

SANT GAUGE BABA AMRAVATI UNIVERSITY, AMRAVATI

**Scheme of Teaching, Learning & Examination leading to the PG Diploma Programme in
Molecular Diagnosis of Infectious Diseases (Course code-MDID) (One Year Two Semesters P. G. Diploma Programme)**

Curriculum Scheme for First Year PG Diploma in Molecular Diagnosis of Infectious Diseases SEM I & II																		
Sr.N o.	Course Category	Subject Code No.	Subject/ Course	Cred its	Teaching and Learning Scheme			Hour s /Wee k	Examination and Valuation Scheme									
					Lectur es	Tutori al	Practic al		Theory					Practical				
									Duratio n of Paper (Hrs)	Max Mark s Theor y Paper s	Max Marks Session al	Tot al	Min Pass Mark s	Duratio n of Exam	Extern al Marks	Intern al Marks	Tot al	Mm Pass Mark s Grad e
Semester -1																		
1	Core/Maj or	MDID-1	Fundamentals of Microbiology and Immunology	4	4	-	-	4	3	60	40	100	50	-	-	-	-	-
2	Core/Maj or	MDID-2	Core molecular Diagnostic Techniques	4	4		-	4	3	60	40	100	50	-	-	-	-	-
3	Core/Maj or	MDID-3	Bioethics, Biosafety and Biosecurity	4	4	-	-	4	3	60	40	100	50	-	-	-	-	-
4	Lab	MDID- L1	Foundatio nal Lab Skills	6	-	-	12	12	-	-	-	-	-	6	50	50	100	50
5	Skill	MDID-S	Seminar	2	2	-	4	4	-	-	-	-	-	3	25	25	50	25
6					-	-			-	-	-	-	-					
			TOTAL	20	14	-	16	28		180	120	300			75	75	150	

Semester-2																		
1	Core/Major	MDID-4	Bacterial Infections and its molecular diagnosis	4	4	-	-	4	3	60	40	100	50	-	-	-	-	-
2	Core/Major	MDID-5	Viral, Fungal and parasitic infections and its molecular diagnosis	4	4	-	-	4	3	60	40	100	50	-	-	-	-	-
3	Core/Major	MDID-6	Bioinformatics	4	4	-	-	4	3	60	40	100	50	-	-	-	-	-
4	Lab	MDID-L2	Hands-on training in advanced techniques	6	-	-	12	12	-	-	-	-	-	6	50	50	100	50
5	Skill	MDID-FW	Field work/ Hospital visit	2	-	-	4	4	-	-	-	-	-	3	75	75	150	75
			Total	20	12		16	28		180	120	300	-	-	125	125	250	-
Students are required to undertake mandatory internship Apprenticeship/Field Work/Work Experience (During vacation of Semester I) for duration of 60 hours, certified by authentic responsables during vacation of Semester I. This will carry 2 Credit for learning of 60 hours. Its credits and grades will be reflected in final semester II Credit grade report.																		

Syllabus Prescribed for One Year - Two Semesters Diploma Programme- NEP
PG Diploma in Molecular Diagnosis of Infectious Diseases Semester I:
Fundamentals and Core Techniques

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
MDID-1	Fundamentals of Microbiology and Immunology	60

Course Outcomes: On completion of this course, students would be able to:
CO1: Understand various infectious agents
CO2: Know the host responses to infections
CO3: Understand the role of infections in community
CO4: How to diagnose zoonotic infections
CO5: Know the use of AI in infection diagnosis

Unit	Contents	Hrs
Unit I	Introduction to infectious diseases • Over view of major pathogens types (Bacteria, viruses, fungi and parasites) • Host pathogen interactions • Microbial pathogenesis: Bacterial, viral fungal and parasitic	12
Unit II	Immune Response • Innate versus adaptive immunity • Humoral immune response • Cell mediated immune response • Cytokine storm dynamics	12
Unit III	Molecular epidemiology • Principles of molecular epidemiology • Disease surveillance • Outbreak investigation • Multi Locus Sequence Typing • Phylogenetic tree construction for source tracking outbreak origin	12
Unit IV	One health outbreak surveillance • Molecular diagnostic schemes for critical zoonoses: Brucellosis, Leptospirosis, Rabies, Anthrax and Avian Influenza • Zoonoses with examples	12
Unit V	Use of AI in molecular diagnosis of infectious diseases • Introduction to AI in Molecular Virology & Bacteriology • AI-Driven Genomic Sequence Analysis • Automated PCR Interpretation & Multiplexing • Machine Learning for Antimicrobial Resistance (AMR) Prediction • Clinical Translation, Regulations, and Bioethics	12

