Structure of Post Graduate Diploma in Genetic Counseling Program

Semester	Discipline-Specific Courses (DSC)	Skill Enhancement Courses (SEC) / Internship	Total Credits
I	Inheritance Biology @ 4 credits	Internship/Research Project @8 credits	24
	Cell Biology & Clinical Cytogenetics @ 4 credits		
	Reproductive Biology & Embryology @ 4 credits		
	Lab skills @ 4 credits		
II	Adult–onset disease & Cancer Genetics @ 4 credits	Internship/Research Project @16 credits	24
	Genetic Counseling & Psychology @ 4 credits		
	@ 24 credits	@24 credits	48

Issuance of Certificate

Student who declared to have qualified all the course work as prescribed, concerned Diploma will be awarded.

Department of Genetics

Course structure & credit matrix of PG Diploma in Genetic Counseling Program

Scheme of Examination (PGDGC)

		Discipline Specific Courses	Skill enhancement courses/internship	Credits	Marks
	Semester I	DSC1@4 credits DSC2@4 credits DSC3@4 credits DSC4@4 credits	Internship @ 8 credits	24	600
	Semester II	DSC5@4 credits DSC6@4 credits	Internship @ 16credits	24	600
	Grand Total			48	1200

SEMESTER 1				
Course code	Title of Course	L-T-P credits		Total Marks
24GEND101DS01	Inheritance Biology	4-0-0	100	100
24GEND101DS02	Cell Biology &Clinical Cytogenetics	4-0-0	100	100
24GEND101DS03	Reproductive Biology &Embryology	4-0-0	100	100
24GEND101DS04	Lab skills	0-0-4	100	100
24GEND101SEC01	Internship	0-0-8	200	200
Sub total		24	600	
SEMESTER II				
Course code	Title of Course	L-T-P credits		Total Marks
24GEND102DS01	Adult-onset disease & Cancer Genetics	4-0-0	100	100
24GEND102DS02	Genetic Counseling & Psychology	4-0-0	100	100
24GEND102SEC02	Internship in Genetic counseling	0-0-16	400	400
Sub total		24	600	1200

Grand Total Credits =48 Marks= 1200

Name of the Department: GENETICS

1. Name of the Discipline Specific Course: INHERITANCE BIOLOGY

Semester: I

Course Code	**24GEND101DS01**	**Course Credits**	4(L:4-T:0-P:0)
Max. Marks	100{External(term-end exam) –50}(Internal–50)	**Time duration of end term Examination**	3 Hours

Note: Examiner will set nine questions, and the candidates will be required to attempt five questions in all. Question number one will be compulsory, containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

Students will acquire the:

- CLO 1: Comprehensive knowledge of Genetic Principles**.**
- CLO 2: Understanding of concepts of Human Genetics.
- CLO 3: Ability to Analyze and Apply Mutation and Genetic Counseling Concepts.

Unit–I

Mendelian principles of inheritance—: Dominance, segregation, independent assortment, Punnet checkerboard for inheritance; Concept of gene: Allele, multiple alleles, pseudoallele; Extensions of Mendelian principles: Co dominance, incomplete dominance, complementation. - Examples of Inherited diseases

Unit– II

Gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over. Extra chromosomal inheritance: Inheritance of Mitochondrial genes, maternal inheritance. Quantitative genetics: Polygenic inheritance, heritability and its measurements, Population Genetics/founder effects, Consanguinity/endogamy

Unit– III

Human Genetics: Pedigree analysis: pedigree chart, Autosomal pedigree and X linked pedigree, Hereditary disorders: Autosomal dominant, autosomal recessive, X-linked dominant and X-linked recessive disease (in males & females) Sex linkage, sex-limited, and sex influenced characters. Sex Determination mechanism in humans, X chromosome inactivation in human/Dosage compensation

Unit– IV

Organization of genes and chromosomes: unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons, Central Dogma, DNA replication & repair, Recombination, nondisjunction – sister chromatic exchange. Mutation: Types, causes and detection, germinal verses somatic mutants

