of genetic counseling, including its types, process, and significance in Mendelian and non-Mendelian disorders.

CO2: Students will explore the psychosocial, ethical, and behavioural dimensions of counseling for individuals, families, and groups affected by genetic conditions.

CO3: Students will examine genetic counseling approaches in specific disorders, such as neuromuscular diseases, infertility, hereditary cancers, and developmental anomalies.

CO4: Students will understand national and international ethical guidelines, informed consent, genetic discrimination, and the functioning of genetic counselling clinics.

CO5: Students will be familiarized with legal frameworks, including the PCPNDT Act, regulations on genetic services, and the legal responsibilities of genetic counsellors.

Unit-I: Introduction to Genetic Counseling **12hours**

1.1 An overview of the history and development of Genetic Counseling

1.2 The fundamental components and skills utilized in pediatric and adult genetic counseling.

1.3 Types of Genetic Counseling: Individual, Family and Group.

1.4 Indications of Genetic counseling in prenatal, pediatric and adult-onset genetic disorders.

Unit-II:TheGenetic Counseling Process **12hours**

2.1 Taking clinical/medical history, family history and its interpretation, Bayesian theorem.

2.2 Psychosocial and Behavioral aspects of Genetic Counseling.

2.3 Explaining risks and reproductive options in cytogenetic disorders, Mendelian and Non-Mendelian disorders.

2.4 Understanding the Genetic Counseling context: Screening verses Diagnostics testing.

Unit-III Genetic Counseling in Genetic Disorders **12hours**

3.1 Neuromuscular Disorders/Deafness and Blindness.

3.2 Infertility and Recurrent Pregnancy Loss.

3.3 Hereditary and Familial Cancers.

3.4 Trinucleotide repeat expansions: Understanding anticipation.

Unit-IV Fundamentals of Pre-test and post-test Counseling **12hours**

4.1 Explaining the advantages and limitations of tests and interpretation results of the genetic tests (Chromosomal, biochemical and molecular diagnostic tests).

4.2 Determining the mode of inheritance and risk of occurrence and recurrence of the genetic condition/birth defects, and appropriate communication.

4.3 Explaining the diagnosis, etiology, natural history, monitoring and management of the genetic disorder and providing counseling for reproductive options.

4.4 Providing written documentation of medical, genetic and counseling information for families (extended screening and cascade testing) and other health professionals.

Unit-V Ethos of Genetic Counseling **12hours**

5.1 Ethical principles of Genetic Counseling: Privacy, Confidentiality and GeneticDiscrimination, Informed Consent and Right of Choice.

5.2 Genetic Counseling in Clinics: Types, working & Maintenance of Genetic Registers, preparing Genetic Counseling Reports.

5.3 Role of Genetic Counselors in era of Clinical Genomics.

5.4 Status of Genetic Counseling in India and Global Scenario.

Books Recommended

1. Pyeritz, R. E., Korf, B. R., & Grody, W. W. (Eds.). (2024). *Emery and Rimoin's principles and practice of medical genetics and genomics* (7th ed.). Academic Press.
2. Cohn, R. D., Scherer, S. W., &Hamosh, A. (Eds.). (2024). *Thompson & Thompson genetics and genomics in medicine* (9th ed.). Elsevier.
3. Dave, U., & Shetty, D. (2021). *Genetic counseling: Clinical and laboratory approach* (1st ed.). Springer.

4. Veach, P. M., LeRoy, B. S., & Callanan, N. P. (2020). *Genetic counselling practice: Advanced concepts and skills* (2nd ed.). Springer.
5. Clarke, A., Murray, A., & Sampson, J. (2020). *Harper's practical genetic counselling* (8th ed.). CRC Press.
6. Hurst, J. A., & Firth, H. V. (2017). *Oxford desk reference: Clinical genetics and genomics*. Oxford University Press.

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Test II (after 30 days)	21-40%	1:30 hour	10+10 (20)
Major test (after 90 days)	100%	3 hours	60
Total			**100**
Practical's/ Research			
Internal Examination	100%	2 hours	25
External examination	100%	2 hours	25
Total			**50**

Note:

1. **Test I and Test II**

   The Subjective Test of Test I and Test II would consists of three short answer type questions (05marks each). Students are required to answer any two questions. No preparatory holidays shall be provided for the Test I and Test II. Those candidates who have appeared in Test I and Test II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test IIonly once.

2. **Major test**

The Major test will comprise of two sections, Section- A and Section- B.

- Section A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each.

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SEMESTER-II
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Semester	Course No.	Course Title	Credits	Assessment Scheme
II	P1HGTC202	Fundamentals of Immunology	Theory: 04 Practical:02 Total: 06	Minor Test I: 20 Minor Test II: 20 Major test: 60

COURSE OUTCOMES:

CO1: Students will be able to explain the organization and function of the immune system, including the roles of various immune cells, antigens, antibodies, and the molecular basis of immune recognition and response.

