Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
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વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
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ક્રમાંક :ઓથો./પરિપત્ર/૧૨૨૬૦/૨૦૨૫
તા.૦૨/૦૬/૨૦૨૫

પ્રતિ,
વડાશ્રી,
બાયોસાયન્સ વિભાગ,
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી,
સુરત.

વિષય:– PG Diploma in Cytogenetic ના અભ્યાસક્રમ અંગે.

સુજ્ઞશ્રી,

સવિનય જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૫–૨૬ થી અમલમાં આવનાર PG Diploma in Cytogenetic ના અભ્યાસક્રમને વિજ્ઞાન વિદ્યાશાખાની તા.૩૦/૦૪/૨૦૨૫ની સભાનાં ઠરાવ ક્રમાંક: ૪ અંતર્ગત સુચવેલ સુધારા સાથે જૈવ વિજ્ઞાન વિષયની અભ્યાસ સમિતિનાં ચેરમેનશ્રીએ અભ્યાસ સમિતિ વતી અને વિજ્ઞાન વિદ્યાશાખાનાં અભ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખા વતી મંજુર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણસ્વીકારી એકેડેમિક કાઉન્સિલની તા.૦૫/૦૫/૨૦૨૫ ની સભાનાં ઠરાવ ક્રમાંક:૧૫૨ થી મંજુર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

કુલસચિવ

પ્રતિ,
૧) ડીનશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૨) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

[redacted]

1. **Title of the Course: Post Graduate Diploma in Cytogenetics (PGDC).**

2. **Eligibility:** Candidate should have any of the following degree:

   Any graduate in Lifesciences and related areas.

3. **Duration:** One Year (2 Semester)

4. **Medium of Instruction:** English

5. **Program Outcome**:

The Postgraduate Diploma in Cytogenetics equips students with comprehensive knowledge of chromosomal structure, function, and genetic variation in plants, animals, and microbes. It emphasizes hands-on expertise in advanced molecular and computational techniques such as PCR, FISH, microarrays, NGS, and bioinformatics tools, enabling students to perform accurate genetic analysis and diagnostics. The program provides specialized training in clinical and cancer cytogenetics, preparing students to identify and interpret chromosomal abnormalities and understand microbial oncogenesis. Through a strong research component, students develop the ability to design experiments, formulate hypotheses, and analyze complex cytogenetic data using modern statistical and AI tools. The course also integrates the application of cytogenetic principles across microbiology, zoology, and botany—supporting fields like plant breeding, animal conservation, and microbial genetics. Ethical practices, data privacy, and research integrity are emphasized to foster responsible scientific conduct. Ultimately, the program prepares graduates with the technical, analytical, and professional skills required to succeed in research labs, diagnostic centers, and the biotechnology industry.

At the end of the program, candidates will be able to...

- **Demonstrate in-depth understanding of human cytogenetics**, including chromosomal structure, function, abnormalities, and their clinical significance.
- **Perform standard cytogenetic techniques**, such as karyotyping, FISH (Fluorescence In Situ Hybridization), and molecular cytogenetics, in diagnostic and research settings.
- **Analyze and interpret chromosomal data** to identify genetic disorders, cancers, and congenital abnormalities.
- **Apply quality control and assurance protocols** in cytogenetic laboratories in accordance with national and international standards.
- **Collaborate effectively with clinical geneticists, pathologists, and other healthcare professionals** to contribute to patient diagnosis and management.
- **Understand ethical, legal, and social implications** related to genetic testing and counseling.
- **Engage in continued professional development and research** in cytogenetics and related fields such as genomics or molecular biology.

6. Program Specific Outcome:

Graduates of the PG Diploma in Cytogenetics will be equipped with advanced skills and knowledge to perform comprehensive cytogenetic analyses, including karyotyping, chromosomal banding techniques, and fluorescence in situ hybridization (FISH), applicable in both clinical and research settings. They will be proficient in utilizing molecular tools such as PCR, sequencing, and microarray analysis, as well as bioinformatics and AI-driven approaches for accurate interpretation of chromosomal and genomic data. The program prepares students to apply cytogenetic techniques in the diagnosis of genetic disorders, cancer mutations, and microbial genome variations, while also promoting their use in biodiversity conservation efforts. Graduates will be capable of conducting independent research, designing experiments, analyzing data, and contributing to the advancement of genetic diagnostics through scientific publications. Furthermore, they will be able to integrate cytogenetic knowledge with allied sciences like Microbiology, Zoology, and Botany, supporting innovations in plant breeding, veterinary medicine, and microbial genetics.