Suggested Readings:

1. Genetics: Analysis and Principles" by Robert J. Brooker
2. Concepts of Genetics" by William S. Klug, Michael R. Cummings, Charlotte A. Spencer, and Michael A. Palladino
3. Genetics: From Genes to Genomes" by Leland Hartwell, Michael L. Goldberg, Janice Fischer, and Charles Aquadro
4. Principles of Genetics" by D. Peter Snustad and Michael J. Simmons

Name of the Department: GENETICS

2. Name of Discipline Specific Course: CELL BIOLOGY & CLINICAL CYTO GENETICS

Semester: I

Course Code	**24GEND101DS02**	**Course Credits**	4(L:4-T:0-P:0)
Max. Marks	100{External(term-end exam) –50}(Internal–50)	**Time duration of end term Examination**	3 Hours

Note: Examiner will set nine questions, and the candidates will be required to attempt five questions in all. Question number one will be compulsory, containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

Students will acquire:

- CLO 1: Understanding of Cellular and Molecular Structures and Functions
- CLO 2: Knowledge of Cell Cycle Regulation, cytogenetics
- CLO 3: Ability to identify & work on chromosomal abnormalities

Unit–I

Structural organization and function of intracellular organelles: Cell membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes)
Cell division and cell cycle-: Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle, Recombination, non--disjunction – sister chromatid exchange

Unit– II

Human chromosome – Types of chromosomes, IUCN, Nomenclature of chromosomes; Karyotyping Techniques for blood cells and other somatic cells; Differential and selective banding techniques, high-resolution banding.

Unit– III

Types of chromosomal anomalies: Numerical (polyploidy, aneuploidy monosomy, trisomy and polysomy). Autosomal aneuploid syndromes- (trisomy 21, trisomy 18, trisomy 13.) Sex chromosome aneuploidy (syndromes- Turner, Klinefelter, Triple X, XYY). Factors causing aneuploidy, nondisjunction; Structural chromosomal aberrations - Duplication, deletion, translocation, reciprocal translocation, Robertsonian translocation, microdeletion, ring chromosome, inversion, isochromosome.

Unit– IV

Molecular cytogenetics: FISH, different type of FISH probes; Clinical applications of FISH.; CGH: CGH array and its clinical applications

Suggested Readings:

1. Molecular Biology of the Cell" by Bruce Alberts, Alexander D. Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter
2. The Cell: A Molecular Approach" by Geoffrey M. Cooper and Robert E. Hausman
3. The Principles of Clinical Cytogenetics" by Steven Gersen and Martha B. Keagle

Name of the Department: GENETICS

3. Name of Discipline Specific Course: REPRODUCTIVE BIOLOGY & EMBRYOLOGY

Semester: I

Course Code	**24GEND101DS03**	**Course Credits**	4(L:4-T:0-P:0)
Max. Marks	100{External(term-end exam) –50}(Internal–50)	**Time duration of end term Examination**	3 Hours

Note: Examiner will set nine questions, and the candidates will be required to attempt five questions in all. Question number one will be compulsory, containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

Students will acquire:

- CLO 1: Comprehensive Understanding of Reproductive Genetics & Embryology
- CLO 2: Proficiency in prenatal screening and diagnosis tests.
- CLO 3: In-Depth Knowledge of Assisted Reproductive techniques.

Unit–I

Male and female reproductive anatomy and Hormones, Basic concepts of development: Potency, commitment, specification, induction, competence, determination, and differentiation; imprinting; Pregnancy & childbirth. Chromosomal anomalies in fertility, Antenatal care (Embryology from Zygote to Birth, Gestation periods), Teratogenesis, fetal development,

Unit– II

Prenatal screening tests - Invasive and Non-Invasive (ultrasound screening, maternal serum screening (Double & Quadruple Marker), Non-Invasive Prenatal Screening (NIPT). Chromosome Abnormalities and Pregnancy Loss,

Unit– III

Pre-natal Diagnosis - Advantages, Invasive Procedure: Amniocentesis, Timeline, risks and limitations, chorionic villus sampling, Cordocentesis (Fetal blood sample collection) and Fetal reduction, Non-invasive techniques.)