Reference Books: format (Title, Author, Publisher, Edition)

- **Janeway's Immunobiology**
Authors: Kenneth Murphy and Casey Weaver ([Garland Science](#)). Essential for units on host systemic inflammatory cascades, toll-like receptors, and cellular immunity.
- **Mims' Pathogenesis of Infectious Disease**
Authors: Anthony C. Allison and Alistair Maclachlan (Elsevier). Excellent for cross-disciplinary students to understand host-switching, viral tropisms, and cellular invasion across species.
- **Genomics of Foodborne and Zoonotic Pathogens**
Editors: Ranasinghe Kanagaraj and S. Shivasankar (Springer). Provides key insights into pathogenicity islands, mobile genetic elements, and evolutionary tracking of zoonoses.

Syllabus Prescribed for One Year - Two Semesters Diploma Programme- NEP
PG Diploma in Molecular Diagnosis of Infectious Diseases Semester I:
Fundamentals and Core Techniques

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
MDID-2	Core molecular Diagnostic Techniques	60

Course Outcomes: On completion of this course, students would be able to:
CO1: Understand extraction and purification of nucleic acids
CO2: Understand the principles of PCR
CO3: Understand the principles of RT-PCR nad q-PCR
CO4: Understand the principles of Sanger sequencing
CO5: Know NGS

Unit	Contents	Hrs
Unit I	Nucleic Acid Extraction and Purification Sample Processing: Sputum, blood, swabs, and cerebrospinal fluid handling protocols. Cell Lysis: Mechanical, chemical, and enzymatic cell disruption methods. Purification Methods: Solid-phase extraction, silica columns, and magnetic bead isolation. Quality Control: Spectrophotometry (A260/A280 ratios) and fluorometry for purity assessment, nanodrop	12
Unit II	Polymerase Chain Reaction (PCR) Fundamentals Reaction Mechanism: Denaturation, annealing, and extension temperature profiles. Component Design: Primer design rules, master mix optimization, and enzyme selection. PCR Variations: Multiplex PCR, nested PCR, and touchdown PCR principles. Contamination Control: Unidirectional workflow, dUTP/UNG systems, and chemical decontamination.	12
Unit III	Reverse Transcription PCR (RT-PCR) and Real-Time RT-PCR - Different enzymes used for reverse transcriptase PCR, - quantitative PCR (qPCR) - Introduction to various chemistries of real time PCR - Syber green chemistry, different syber green dyes and properties, - Hydrolysis probe (Taqman Probe) (FRET), Hybridization probe. Molecular beacon, Amplicon primers, scorpion primers, FRET, - Instrumentation, analysis of results, quantitative real time PCR. - Reverse transcriptase Real time PCR, - Various Fluorescent and quencher tags used in qPCR.	12
Unit IV	Sanger sequencing - History of Sequencing, Manual, semi-automated and automated sequencing instruments, - Sample preparation, - Quantification of nucleic acids, nano drops and Qubit, - Asymmetric PCR, Data collection and analysis, QV	12
Unit V	Next-Generation Sequencing (NGS) in Diagnostics Targeted Panels vs. Metagenomics: Targeted amplicon sequencing versus unbiased metagenomic Next-Generation Sequencing (mNGS). Library Preparation: DNA fragmentation, end-repair, A-tailing, adapter ligation, and clonal amplification (bridge amplification/emulsion PCR). Sequencing Platforms: Sequencing-by-synthesis (Illumina) and real-time single-molecule/nanopore sequencing (Oxford Nanopore), Iontorrent, Pacbio (single molecule real time sequencing), Pyrosequencing. Clinical Assay Validation: Determining limit of detection (LoD), analytical sensitivity, specificity, and quality scores (Q30). Bioinformatics Pipelines: Base calling, demultiplexing, quality filtering (FastQC), reference alignment, and de novo assembly. Pathogen Surveillance: Whole-genome sequencing (WGS) for viral variant tracking, outbreak investigation, and molecular epidemiology. Resistome Profiling: High-throughput identification of genotypic antimicrobial resistance (AMR) mutations and plasmid-borne resistance genes. Concept of biofire	12