CO2: Students will develop skill to demonstrate mechanisms underlying humoral and cell-mediated immunity, antigen presentation, complement activation, and cytokine function in immune regulation.

CO3: Students will be able to analyze immunological dysfunctions such as hypersensitivity reactions, autoimmune diseases, immunodeficiency disorders, and graft rejection, including their cellular and molecular basis.

CO4: Students will be able to demonstrate immunological techniques such as ELISA, immunoblotting, flow cytometry, and immunoelectrophoresis for the diagnosis of diseases and characterization of immune responses.

CO5: Students will acquire knowledge to evaluate modern immunotherapies, including CAR-T cell therapy, monoclonal antibodies, and vaccine strategies, and assess their clinical applications and mechanisms of action.

UNITI: Introduction to the Immune System **12hours**

1.1 Introduction to immune system, Innate and acquired immunity, clonal nature of immune response; Organization and structure of lymphoid organs, Hematopoiesis and differentiation, Cells of the immune system: B- lymphocytes, T-lymphocytes, Macrophages, Dentritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells.

1.2 Nature and Biology of antigens and super antigens.

1.3 Antibody structure and function, antibody mediated effector functions, antibody classes and biological activity

1.4 Antigenic determinants on immunoglobulins, Immunoglobulin superfamily, BCR &TCR, generation of antibody diversity.

UNIT-II: Humoral and Cell Mediated Immunity **12hours**

2.1 Regulation of immune response, Antigen processing and presentation, generation of humoral and cell mediated immune responses, Activation of B- and T- lymphocytes,

2.2 Complement System: components of complement, complement activation, complement cascade, regulation of complement System.

2.3 Cytokines, cytokines receptors, cytokines antagonists, role of cytokines in T H 1/T H 2 subset development and their role in immune regulation, MHC: MHC molecules and genes, MHC restriction.

2.4 Cell-mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity.

UNITIII: Errors of the Immune System **12hours**

3.1 Immunological tolerance: central tolerance, peripheral tolerance, component of peripheral tolerance.

3.2 Hypersensitivity: IgE mediated Hypersensitivity, Antibody mediated cytotoxic Hypersensitivity, Immune complex- mediated Hypersensitivity, Delayed type Hypersensitivity.

3.3 Inborn Errors of Immune System: organ specific and systemic autoimmune diseases, animal models for autoimmune diseases and the molecular mechanism, immunodeficiency disorder- AIDS.

3.4 Transplantation immunology: Immunological basis of graft rejection, clinical manifestation of graft rejection, general immunosuppressive therapy, specific immunosuppressive therapy, immune tolerance to allografts.

UNIT IV: Immunodiagnostic Procedures **12hours**

4.1 Antigen- Antibody interactions and Techniques – ELISA and its variants, ELISPOT, Radio immunoassay, Immunofluorescence, Flow cytometry and Fluorescence,Immuno electron microscopy.

4.2 Agglutination and haemagglutination assays.

4.3 Types of immunodiffusion and immunoelectrophoretic procedures, isoelectric focusing.

4.4 Affinity chromatographic methods and Immunoblotting.

UNIT V: Immunology-Based Therapies **12hours**

5.1 Immunotherapy: CAR T-cell therapy, Immune checkpoint inhibitors, Monoclonal antibodies, interleukin therapy, vaccines.

5.2 Chimeric antigen receptor (CAR) T-cell therapy: working, application and side effects, approved CAR T-cell therapies.

5.3 Hybridoma Technology and Monoclonal antibodies detection and application of monoclonal antibodies.

5.4 Vaccines: History of vaccine development, introduction to the concept of vaccine, Active and passive immunization, Designing vaccines for active immunization: Conventional vaccines, subunit vaccines, conjugate vaccines, DNA vaccines, Recombinant vector vaccines.

BOOKS RECOMMENDED

1. Punt, J., Stranford, S., Snell, P. J., & Williams, P. J. (2023). *Kuby immunology* (9th ed.). W.H. Freeman and Company.
2. Abbas, A. K., Lichtman, A. H., Pillai, S., & Henrickson, S. (2025). *Cellular and molecular immunology* (11th ed.). Elsevier.
3. Flajnik, M. F., Singh, N. J., & Holland, S. M. (Eds.). (2022). *Paul's fundamental immunology* (8th ed.). Wolters Kluwer Health.
4. Immunology, International 9th Edition 2020 by David Male.
5. Coleman, R.M., Lombard, M.F. and Sicard, R.E.(1992). Fundamental Immunology.
6. Male, D., Brostoff, J., Roth, D., &Roitt, I. (Eds.). (2012). *Immunology* (8th ed.). Elsevier Health Sciences
7. Benjamini, E., Coico, R., & Sunshine, G. (2021). *Immunology: A short course* (8th ed.). Wiley-Blackwell
8. Davies, H. (2024). *Introductory immunobiology*. CRC Pres.
9. Wood, P. (2011). *Understanding immunology* (3rd ed.). Pearson Education.