At the end of programme, the candidates shall be able to:

1. Perform advanced cytogenetic techniques such as karyotyping, chromosomal banding, and fluorescence in situ hybridization (FISH) for both clinical and research applications.
2. Utilize molecular and bioinformatics tools, including PCR, DNA sequencing, microarray analysis, and AI-based interpretation, for comprehensive chromosomal studies.
3. Apply cytogenetic knowledge in the diagnosis of genetic disorders, detection of cancer mutations, analysis of microbial genome variations, and biodiversity conservation efforts.
4. Design and conduct independent research projects in cytogenetics, including data analysis and publication of scientific findings.
5. Integrate cytogenetic principles with allied sciences such as Microbiology, Zoology, and Botany to support advancements in plant breeding, veterinary genetics, and microbial research.

7. Paper Style for Core Papers: Total Marks: 70

Q-1: 14 marks: Objective type Question (Equal distribution from each unit)
Q-2: 14 marks (Unit 1)
Q-3: 14 marks (Unit 2)
Q-4: 14 marks (Unit 3)
Q-5: 14 marks (Unit 4)

8. Standard of Passing:

a. Candidate must obtain 40 % marks in theory papers and practical papers separately.

b. There will be a separate head of passing for theory papers and practical. If candidate fails in one of the heads, he / she has to reappear only for the failed head.

9. Qualification of the Examiners: All examiners on the University panel for theory and practical should have Master degree in the subject/ relevant subject. There will be two examiners (Preferably one internal and one external) for practical examination in each subject.

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Post Graduate Diploma in Cytogenetics (PGDC) Course

Structure of Semester 1

Semester-1							
Course Code	**Title of The Course**	**Course Credit**	**Hrs. Per Week**	**Internal Exam Marks**	**External Exam Marks**	**Total Marks**	**Duration of External Exam (Hr.)**
Core Course							
PGDC-1001	**Fundamentals of Cytogenetics**	04	04	30	70	100	03
PGDC-1002	**Molecular Techniques in Cytogenetics**	04	04	30	70	100	03
PGDC-1003	**Clinical and Cancer Cytogenetics**	04	04	30	70	100	03
PGDC-1004	**Bioinformatics and Cytogenomic Data Analysis**	04	04	30	70	100	03
Practical Course							
PGDC-1005	**Laboratory Techniques in Cytogenetics-I**	08	16	60	140	200	06
Skilled Based Elective Course (Any One)							
PGDC-1006	MOOC/Swayam	02	02	20	30	50	02
Total		26	34	200	450	650	

PGDC-1001: Fundamentals of Cytogenetics

Semester: I	
Course (subject) Code	PGDC-1001
Subject Title	**Fundamentals of Cytogenetics**
Course Type	Core Compulsory
Teaching Time	15×4=60 Hours
Subject Outcome	Upon completion of the course **"Fundamentals of Cytogenetics"**, students will be able to recall and define essential terms, concepts, and structures related to chromosomes, cell division, and chromosomal organization. They will demonstrate an understanding of the principles of mitosis, meiosis, chromosomal behavior, and inheritance patterns. Students will apply basic cytogenetic techniques such as chromosome preparation, banding methods, and karyotyping in laboratory settings to identify normal and abnormal chromosomal configurations. They will analyze chromosomal abnormalities, including structural and numerical variations, and interpret their implications in genetic disorders. Learners will evaluate cytogenetic data and discuss the clinical significance of chromosomal alterations in human health and disease. Finally, students will integrate theoretical and practical knowledge to develop simple cytogenetic case reports and propose foundational approaches to studying chromosomal anomalies in genetic research and diagnostics.

Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Introduction to Cytogenetics and Evolutionary Genetics**	**15 Hr.**
1.1	Structure and function of chromosomes in plants, animals, and microbes.	
1.2	Mitosis and meiosis in unicellular and multicellular organisms.	
1.3	Chromosomal variations in different taxonomic groups.	
1.4	Evolutionary cytogenetics and genome evolution.	
Unit-2	**Chromosomal Banding and Genome Organization**	**15 Hr.**
2.1	G-banding, C-banding, Q-banding, R-banding in animal and plant species.	
2.2	Organization of prokaryotic and eukaryotic genomes.	
2.3	Supercoiling and chromatin structure in microbial and plant systems.	
2.4	Endosymbiotic theory and organelle genome evolution (mitochondria and chloroplast).	
Unit-3	**Numerical and Structural Chromosomal Abnormalities**	**15 Hr.**
3.1	Aneuploidy in humans, plants, and microbial mutants.	
3.2	Structural chromosomal variations in higher plants and animals.	
3.3	Polyploidy in crop plants and evolutionary significance.	
3.4	Applications of cytogenetics in breeding and hybridization.	
Unit-4	**Applications of Cytogenetics in Microbiology, Zoology, and Botany**	**15 Hr.**
4.1	Cytogenetics in bacterial genetics and antimicrobial resistance.	
4.2	Chromosomal studies in endangered and economically important species.	
4.3	Cytogenetics in agriculture and plant breeding.	