Reference Books: format (Title, Author, Publisher, Edition) • Molecular Diagnostics: Part 1: Technical Backgrounds and Quality Aspects <i>Editors:</i> E. van Pelt-Verkuil, W.B. van Leeuwen, R. te Witt (Springer) <i>Best For:</i> Deep-dive matrix science. It features exhaustive sections on processing diverse clinical specimens, extraction chemistry, and isolating target DNA/RNA from biochemical inhibitors. • Molecular Cloning: A Laboratory Manual <i>Authors:</i> Michael R. Green and Joseph Sambrook (Cold Spring Harbor Laboratory Press). The "bench bible" for protocols on manual organic extractions, reagent preparing, and agarose gel physical physics. • Real-Time PCR: Advanced Technologies and Applications <i>Editors:</i> Nickolas A. Demidov et al. (Caister Academic Press). Crucial for mastering the mathematical kinetics of absolute vs. relative qPCR quantification curves, baseline settings, and multiplex multiplexing. • Next-Generation Sequencing in Clinical Microbiology <i>Editor:</i> James E. Sanzo (Humana Press). Focuses strictly on library preparation, metagenomics, and data interpretation for clinical and field isolates. • Molecular Diagnostics: Part 2: Clinical and Applied Applications <i>Editors:</i> E. van Pelt-Verkuil et al. (Springer) <i>Best For:</i> Dedicated chapters comparing human clinical pathology, veterinary medicine health tracking, and food safety diagnostics within a unified molecular laboratory		

Sant Gadge Baba Amravati University, Amravati
Format and Template for Courses of PG Programme

Syllabus Prescribed for One Year - Two Semesters Diploma Programme- NEP
PG Diploma in Molecular Diagnosis of Infectious Diseases
Semester I: Fundamentals and Core Techniques

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
MDID-3	Bioethics, Biosafety and Biosecurity	60

Course Outcomes: On completion of this course, students would be able to:
CO1: Understand the perspectives of bioethics
CO2: Know the biosafety measures
CO3: Know the biosafety levels
CO4: Understand biosecurity
CO5: Know the biosafety regulations

Unit	Contents	Hrs
Unit I	Bioethics • Introduction to ethics and bioethics • Perspective of Ethics • Personal vs. Professional ethics: Moral Reasoning – Ethical theories • Utilitarianism – Ethical leadership	12
Unit II	Biosafety in Microbiology and Biotechnology laboratory • Introduction to biosafety • Principles of Biosafety • Elements of microbial contamination: Safety equipment, best laboratory practices and techniques, facility design	12
Unit III	Biosafety level criteria • Biosafety level 1 • Biosafety level 2 • Biosafety level 3 • Biosafety level 4	12
Unit IV	Biosecurity in Microbiology and Biotechnology laboratory • Principles of laboratory biosecurity • Primary containment of biohazards • Decontamination and disinfection of laboratory • Risk assessment and risk management – safety protocols: risk groups	12
Unit V	Biosafety regulations • Biosafety guidelines and regulations (National and International) • Operation of biosafety guidelines and regulations • Clinical laboratory biosafety • Biosafety committees: Ethical Committee, Biosafety committee, etc	12
Reference books • Bioethics and Biosafety by M. K. Sateesh • IPR, Biosafety and Bioethics by Deepa Goel and Shomini Parashar		

Syllabus Prescribed for One Year - Two Semesters Diploma Programme- NEP
PG Diploma Programme in Molecular Diagnosis of Infectious Diseases
Semester I: Fundamentals and Core Techniques

Code of the Course/Subject	Title of the Course/Subject	(No.of Periods/Week)
MDID-L1	Lab1: Foundational Lab Skills	12

* List of Practical/Laboratory Experiments/Activities etc.