Unit– IV

Preimplantation genetic diagnosis and in vitro fertilization Assisted reproductive techniques – Intrauterine insemination, In vitro fertilization, Donor Sperm/Egg, Surrogacy, Pre-implantation Genetics – PGT-A, PGT-SR, PGT-M Blastocyst biopsy Post-natal screening tests, Newborn Screening

Suggested Readings:

1. "The Physiology of Reproduction" edited by Ernst Knobil and Jimmy D. Neill.
2. "Human Embryology and Developmental Biology" by Bruce M. Carlson
3. Essentials of Developmental Biology" by Jonathan M.W. Slack
4. Prenatal genetic screening by S Gordon 2023 Stat Pearls
5. Prenatal diagnosis edited by Brynn Levy Springer 2019

Name of the Department: GENETICS

4. Name of Discipline Specific Course: LAB SKILLS

Semester: I

Course Code	**24GEND101DS04**	**Course Credits**	4(L:0T:0P:4)
Max. Marks	100{External(term-end exam) –50}(Internal– 50)	**Time duration of practical examination**	8 Hours

Course Outcomes:

Students will acquire practical exposure of:

- Proficiency in various Genetic Testing techniques and Interpretation
- Methodological and Analytical Skills for Karyotyping
- Practical Application in Clinical Settings
- Introduction to Bioinformatics

1. Sterilization methods, Preparation of buffers, stain and other reagents.
2. Human chromosome preparation (Peripheral blood lymphocyte culture),GTG banding, karyotyping.
3. Genotyping methods: DNA Sequencing, Sanger sequencing, Introduction to massively parallel sequencing, analysis and interpretation of the sequence data.
4. Hands on training in various techniques involved in Prenatal and Post natal diagnosis of Genetic Disorders, along with basic to advance techniques in Clinical Genetics, Biochemistry, Cytogenetics, Molecular Biology and Environmental Toxicology.
5. Introduction to Bioinformatics: Usage of databases like OMIM, NCBI, Ensemble, UCSC Genome browser, Emboss, PDB.

Name of the Department: GENETICS

5. Name of Skill enhancement Course: Internship

Semester: I

Course Code	**24GEND101SEC01**	**Course Credits**	8 (L:0T:0P:16)
Max. Marks	200{External(term-end practical exam) 100}(Internal– 100)	**Time duration of practical examination**	3Hours

Course Outcomes:

Students will acquire practical exposure of:

- Comprehensive Understanding of Genetic counseling
- Effective Communication and Counseling Skills
- Practical Application in Clinical Settings

Candidate has to submit a Project report for internship:

Includes survey-based study to assess the knowledge, attitudes, and practices regarding different aspects of reproductive health, including contraception, infertility, prenatal care etc.

Name of the Department: GENETICS

Semester: 2

1. Name of Discipline Specific Course: ADULT-ONSET DISEASE & CANCER GENETICS

Course Code	**24GEND102DS01**	**Course Credits**	4(L:4-T:0-P:0)
Max. Marks	100{External(term-end exam) –50}(Internal–50)	**Time duration of end term Examination**	3 Hours

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

Students will acquire the:

- CLO 1: Proficiency in Life style disorder identification
- CLO 2: Understanding pattern late onset of disease & neurological disorders.
- CLO 3: Knowledge of Cancer Genetics & personalized treatment

Unit–I

Lifestyle Disorders – Diabetes (Type 1& type 2), Obesity, Atherosclerosis, Osteoporosis, Hypertension, Cardiac Vascular Disease, Allergies – Asthma; Nutrogenomics; Pharmacogenomics and Personalized Medicine

Unit– II

Neurological associated disorders - Spinocerebellar ataxia, Huntington's Disease, Parkinson Disease, Alzheimer's Disease, Ataxia Telangiectasia, Amyotrophic lateral sclerosis, Schizophrenia and Dementia, Polygenic Risk Score;

Classification & Properties of amino acids, Hemoglobin and Myoglobin , Sickle cell disease & trait, Uniparentaldisomy (UPD) - Angelman's syndrome, Prader – Willi Syndrome

Unit– III

Basics of cancer biology - diagnosis and treatment, Oncogenes, Tumor Suppresor and Repair genes, Hereditary cancer and neoplasia syndromes - genetics and inheritance, Evaluation of personal and family cancer history.

