SYLLABUS FOR THE BATCH FROM YEAR 2025 TO 2026

FOR

Certificate Course in Molecular diagnostics (CMD)

(Credit Based Evaluation and Grading System)

Semester: I
EXAMINATIONS: 2025-2026

The Certificate Programme Offered:
- **Certificate Course in Molecular diagnostics (6 Months duration)**

Program Outcomes:
- **Fundamental Knowledge of Molecular diagnostics** – Students will gain an understanding of the biomolecules and their relation with disease
- **Enhanced Technical Skills** – The major objective of the programme is to provide personnel with good technical know-how in the area of Molecular diagnostics.
- **Practical Experience** – Through assignments and online video links, students will be enabled to conduct molecular tests.
- **Career Readiness & Employability** – The program prepares students for entry-level positions in the field of molecular diagnosis

Department of Molecular Biology & Biochemistry

In collaboration with

Directorate of Open & Distance Learning and Online Studies

GURU NANAK DEV UNIVERSITY AMRITSAR

Certificate Course in Molecular Diagnostics (CMD) Offered by Department of Molecular Biology & Biochemistry in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Eligibility:

- 10+2 in Science (with Biology)
- Any student doing Bachelor Degree, Master Degree, M.Phil., Ph.D./ lab technician from GNDU campus constituted or affiliated college.

SEMESTER-I

Paper Code	Subject	Marks			Credits
		Internal Assessment	End Term	Total	
ODCMD101T	**Molecules and diseases**	30	70	100	4
ODCMD102T	**Basics of Molecular Diagnostics**	30	70	100	4
ODCMD103T	**Cancer diagnostics**	30	70	100	4
ODCMD104T	**Molecular diagnosis in infectious diseases**	30	70	100	4
	Total Marks & Credits	**120**	**280**	**400**	**16**

Certificate Course in Molecular Diagnostics (CMD) Offered by Department of Molecular Biology & Biochemistry in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: MOLECULES AND DISEASES

Subject Code: ODCMD101T

Semester-I

Time: 03 Hours

Max. Marks: 100 Marks

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

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

Course Objective: To provide an in-depth understanding of the molecular components in disease diagnosis

SECTION A

Introduction to Molecular Diagnostics: Definition, history and scope of Molecular Diagnostics, Advantages and Limitations of Molecular Diagnostics, Laboratory Setup for Molecular Diagnostics, Overview of tools used in Molecular Diagnostics.

SECTION B

Overview of Biomolecules: Types of carbohydrates and their chemical properties, Types of lipids and properties of fats and oils, Types of amino acids and their properties, Types of nucleic acids and their function, building blocks of nucleic acids. Types of Metabolites.

SECTION C

DNA Polymorphisms and Human Diseases: RFLP, STR's and single-nucleotide polymorphisms with examples, diseases related to mutations in mitochondrial genes, Nucleotide repeat expansion disorders like Fragile X syndrome and Huntington disease, Single gene disorders and their detection: Sickle cell anemia, Thrombophilia, Muscular Dystrophy, hemochromatosis, cystic fibrosis.

SECTION D

Molecular diagnostics in Disease Detection and Prenatal diagnostics: Use of molecular diagnostics in transplantation diseases, cardiovascular diseases and metabolic diseases, non-invasive prenatal testing.

Course Outcomes:

1. To understand the fundamentals of molecular diagnostics
2. To understand the role of biomolecules in molecular diagnostics
3. To understand DNA polymorphisms and their association with human diseases
4. Application of molecular diagnostics in disease detection and prenatal testing.

Recommended Books:

1. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications by Lela Buckingham and Maribeth L., FA Davis Co; 3rd Edition. ISBN-13: 978-0803668294
2. Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory by Wayne W. Grody, Robert M. Nakamura and Fredrick Kiechle, Academic Press; 1st edition (2009).
3. Diagnostic Molecular Pathology: A Guide to Applied Molecular Testing by William B. Coleman and Gregory J. Tsongalis., Academic Press; 1st Edition. ISBN-13: 978-0128008867.

Certificate Course in Molecular Diagnostics (CMD) Offered by Department of Molecular Biology & Biochemistry in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: BASICS OF MOLECULAR DIAGNOSTICS

Subject Code: ODCMD102T

Semester-I

Time: 03 Hours

Max. Marks: 100 Marks

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

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

Course objectives: This course will provide a detailed understanding of the basics of various molecules needed for the molecular diagnostics and theory and working of the various techniques used for it.

Section A

Molecular biology basics: DNA and RNA: structure and functions, Introduction to DNA replication, Taq polymerase and their types, Proofreading activity of DNA polymerases, Genetic variations: Mutations, SNPs, DNA and RNA isolation.

Section B

DNA hybridization: Electrophoresis techniques (Agarose and SDS-PAGE electrophoresis), Nucleic acid hybridization techniques (Southern Blotting, Northern Blotting, branched DNA assay, fluorescence in situ hybridization).

Section C

DNA amplification: Primer designing for Polymerase Chain Reaction (PCR), melting temperature of DNA, PCR, nested PCR, ARMS-PCR, Multiplex-PCR, RAPD-PCR, Real-time PCR.

Section D

DNA profiling: Restriction Fragment Length Polymorphism (RFLP), PCR-RFLP, Variable Number of Tandem Repeats, DNA fingerprinting, DNA sequencing.