4.4	Case studies in genetic disorders of plants, animals, and microbes.	

Reference Books:

Sr. No.	Title
1	Principles of Genetics by D. Peter Snustad and Michael J. Simmons.
2	Cytogenetics: The Chromosome in Division, Inheritance, and Evolution by P.K. Gupta.
3	Chromosome Structure and Function by Andreas Houben and Thomas Schmidt.
4	Genome by T.A. Brown.
5	Chromosome Banding by Arun Kumar Sharma and Archana Sharma.
6	Human Chromosomes by Orlando J. Miller and Eeva Therman.
7	The Principles of Clinical Cytogenetics by Steven Gersen and Martha Keagle.

PGDC-1002: Molecular Techniques in Cytogenetics

Semester: I	
Course (subject) Code	PGDC-1002
Subject Title	**Molecular Techniques in Cytogenetics**
Course Type	Core Compulsory
Teaching Time	15×4=60 Hours
Subject Outcome	At the end of the course the students will Upon completion of the course **"Molecular Techniques in Cytogenetics"**, students will be able to recall and define fundamental concepts and terminology related to molecular cytogenetic techniques, such as fluorescence in situ hybridization (FISH), comparative genomic hybridization (CGH), and polymerase chain reaction (PCR). They will develop an understanding of the underlying principles of these methods and be able to describe the distinctions between traditional and molecular cytogenetics. Students will apply these techniques in practical settings, demonstrating the ability to detect chromosomal abnormalities and interpret case studies involving genetic disorders. Through critical analysis, they will compare various molecular approaches, evaluating their strengths and limitations in both clinical and research contexts. Furthermore, students will assess the appropriateness of specific techniques for different diagnostic applications and critique scientific literature that employs these methods. Ultimately, they will synthesize their knowledge to design molecular cytogenetic experiments and propose innovations that could improve diagnostic accuracy and efficiency.

Course Content

Unit No.	**Content**	**Teaching Hours**
Unit-1	**DNA and RNA Analysis in Microbial, Animal, and Plant Cytogenetics**	**15 Hr.**
1.1	DNA extraction techniques in microbes, animals, and plants.	
1.2	PCR applications in environmental microbiology and forensic zoology.	
1.3	Genome sequencing in plants for crop improvement.	
1.4	Microbial plasmids and their role in genetic recombination.	
Unit-2	**Hybridization and Genome Analysis**	**15 Hr.**
2.1	Southern and Northern blotting in medical and plant genetics.	
2.2	FISH and Microarray techniques in crop and livestock improvement.	
2.3	Genomic applications in microbial evolution and pathogen identification.	
2.4	Transposable elements in plant and microbial genome.	
Unit-3	**Fluorescence Microscopy and Advanced Imaging.**	**15 Hr.**
3.1	Confocal microscopy in animal and plant cytogenetics.	
3.2	Chromosome painting in wildlife conservation genetics.	
3.3	Multicolor FISH (mFISH) and Spectral Karyotyping (SKY) in biodiversity research.	
3.4	Whole-genome visualization in fungal and algal species.	
Unit-4	**Molecular Technologies in Microbiology, Zoology, and Botany.**	**15 Hr.**
4.1	CRISPR-Cas9 genome editing in microbial and plant biotechnology.	

4.2	RNA interference (RNAi) in pest-resistant crops and disease modelling.
4.3	Functional genomics in model organisms (Drosophila, Arabidopsis, Yeast).
4.4	Metagenomics and microbiome studies in human, animal, and soil health.

Reference Books:

Sr. No.	
1	Molecular Cytogenetics: Protocols and Applications by Yao-Shan Fan.
2	Human Molecular Genetics by Tom Strachan and Andrew Read.
3	Principles of Cytogenetics and Genome Analysis by P.K. Gupta.
4	Molecular Biology of the Cell by Alberts.
5	Fluorescence In Situ Hybridization (FISH): Protocols and Applications by B.A. Bridger and A.L. Volpi.