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Test II (after 30 days)	21-40%	1:30 hour	10+10 (20)
Major test (after 90 days)	100%	3 hours	60
Total			**100**
Practical's/ Research			
Internal Examination	100%	2 hours	25
External examination	100%	2 hours	25
Total			**50**

Note:

1. **Test I and Test II**

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- Section A will have one compulsory question comprising of 08 parts (minimum 01 from each unit) of 03 marks each.
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Semester	Course No.	Course Title	Credits	Assessment Scheme
II	P1HGTE205	Basics of Artificial Intelligence	Theory: 02	Minor Test I: 5+5 Minor Test II: 5+5 Major test: 30 Total:50

COURSE OUTCOMES:

CO1: Students will be able to introduce the fundamentals of Artificial Intelligence and biological data, including types of data, data processing techniques, and ethical concerns such as privacy and algorithmic bias.

CO2:Students will be able to explore core machine learning and deep learning techniques, including supervised, unsupervised, and reinforcement learning, with practical applications in biological research using tools like BioPython and AlphaFold.

CO3: Students will be able to demonstrate real-world applications of AI in biology, such as drug discovery, disease diagnosis, crop improvement, and environmental sustainability, highlighting ethical considerations in AI-driven biological research.

UNIT I: Introduction to AI and Databases **10hours**

1.1 Artificial intelligence and Its foundations Definition and history of AI; Branches of AI: Machine Learning (ML), Deep Learning (DL): AI vs. traditional programming: Generative AI: ChatGPT, DeepSeek: AI vs. Biological Intelligence.

1.2 Biological data: Types of biological data: imaging, experimental, clinical, and environmental: Challenges in biological data analysis.

1.3 Computational tools and data management, Need for computational tools in biology: Data storage and analysis: Cloud vs. server-based data storage and analysis: Data privacy and security: Algorithmic bias and fairness: Sources of bias in biological datasets.

1.4 Data processing techniques: Data cleaning and handling: Dealing with missing values, noise, and outliers: Data transformation: Normalization, standardization, and scaling of data.

UNIT II: Machine Learning and Deep Learning **10hours**

2.1 Machine learning; Types of ML: Supervised, unsupervised, Reinforcement learning; Use cases in biology: AlphaFold, trRosetta, AIDDISON; Common tools and libraries: Bio Python, EMBOSS, etc.

2.2 Deep Learning architectures, Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs): Applications, advantages, and limitations in biology.

2.3 Data processing techniques: Data cleaning and handling: Dealing with missing values, noise, and outliers: Data transformation: Normalization, standardization and scaling of data.

2.4 Programming languages: Python, Bio Python, R, Shell/Bash; Practical examples and hands-on coding exercises. Programming without coding.

UNIT III: Applications in Biology **10hours**

3.1 Bioinformatics: Overview of commonly used AI-based tools, AI-based phenotype tools and databases for nucleic acid protein, metabolite analysis.

3.2 Drug discovery and development: Target identification and validation: Lead discovery and optimization: Preclinical and clinical trial data analysis.

3.3 Use of AI in Human Diseases: Cancer Diagnosis, Imaging and Pattern Recognition in Syndromes(AI tools: Face2Gene and GestaltMatcher).Drug repurposing using molecular and clinical data (AI tools: DeepChem, DeepTox, ChEMBL etc.).

3.4 Agricultural and environment: Crop yield prediction; Disease and pest detection; Resource optimization (e.g., water, fertilizers); Environmental monitoring and sustainability. Ethical principles and bias in AI applications for biology.

Books Recommended:

1. Raja Sekar, M. N., Saxena, A., et al. (2021). Artificial Intelligence in Precision Health: From Concept to Practice. Springer.
2. Bennett, M. (2025). *A Brief History of Intelligence: Why the Evolution of the Brain Holds the Key to the Future of AI.*
3. Olson, P. (2024). *Supremacy: AI, ChatGPT and the Race That Will Change the World.* Pan Macmillan/St. Martin's Press.