Course Outcomes:

The students will have understanding of basic elements involved and various techniques used in molecular diagnostics (DNA: hybridization, amplification and profiling) for the diagnosis of various diseases.

Recommended Books:

1. Buckingham L. *Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications*. 3rd ed., Philadelphia: F.A. Davis Company; 2019.
2. Van Pelt-Verkuil, E., van Leeuwen, W. B., & te Witt, R. (Eds.). (2019). *Molecular Diagnostics: Part 1: Technical Backgrounds and Quality Aspects.* Singapore: Springer Nature; *2019.*

Certificate Course in Molecular Diagnostics (CMD) Offered by Department of Molecular Biology & Biochemistry in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: CANCER DIAGNOSTICS
Subject Code: ODCMD103T
Semester-I

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

Internal Assessment: 30 Marks

End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

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

Course Objective: This course provides a comprehensive understanding of cancer diagnostics, covering histopathological, molecular, imaging, and emerging technologies for detecting cancer.

Section A
Fundamentals of Cancer Diagnosis: Introduction to cancer biology: Types of cancer, tumor grading & staging (TNM classification). Histopathology & Cytology: Tissue biopsy, Fine Needle Aspiration Cytology (FNAC), Immunohistochemistry (IHC) in cancer detection. Tumor markers: Serum markers (e.g., PSA, CA-125, CEA, AFP), Liquid biopsy, and circulating tumor DNA (ctDNA).

Section B
Molecular Diagnostics in Cancer: DNA & RNA-based diagnostics: PCR, qPCR, and RT-PCR in cancer detection. Genomics & epigenetics in Cancer: Oncogenes, tumor suppressor genes (e.g., TP53, BRCA1), DNA methylation in cancer. Liquid biopsy and circulating biomarkers: circulating tumor cell (CTC) in cancer detection

Section C
Imaging & Radiological Techniques in Cancer: Theory of cancer imaging: Role of imaging in tumor staging. Imaging techniques: X-ray, Mammography, CT, MRI, PET scans, PET-CT scan, SPECT, Ultrasound (Sonography), and Endoscopy.

Section D

Emerging Technologies & Future of Cancer Diagnostics: Advances in imaging technology: Theranostics, Spatial transcriptomics, wearable smart devices in cancer diagnosis.

Course Outcome: After completing this course, students will have an understanding in traditional, molecular, and emerging diagnostic technologies in cancer detection

Recommended Books:

1. Mendelsohn, John, Peter M. Howley, Mark A. Israel, Joe W. Gray, and Craig B. Thompson. 2015. The Molecular Basis of Cancer. 4th ed. Elsevier.
2. Hayat, M. A. 2010. Methods of Cancer Diagnosis, Therapy, and Prognosis. Vol. 7. Springer.
3. Gabriel D. Dakubo. 2017. Cancer Biomarkers in Body Fluids: Biomarkers in Circulation. 1st ed. Elsevier.
4. Basu, Sandip, Amitava Mukherjee, and Rajarshi Gupta, eds. 2017. Biosensors and Molecular Technologies for Cancer Diagnostics. Boca Raton, FL: CRC Press.
5. Athanasios D. Gouliamos, John A. Andreou. And Paris A. Kosmidis. 2013. Imaging in Clinical Oncology. 1 st ed. Springer Nature.

Certificate Course in Molecular Diagnostics (CMD) Offered by Department of Molecular Biology & Biochemistry in collaboration with Directorate of Open & Distance Learning and Online Studies, Guru Nanak Dev University, Amritsar

Subject Name: MOLECULAR DIAGNOSIS OF INFECTIOUS DISEASES
Subject Code: ODCMD104T
Semester-I

Time: 03 Hours

Max. Marks: 100 Marks
Internal Assessment: 30 Marks
End Term: 70 Marks

Instructions for the Paper-Setter/examiner:

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

Course objectives: This course would help the candidate to attain a comprehensive understanding of the tools used for molecular detection of infectious diseases.

SECTION A

Diagnosis of bacterial pathogens: Overview of traditional methods for detection of bacterial pathogens. Molecular methods for detection of tuberculosis, *E.coli* infections, molecular typing of bacteria, molecular diagnosis of hospital acquired infections (*Staphylococcus aureus*), antimicrobial resistance testing.

SECTION B

Diagnosis of protozoans and helminths: Traditional and PCR based methods for detection of malaria parasite, species identification, use of molecular diagnosis in mixed infections and asymptomatic cases, screening of populations, molecular techniques for helminth detection – PCR based methods, strain identification by RFLP and multi-species detection.

SECTION C

Diagnosis of viral infections: NAAT in viral disease diagnosis, virus detection, genotyping and quantification, isothermal amplification, COVID-19, influenza and HIV diagnosis.

SECTION D

Diagnosis of fungal infections: Traditional and PCR based methods for detection of infectious fungi (*Aspergillus, Candida, Cryptococcus*), Film Array Blood Culture Identification, Proteomics Profiling, multiplex assays.

Course Outcome: After completion of this course, candidates will have a good understanding of traditional, advanced and emerging methods for detection of infectious diseases

Recommended Books:

1. Buckingham L. *Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications*. 3rd ed., Philadelphia: F.A. Davis Company; 2019.
2. Pelt-verkuil, Elizabeth & Leeuwen, Willem & te Witt, René. (2017). Molecular Diagnostics: Part 2: Clinical, Veterinary, Agrobotanical and Food Safety Applications. 10.1007/978-981-10-4511-0.