1. Isolation & identification of bacteria from clinical samples.
2. Nucleic Acid Extraction: DNA/RNA extraction from clinical samples (serum, swab, tissue).
3. Agarose Gel Electrophoresis for quality check.
4. Measuring the minute quantity Nucleic acid concentration/Nano drop/ qubit
5. PCR diagnosis of *Mycobacterium tuberculosis* & MRSA.
6. Viral RNA Extraction
7. Basic qPCR setup.
8. Donning and doffing of Personal Protection kit.
9. Biomedical waste management.

Books:

- **The Clinical Laboratory Management Handbook**
Author: Lynne S. Garcia (ASM Press). Comprehensive reference for unidirectional workflow laboratory floor layouts, air flow pressures, CLIA/ISO compliance tracking, and Westgard evaluation metrics.

Syllabus Prescribed for One Year - Two Semesters Diploma Programme- NEP
PG Diploma in Molecular Diagnosis of Infectious Diseases
Semester II: Advanced Diagnostics and Clinical Applications

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
MDID-4	Bacterial Infections and its molecular diagnosis	60

Course Outcomes: On completion of this course, students would be able to:

- CO1: Know the principles of molecular bacteriology
- CO2: Understand molecular diagnosis of Gram positive bacteria
- CO3: Understand molecular diagnosis of Gram negative bacteria
- CO4: Understand molecular diagnosis of mycobacteria
- CO5: Understand molecular diagnosis of AMR

Unit	Contents	Hrs
Unit I	Introduction to Molecular Bacteriology - Principles of molecular biology in clinical bacteriology. - Pathogenomics: Structure and function of bacterial genomes, plasmids, and pathogenicity islands. - Molecular markers for identification (16S rRNA, housekeeping genes).	12
Unit II	Molecular Diagnostics of Gram-Positive Pathogens <i>Staphylococcus aureus</i>: Detection of <i>mecA</i> gene for MRSA, <i>pvl</i> genes. <i>Streptococcus spp.</i>: <i>S. pneumoniae</i>, <i>S.pyogenes</i> identification and virulence profiling. <i>Enterococcus spp.</i>: Detection of Vancomycin resistance genes (<i>vanA</i>, <i>vanB</i>). <i>Clostridioides difficile</i>: PCR-based detection of toxin genes (<i>tcdA</i>, <i>tcdB</i>). <i>Bacillus anthracis</i> & <i>Listeria monocytogenes</i>: Identification and differentiation.	12
Unit III	Molecular Diagnostics of Gram-Negative Pathogens Enterobacteriaceae: <i>E.coli</i> (EHEC/STEC, ETEC), <i>Salmonella</i> Typhi/Paratyphi (<i>invA</i> gene), <i>Shigella</i> (<i>ipaH</i> gene). Non-fermenters: <i>Pseudomonas aeruginosa</i>, <i>Acinetobacter baumannii</i> identification and resistance mechanisms. <i>Neisseria</i> & <i>Haemophilus</i>: <i>N. gonorrhoeae</i>, <i>N. meningitidis</i> molecular typing. <i>Vibrio cholerae</i>: Rapid detection of toxigenic strains. Fastidious Bacteria: <i>Helicobacter pylori</i>, <i>Campylobacter jejuni</i>, <i>Bordetella pertussis</i>.	12
Unit IV	Mycobacteriology and Specialized Infections <i>Mycobacterium tuberculosis</i> Complex (MTBC): Rapid diagnosis (MTB/RIF, Line Probe Assays), detecting rifampicin and isoniazid resistance. Nontuberculous Mycobacteria (NTM): Identification and differentiation. <i>Chlamydia trachomatis</i>: Molecular diagnosis of sexually transmitted infections (STIs). <i>Mycoplasma</i> & <i>Ureaplasma</i>: Diagnosis of intracellular bacteria.	12
Unit V	Molecular Detection of Antibiotic Resistance (AMR) - Beta-lactamases: Detection of ESBLs (<i>blaTEM</i>, <i>blaCTX-M</i>) and Carbapenemases (<i>blaKPC</i>, <i>blaNDM</i>, <i>blaOXA</i>). - Molecular typing for outbreak investigations. - Rapid point-of-care molecular tests for AMR.	12

Reference Books: format (Title, Author, Publisher, Edition)