PGDC-1003: Clinical and Cancer Cytogenetics

Semester: I	
Course (subject) Code	PGDC-1003
Subject Title	**Clinical and Cancer Cytogenetics**
Course Type	Core Compulsory
Teaching Time	15×4=60 Hours
Subject Outcome	At the end of the course, the students will get knowledge of Upon completion of the course **"Clinical and Cancer Cytogenetics"**, students will be able to recall and define key concepts, terminology, and chromosomal abnormalities associated with inherited and acquired genetic disorders, including various types of cancers. They will understand the clinical relevance of chromosomal alterations, such as translocations, deletions, duplications, and aneuploidies, and explain the cytogenetic mechanisms underlying genetic diseases and cancer progression. Students will apply cytogenetic techniques, including karyotyping, FISH, and array-based methods, to diagnose genetic and oncologic conditions in clinical case scenarios. They will analyze chromosomal patterns and correlate them with specific clinical phenotypes and disease prognoses. Furthermore, students will evaluate the diagnostic and prognostic value of cytogenetic findings in patient management and assess current practices in cancer cytogenetics critically. Ultimately, they will be able to design diagnostic workflows for clinical and cancer cytogenetic laboratories and propose strategies for integrating new technologies to enhance the detection and interpretation of chromosomal abnormalities in medical genetics and oncology.

Course Content

Unit No.	**Content**	**Teaching Hours**
Unit-1	**Chromosomal Basis of Genetic Disorders in Humans, Animals, and Plants**	**15 Hr.**
1.1	Chromosomal abnormalities in human and veterinary medicine.	
1.2	Inherited genetic disorders in wildlife conservation.	
1.3	Cytogenetics of plant-pathogen interactions.	
1.4	Case studies of chromosomal instability in disease ecology.	
Unit-2	**Cytogenetics of Cancer and Microbial Oncogenesis**	**15 Hr.**
2.1	Chromosomal translocations in human and animal cancers.	
2.2	Viral oncogenes and microbial contributions to cancer.	
2.3	Tumor suppressor genes in wildlife health and conservation genetics.	
2.4	Cancer cytogenetics applications in pharmaceutical microbiology.	**15 Hr.**
Unit-3	**Cytogenetics in Personalized Medicine and Biotechnology**	
3.1	Stem cell cytogenetics in human and veterinary medicine.	
3.2	Genomics in drug discovery and microbial antibiotic resistance.	

3.3	Role of plant-derived compounds in genome stability and cancer prevention.	
3.4	Biotechnological applications in pharmaceutical and agricultural genetics.	
Unit-4	**Genetic Counselling and Clinical Applications**	**15 Hr.**
4.1	Case studies in human, veterinary, and agricultural genetics.	
4.2	Ethical concerns in wildlife genetics and conservation cytogenetics.	
4.3	Genetic counselling for hereditary diseases in humans and animals.	
4.4	Applications of genome sequencing in forensic and medical microbiology.	

Reference Books:

1	The Principles of Clinical Cytogenetics by Steven Gersen and Martha Keagle
2	Human Chromosomes: Principles and Techniques" by Ram S. Verma and Arvind Babu
3	Cancer Cytogenetics: Chromosomal and Molecular Genetic Aberrations of Tumor Cells by Sverre Heim and Felix Mitelman
4	Medical Cytogenetics by F. Vogel and A.G. Motulsky
5	Molecular Cytogenetics: Protocols and Applications" by Yao-Shan Fan

PGDC-1004: Bioinformatics and Cytogenomic Data Analysis (4 Credits)

Semester: I	
Course (subject) Code	PGDC-1004
Subject Title	**Bioinformatics and Cytogenomic Data Analysis**
Course Type	Core Elective
Teaching Time	15×4=60 Hours
Subject Outcome	At the end of the course, the students will get knowledge of Upon completion of the course **"Bioinformatics and Cytogenomic Data Analysis"**, students will be able to recall and define core concepts of bioinformatics, genomic databases, and data formats relevant to cytogenetics and genomics. They will demonstrate an understanding of how computational tools are used to analyze, interpret, and visualize cytogenomic data, including copy number variations, structural variations, and chromosomal rearrangements. Students will apply bioinformatics software and platforms, such as UCSC Genome Browser, Ensembl, and various cytogenomic tools, to analyze high-throughput data from technologies like array CGH, SNP arrays, and next-generation sequencing. They will analyze cytogenomic datasets to identify clinically significant genomic alterations and interpret their implications in the context of genetic disorders and cancer. Furthermore, students will evaluate the strengths and limitations of different bioinformatics pipelines and data analysis approaches for cytogenomic applications. Ultimately, they will be capable of designing data analysis workflows, integrating multi-omic data, and proposing computational strategies for research and diagnostic use in modern cytogenetics.