Unit– IV

Assess eligibility for genetic testing and provide cancer risk assessment counseling for patients and their family members, Psychosocial aspects of the disease, Founder mutations in populations, Somatic versus Germ line testing, Targeted and pharmacogenomic testing for cancer treatment.

Suggested Readings:

1. "The Genetic Basis of Adult Disease" by Benjamin E. Berkman, Sara Chandros Hull, and Steven Joffe
2. "Principles of Cancer Genetics" by Fred Bunz

"Cancer: Principles & Practice of Oncology" by Vincent T. DeVita, Jr., Theodore S. Lawrence

Name of the Department: GENETICS

Semester: 2

2. Name of Discipline Specific Course: GENETIC COUNSELING & PSYCHOLOGY

Course Code	**24GEND102DS02**	**Course Credits**	4(L:4T:0P:0)
Max. Marks	100{External(term-end exam) –50}(Internal–50)	**Time duration of end term Examination**	3 Hours

Note: Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing short answer type questions from all units. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.

Course Learning Outcomes (CLO):

Students will acquire the:

- CLO 1: Proficiency in Public Health Genetics and Ethical Considerations**.**
- CLO 2: In-depth Knowledge of Hereditary Syndromes.
- CLO 3: Expertise in Advanced Genetic Testing Techniques

Unit–I

Genetic Counseling- Importance of non-verbal communication - Listening - types and barriers to listening - speaking - planning and audience awareness - persuasion- goals - motivation and hierarchy of needs - attending and conducting interviews-participating in discussions, debates – and conferences - presentation skills.

Unit– II

Pedigree analysis - Drawing a Pedigree, pedigree symbols - Identifying mode of inheritance, Calculating Recurrent Risk Scores, Explain genetic concepts and risk/probability to the patient in appropriate and culturally sensitive language.

Unit– III

Ethical dilemmas - techniques for conveying bad news, pre- and post-test counseling, Writing a counseling Note, Telephonic Counseling Skills, Advocacy for Patients/families.

Unit– IV

Definition of Psychology - Perception, Cognition, Social psychology - Grief Counselling - Motivational counseling – Social and Educational counseling, Philosophy of genetic counseling, Relevant counseling theories - Core and advanced counselling skills (The range of potential psychological and emotional reactions to living with a genetic condition in the family or living at risk).

Suggested Readings:

1. A Guide to Genetic Counseling"by Wendy R. Uhlmann, Jane L. Schuette, and Beverly Yashar
2. Genetic Analysis of Complex Disease" by Jonathan L. Haines and Margaret A. Pericak-Vance
3. "Psychosocial Genetic Counseling"by Jon Weil
"Genetics and Ethics in Global Perspective"edited by Dorothy C. Wertz and John C. Fletcher

Name of the Department: GENETICS
Name of the Skill enhancement Course: Internship in Genetic counseling

Semester: 2

Course Code	**24GEND102SEC02**	**Course Credits**	16(L:0-T:0-P: 32)
Max. Marks	400{External(term-end practical exam) –200}(Internal– 200)	**Time duration of end term practical examination**	3Hours

Course Outcomes:

Students will learn hands on counseling clinic methodology with :

- Proficiency in Genetic Risk Assessment and Communication
- Competence in Psychosocial Support and Counseling Techniques
- Ethical and Professional Practice in Genetic Counseling

Student has to submit a Project Report of internship

Includes case reports/ observation of genetic cases at government hospitals along with pathophysiology, management and counseling the affected families.