UNIVERSITY OF JAMMU
INSTITUTE OF HUMAN GENETICS
SYLLABUS FOR POST GRADUATE PROGRAMME IN HUMAN GENETICS
(1-YEAR M.Sc. COURSE) AS PER NATIONAL EDUCATION POLICY (NEP-2020)
SEMESTER-II
Syllabi for the examinations to be held in the years May 2027, 2028, 2029

Semester	Course No.	Course Title	Credits	Assessment Scheme
II	**P1HGTE206**	**Bioethics and IPR**	**Theory: 02**	**Minor Test I: 5+5** **Minor Test II: 5+5** **Major test: 30** **Total:50**

COURSE OUTCOMES:

CO1: Students will be able tofamiliarize with the fundamentals of Intellectual Property Rights (IPRs) and their specific applications in biotechnology, including patents, trademarks, copyrights, and sui generis protections.

CO2: Students will be able tounderstand the procedures and challenges of patenting in the life sciences, including patent filing, licensing, technology transfer, and the roles of national and international patent authorities.

CO3: Students will be able to critically examine ethical and legal issues in biotechnology, including gene therapy, GMOs, organ transplantation, and environmental protection, guided by national policies and international bioethical principles.

UNIT-I:Intellectual Property **10hours**

1.1 Introduction to IPRs; various types of IPRs: Trademarks, Copyrights, Geographical indications, Trade Secrets; Role of IPRs in Biotechnology

1.2 Patents: Criteria for patenting in Biotechnology/Microbiology/Biochemistry: novelty, non-obviousness, and utility, patentable and non-patentable inventions; Biological Patents; Purpose of patents.

1.3 *Sui generis* system of IPRs: Need for *Sui generis* system; Plant variety protection, Database protection, other forms of *Sui generis* protection.

1.4 Introduction to WIPO and TRIPS, Various provisions in the TRIPS Agreement; Indian legislations for the protection of various types of IPs; National Biodiversity protection initiatives.

UNIT-II:Patenting **10hours**

2.1 Specific challenges in biological patenting: gene patents, diagnostic patents, and biopharmaceuticals patents.

4. Birney, E., Durbin, R. M., et al. (2020). Genomic Data Science and Its Practical Applications. Academic Press
5. Wold, B. J. (2019). Databases and Data Management in Human Genetics. Elsevier.

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

MCQ on LMS+ Subjective Test	**Syllabus to be covered in the examination**	**Time allotted for the examination**	**% Weightage (Marks)**
Test I (after 30 days)	20%	1 hour	05+05 (10)
Test II (after 30 days)	21-40%	1 hour	05+05 (10)
Major test (after 90 days)	100%	2.5 hours	30
Total			**50**

Note:

Major test will have two sections (A & B). Section A is compulsory comprising of 10 questions of 1 mark each and be spread over entire syllabus. Section B comprises of 4 questions from remaining 2 units and candidate must attempt one question fromeach unit of 10 marks each.

2.2 Patent application: various components of Patent application, patent search, patent filing, Pre grant and post grant opposition, Patent Cooperation Treaty (PCT).

2.3 Introduction to Indian patent office, US patent office and European patent office.

2.4 Patent Licensing; Technology Transfer; The role of technology transfer offices in academic and research institutions; Patent Infringement.

UNIT-III:Bioethics **10hours**

3.1 Traditional knowledge and bioethics, Ethical Issues, Statement of Bioethical Principles.

3.2 Gene Therapy, Germ line Gene therapy Moratorium; Medical privacy and genetic discrimination; Organ transplantation.

3.3 Bioethics in research: stem cells, animal cloning; Use of animals in research, animal rights; Human experimentation, Medico Legal issues.

3.4 Genetically Modified foods, environmental risk, labelling and public opinion; Protection of environment and biodiversity, biopiracy.

Books recommended:

1. Philippe Cullet; (2005) Intellectual Property Rights and Sustainable Development, Lexis, Nexis, New Delhi.
2. Arthur William et al.; (2005) Expanding Horizons in Bioethics, Springer.
3. Prabuddha Ganguli; (2001) Intellectual Property Rights, Unleashing the Knowledge Economy, Tata Mc Graw Hill, New Delhi.
4. Venkatratnam J.B (2009) Entrepreneurship Development, Heritage Printers, Hyderabad
5. Patzelt, Holger; Brenner, Thomas (2008), Handbook of Bioentrepreneurship, Springer Publications
6. S. Mitra; (2009) Entrepreneur Journeys Vol. 1, Hachette Publishing Group.
7. R.D. Hisrich; (2006) Entrepreneurship, Tata McGraw-Hill Publishing Co Ltd, 6th Edition.
8. D.F. Kuratko, H.P. Welsch; (2001) Strategic Entrepreneurial Growth, Harcourt College Publishers.
9. P. Ganguli; (2009) Intellectual Property Rights, Tata Mcgraw Hill Publishing Co Ltd.M.B. Rao; (2008) Biotechnology, IPRs and Biodiversity, Pearson Publications.

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SEMESTER-II

(Syllabi for the examinations to be held in the years May 2027, 2028, 2029)

Scheme of Examination: The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

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