Course Content:

Unit No.	**Content**	**Teaching Hours**
Unit-1	**Introduction to Bioinformatics in Cytogenetics**	**15 Hr.**
1.1	Overview of computational tools in genome analysis.	
1.2	Genome databases: NCBI, Ensembl, UCSC Genome Browser.	
1.3	BLAST, FASTA, and sequence alignment techniques.	
1.4	Phylogenetic analysis and evolutionary cytogenetics.	
Unit-2	**Chromosome Mapping and Variant Analysis**	**15 Hr.**
2.1	Karyotype-based chromosomal mapping.	
2.2	Copy Number Variation (CNV) detection using bioinformatics.	
2.3	Whole-genome annotation and variant calling.	
2.4	Functional genomics and gene expression analysis.	
Unit-3	**AI and Machine Learning in Cytogenetics**	**15 Hr.**
3.1	Deep learning for chromosomal image analysis	
3.2	AI-based genetic disorder prediction models	
3.3	Computational tools for FISH and CGH data analysis	
3.4	Role of bioinformatics in cytogenomic epidemiology	
Unit-4	**Ethical and Clinical Applications of Cytogenomics**	**15 Hr.**
4.1	Ethical considerations in genome sequencing.	

4.2	Personalized genomics and precision medicine.	
4.3	Cloud computing in genome data storage and analysis.	
4.4	Regulatory frameworks for bioinformatics in genetic diagnostics.	

Reference Book:

Sr. No.	
1	Bioinformatics: Sequence and Genome Analysis by David W. Mount
2	Cytogenomics: Chromosomal Structure and Function by Thomas Liehr
3	Genomic and Personalized Medicine by Geoffrey S. Ginsburg and Huntington F. Willard
4	Bioinformatics for Geneticists: A Bioinformatics Primer for the Analysis of Genetic Data by Michael R. Barnes
5	Statistical Genomics: Methods and Protocols edited by Michael F. Altman

PGDC-1005

Course Code	PGDC-1005
Course Title	**Laboratory Techniques in Cytogenetics (Practical- Based on 1001-1004)**
Course Type	Core Elective
Teaching Time	8 hrs per week
Course Outcome	On completion of this course, students will get knowledge of Upon completion of the practical course **"Laboratory Techniques in Cytogenetics"**, students will be able to recall and identify essential laboratory equipment, safety protocols, and standard procedures used in cytogenetic analysis. They will demonstrate an understanding of the steps involved in sample collection, cell culture, harvesting, chromosome preparation, and staining techniques such as G-banding, C-banding, and Q-banding. Students will apply these techniques to prepare high-quality metaphase spreads and perform karyotyping for the identification of chromosomal abnormalities. They will analyze prepared slides to detect and interpret structural and numerical chromosomal variations and correlate them with clinical significance. Learners will evaluate the quality of cytogenetic preparations and troubleshoot technical issues during the experimental workflow. Finally, students will develop complete laboratory reports, maintain accurate records, and propose optimized protocols or modifications for improving the efficiency and reliability of cytogenetic laboratory practices.

Course Content

Sr. No.	Practical Title
1	Peripheral blood lymphocyte culture for karyotyping.
2	Chromosome harvesting and slide preparation.
3	GTG-banding, CBG-banding, and NOR-banding techniques.
4	Identification of chromosomal anomalies using staining methods.
5	Karyotyping of normal and abnormal human chromosomes.
6	Chromosomal aberration identification in genetic disorders (Down Syndrome, Turner Syndrome, Klinefelter Syndrome, etc.).
7	Chromosomal translocations and structural variations.
8	Image capturing and karyotyping using digital software.
9	Genomic DNA and RNA extraction from blood and tissue samples.
10	Polymerase Chain Reaction (PCR) and Reverse Transcription-PCR (RT-PCR).
11	Gel electrophoresis and restriction digestion analysis.
12	Preparation and hybridization of Southern, Northern, and Western blotting.
13	Fluorescence In Situ Hybridization (FISH) for detecting chromosomal aberrations.
14	Probe preparation and hybridization for FISH.
15	Multicolor FISH (mFISH) and Spectral Karyotyping (SKY) analysis.
16	Image acquisition and interpretation using fluorescence.
17	Root tip squash preparation (e.g., Onion Allium cepa) and mitotic index calculation.
18	Chromosome counting and arrangement based on size and morphology.
19	Study of female gametophyte development in plants.
20	Visualization of specific DNA sequences on chromosomes.
21	Differentiation of parental genomes in hybrid plants.

Reference Books:

Sr. No.	
1	Human Chromosomes: Principles and Techniques by Ram S. Verma and Arvind Babu
2	Practical Cytogenetics by Daniel L. Hartl and Elizabeth W. Jones
3	Molecular Cytogenetics: Protocols and Applications by Yao-Shan Fan
4	The Principles of Clinical Cytogenetics by Steven Gersen and Martha Keagle
5	Essential Cytogenetics by P.K. Gupta

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Post Graduate Diploma in Cytogenetics (PGDC) Course Structure of Semester-2

Semester-2							
Course Code	**Title of The Course**	**Course Credit**	**Hrs. Per Week**	**Internal Exam Marks**	**External Exam Marks**	**Total Marks**	**Duration of External Exam (Hr.)**
Core Course							
PGDC-2001	**Advanced Cytogenetics and Genomic Technologies**	04	04	30	70	100	03
PGDC-2002	**Cancer Genomics and Precision Medicine**	04	04	30	70	100	03
Skilled Based Elective Course							
PGDC-2003	MOOC/SWAYAM	02	02	20	30	50	02
Dissertation /Internship /Training:							
PGDC-2004	Dissertation /Internship /Training	12	12	120	280	400	06
Total		22	34	200	450	650	

PGDC-2001: Advanced Cytogenetics and Genomic Technologies

Semester: II	
Course (subject) Code	**PGDC 2001**
Subject Title	**Advanced Cytogenetics and Genomic Technologies**
Course Type	Core Compulsory
Teaching Time	15×4=60 Hours
Subject Outcome	At the end of the course, the students will get knowledge of Upon completion of the course **"Advanced Cytogenetics and Genomic Technologies"**, students will be able to recall and define advanced concepts and terminologies associated with high-resolution cytogenetic and genomic techniques. They will demonstrate a comprehensive understanding of technologies such as fluorescence in situ hybridization (FISH), multicolor FISH, spectral karyotyping (SKY), array-based comparative genomic hybridization (aCGH), SNP arrays, and next-generation sequencing (NGS) as applied to cytogenetic studies. Students will apply these advanced methodologies to detect submicroscopic chromosomal changes, structural variants, and complex genomic alterations in clinical and research settings. They will analyze large-scale genomic data to identify pathogenic variants, evaluate chromosomal architecture, and interpret findings in the context of disease mechanisms. Learners will critically assess the advantages, limitations, and diagnostic value of each advanced technique and evaluate scientific literature involving cutting-edge genomic applications. Ultimately, students will integrate cytogenetic and genomic knowledge to design innovative diagnostic workflows, propose novel applications of emerging technologies, and contribute to the advancement of precision medicine in genetics.

Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Cytogenetics in Life Sciences**	**15 Hr.**
1.1	Comparative karyotyping in wild and domesticated animal species	
1.2	Chromosome painting in medicinal and genetically modified plants	
1.3	Bacterial chromosome mapping and plasmid analysis in prokaryotic genomes	
1.4	Microscopy techniques for fungal and microbial cytogenetics	
1.5	Evolutionary perspectives on chromosomal adaptations in different species	
Unit-2	**Next-Generation Sequencing (NGS) for Life Sciences**	**15 Hr.**
2.1	NGS applications in plant genome sequencing for stress resistance	
2.2	Whole-genome sequencing (WGS) in wildlife conservation genetics	
2.3	Metagenomics approaches for microbial diversity and environmental adaptation	
2.4	Applications of NGS in marine biology, fisheries, and environmental genomics	
2.5	Ethical concerns and regulatory guidelines for genomic sequencing in biodiversity research	
Unit-3	**Functional Genomics and Gene Editing**	**15 Hr.**
3.1	CRISPR-Cas9 genome editing in model organisms (Drosophila, Yeast, Arabidopsis)	
3.2	Chromosomal microarray analysis and GWAS in plant breeding and disease resistance	
3.3	Stem cell cytogenetics in regenerative medicine and tissue engineering	
3.4	Epigenetics in microbial adaptation and antibiotic resistance	
3.5	Role of RNA interference (RNAi) in functional genomics and crop improvement	

Unit-4	Bioinformatics and Data Analysis in Cytogenetics	15 Hr.
4.1	Genome annotation tools for animal, plant, and microbial genome studies	
4.2	AI and machine learning applications in evolutionary cytogenetics and species conservation	
4.3	Computational phylogenetics and chromosomal evolution	
4.4	Database mining for genetic variations in human, animal, and plant genomes	
4.5	Future trends: Quantum computing and big data in genomic research.	

Reference Books:

Sr. No.	Title/Edition
1	Cytogenomics: Chromosomal Structure and Function by Thomas Liehr
2	Molecular Cytogenetics: Protocols and Applications by Yao-Shan Fan
3	Genomic Technologies in Reproductive Medicine by Juan Garcia-Velasco and Emre Seli
4	Next-Generation Sequencing in Cytogenetics by Andrzej T. Slominski
5	Bioinformatics: Sequence and Genome Analysis by David W. Mount

PGDC-2002: Cancer Genomics and Precision Medicine

Semester: II	
Course (subject) Code	**PGDC-2002**
Subject Title	**Cancer Genomics and Precision Medicine**
Course Type	Core Compulsory
Teaching Time	15×4=60 Hours
Subject Outcome	Upon completion of the course **"Cancer Genomics and Precision Medicine"**, students will be able to recall and describe key concepts related to the genomic basis of cancer, including oncogenes, tumor suppressor genes, driver mutations, and genomic instability. They will understand the molecular mechanisms underlying tumor development, progression, and heterogeneity, and explain how genomic alterations influence cancer behavior and treatment response. Students will apply genomic technologies such as next-generation sequencing (NGS), whole-exome sequencing (WES), and targeted gene panels to analyze cancer genomes and identify clinically actionable mutations. They will interpret cancer genomic data to stratify patients, predict treatment outcomes, and support evidence-based clinical decision-making. Learners will evaluate the role of biomarkers, companion diagnostics, and genomic profiling in the context of personalized cancer therapy. Finally, they will be able to design individualized treatment strategies based on genomic data, assess current challenges in implementing precision oncology, and propose innovative approaches to integrating cancer genomics into routine clinical practice.

Course Content:

Unit No.	Content	Teaching Hours
Unit-1	**Cancer Genetics and Tumorigenesis**	**15 Hr.**
1.1	Chromosomal mutations and genetic instability in cancer	
1.2	DNA damage response and repair mechanisms	
1.3	Oncogenes, tumor suppressors, and their regulation	
1.4	Cancer hallmarks and genetic predisposition	
Unit-2	**Molecular Profiling of Tumors**	**15 Hr.**
2.1	Liquid biopsy and circulating tumor DNA (ctDNA)	
2.2	Exome sequencing in cancer diagnosis	
2.3	Immunogenomics and cancer vaccines	
2.4	Role of miRNAs and non-coding RNAs in cancer	
Unit-3	**Targeted Therapies and Precision Oncology**	**15 Hr.**
3.1	Personalized treatment approaches in oncology	
3.2	Pharmacogenomics and drug resistance	
3.3	Immunotherapy and checkpoint inhibitors	
3.4	AI-driven cancer diagnosis and treatment	
Unit-4	**Ethical and Regulatory Framework in Cancer Genomics**	**15 Hr.**
4.1	Data privacy and ethical concerns in cancer genomics	
4.2	Clinical trial design for genomic-based therapies	
4.3	FDA and EMA regulations in genomic medicine	
4.4	Genetic counselling and patient consent in oncology.	

Reference Books:

Sr. No.	Title/Edition
1	Cancer Genomics: From Bench to Personalized Medicine by Graham D. Rowe
2	Principles of Cancer Genetics by Fred Bunz
3	Precision Oncology: Tools and Applications for Cancer Targeted Therapy by Loredana Guglielmi and Massimo Cristofanilli
4	The Molecular Basis of Cancer by John Mendelsohn, Peter M. Howley, and Mark A. Israel

PGDC-2004: Dissertation /Internship /Training

Semester: II	
Course (subject) Code	**PGDC-2004**
Subject Title	Dissertation /Internship /Training
Course Type	Dissertation /Internship /Training
Teaching Time	60 days
Subject Outcome	Upon completion of the **Dissertation / Internship / Training in Cytogenetics**, students will be able to recall and apply theoretical knowledge gained from coursework to practical, real-world settings within cytogenetics laboratories or research environments. They will demonstrate an understanding of advanced cytogenetic concepts, laboratory workflows, and research methodologies relevant to clinical or experimental cytogenetics. Students will apply standard and specialized techniques—such as karyotyping, FISH, array CGH, or genomic data analysis—in the context of diagnostic or investigative projects. They will analyze experimental data, troubleshoot technical issues, and interpret results with accuracy and scientific rigor. Learners will critically evaluate published research, engage in scientific discussions, and assess the relevance and limitations of their findings. Ultimately, students will synthesize their learning by producing a well-structured dissertation or internship report, presenting their work clearly and effectively, and proposing future directions or improvements based on their experience, thereby demonstrating readiness for professional practice or further academic research in cytogenetics.

Content (Internship/Training)	**Training Duration**
The student undertake training in different Government/ Semi Government/ Private Cytogenetics related laboratories for 60 days duration. During the training tenure, the students are expected to gain actual pathological and clinical experience and try to make them familiar with the Laboratory/hospital environment. The students have to keep day-to-day record of their actual work done during training and same is to compiled along with the information about the laboratory (in which they have been placed). The students have to submit Laboratory certificate and project report. The concerned teachers are supposed to guide the students for the same. The marks is given based on the Training Certificate (given by the Authorized Clinical Officer/ Concerned authority of the concerned Laboratory) and training report evaluation.	**60 Days**

Content (Dissertation)	Training Duration
Terms and Conditions for Dissertation (Credit 12) **Postgraduate Diploma in Cytogenetics**	**60 Days**

1. Eligibility for Dissertation

- The dissertation is available to students who have successfully completed all core and elective courses in the Postgraduate Diploma in Cytogenetics program.

2. Research Proposal Submission

- Students must submit a detailed research proposal that includes:
  - Research topic
  - Objectives
  - Methodology
  - Expected outcomes
- The proposal must be reviewed and approved by a faculty supervisor from the department before beginning the dissertation work.

3. Supervision and Guidance

- A faculty supervisor will be assigned to each student based on the student's research interests.
- Regular supervisory meetings are mandatory to ensure continuous progress and academic support throughout the research process.

4. Dissertation Scope and Topics

- The dissertation must focus on Cytogenetics or closely related fields such as:
  - Clinical Cytogenetics
  - Molecular Cytogenetics
  - Chromosomal Abnormalities
  - Cancer Cytogenetics
  - Genetic Syndromes
- Topics should be innovative, aligned with contemporary scientific challenges, and should contribute to knowledge advancement or diagnostic practices in cytogenetics.

5. Research and Data Collection

- Students must undertake original research, incorporating appropriate data collection, laboratory experimentation, and analytical methods.
- All research must comply with institutional and national ethical guidelines.
- If applicable, ethical clearance must be obtained before starting fieldwork or laboratory studies involving human or animal samples.

6. Dissertation Writing and Formatting

Structure Requirements:

- **Title Page:** Include title, student name, course, supervisor name, and date of submission
- **Abstract:** 250–300 words outlining research objectives, methods, results, and conclusions
- **Acknowledgements**
- **Table of Contents**
- **Introduction:** Background, problem statement, objectives, scope, and significance of the study
- **Literature Review:** Critical review of existing research, theoretical framework, and identification of research gaps
- **Research Methodology:** Detailed explanation of experimental design, tools, procedures, data collection, and ethical considerations
- **Results and Discussion:** Presentation of data, analysis, interpretation, and comparison with existing literature
- **Conclusion:** Summary of findings, implications, and recommendations for future research

- **References:** Cited works in a consistent citation format (e.g., APA, MLA, Vancouver)
- **Appendices:** Supplementary content such as lab reports, images, raw data, or questionnaires

Formatting Guidelines:

- **Font:** Times New Roman, 12 pt
- **Line Spacing:** 1.5
- **Margins:** 1 inch on all sides

7. Submission and Evaluation

- The dissertation must be submitted on or before the official deadline set by the department.
- Late submissions will attract penalties as per institutional regulations.
- The dissertation will be assessed by a faculty evaluation panel, including the supervisor, based on:
  - Scientific rigor and originality
  - Clarity of writing and structure
  - Relevance to the field of cytogenetics
  - Compliance with research and ethical standards

8. Oral Presentation and Viva Voce

- Students are required to present their research findings in a formal oral presentation (viva voce) before a panel of examiners.
- The viva will evaluate the student's understanding of the subject, research methodology, and ability to defend the conclusions drawn from their work.

9. Completion and Award of Credit

- The dissertation carries **12 academic credits** and must be successfully completed along with the viva voce to be eligible for diploma certification.
- On fulfillment of all dissertation requirements, the student will be awarded the PG Diploma with credits for the dissertation module.