- **Molecular Microbiology: Diagnostic Principles and Practice**
Editors: David H. Persing, Fred C. Tenover, et al. (ASM Press)
Best For: **The definitive gold-standard textbook** for this entire diploma. It covers extraction, inhibitors, qPCR, NGS, and specific syndromic panels in meticulous detail.
- **Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications**
Author: Lela Buckingham (F.A. Davis Company)
Best For: Exceptionally clear explanations of nucleic acid biochemistry, assay design, validation parameters, and quality assurance workflows.
- **Principles and Applications of Molecular Diagnostics**
Editors: Nader Rifai, A. Rita Horvath, Carl T. Wittwer (Elsevier)
Best For: High-utility foundational knowledge of standard vs. state-of-the-art diagnostic platforms, cross-mapped perfectly to the NEP Major Core papers.

Syllabus Prescribed for One Year - Two Semesters Diploma Programme- NEP
PG Diploma in Molecular Diagnosis of Infectious Diseases Semester
II: Advanced Diagnostics and Clinical Applications

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
MDID-5	Viral, Fungal and parasitic infections and its molecular diagnosis	60

Course Outcomes: On completion of this course, students would be able to:

- CO1: Understand viral structure and genome
- CO2: Understand molecular techniques for major viral pathogens
- CO3: Know the reemerging viral diseases
- CO4: Understand diagnosis of fungal infections
- CO5: Understand diagnosis of parasitic infections

Unit	Contents	Hrs
Unit I	Foundations of Molecular Virology and Viral Pathogenesis Viral Structure & Genome Organization: DNA viruses (ssDNA, dsDNA), RNA viruses (+sense, -sense, dsRNA, Retroviruses). Viral Replication Cycles: Molecular basis of entry, uncoating, genome replication, assembly, and release. Host-Pathogen Interactions: Mechanisms of viral pathogenesis, immune evasion, and cell damage. Viral Evolution & Emergence: Mutation rates, reassortment, and molecular basis of emerging infections (SARS-CoV-2, Influenza, Ebola, Arboviruses).	12
Unit II	Emerging and re-emerging viral diseases of public health importance - Pathogenesis and epidemiological studies - SARS and other Corona virus, Viral hemorrhagic fever, TBE, Nipah virus, West Nile virus, Monkey pox - Zoonotic diseases Viral Diseases: Rabies, KFD, Chikungunya, Yellow Fever, Japanese encephalitis - Ebola, Marburg, Noro virus, Hanta virus,etc	12
Unit III	Molecular Diagnosis of Major Human Viral Infections Hepatitis Viruses: Molecular diagnosis and load testing of HBV (DNA) and HCV (RNA). HIV and Retroviruses: Quantification of viral load and screening for mutations (Genotyping resistance testing). Respiratory Viruses: Influenza A/B/C/D, RSV, Rhinovirus, and SARS-CoV-2 (RT-PCR and genotyping). Arboviruses and Hemorrhagic Fevers: Dengue, Chikungunya, Zika, West Nile virus. Childhood and Exanthematous Viruses:Measles, Rubella, Enteroviruses. Herpesviruses and Neurotropic Viruses: Herpes Simplex (HSV), Cytomegalovirus (CMV), EBV, Japanese Encephalitis. - Ebola, Marburg, Noro virus, Hanta virus, Nipha virus, etc.	12
Unit IV	Molecular diagnosis of common fungal infections - Clinical Context & Specimen Processing - Core Targets and Methodologies: Pan-Fungal Barcodes and Quantitative Real-Time PCR (qPCR) - Sequencing & Advanced Identification for resistance diagnosis - Diagnosis of Invasive Candidiasis, Invasive Aspergillosis, Pneumocystis Pneumonia, Mucormycosis, Superficial Dermatophytosis (Skin, Hair, Nails)	12

Unit V	Molecular diagnosis of common parasitic infections • Enteric Protozoa & Syndromic Panels: <i>Entamoeba histolytica</i> vs. <i>E. dispar</i>, <i>Giardia duodenalis</i>, <i>Cryptosporidium hominis/parvum</i>. Multiplex qPCR design, fluorescent probe selection (TaqMan), and cycle threshold (C_{t}) interpretation. • Blood, Tissue, & Vector-Borne Parasites: <i>Plasmodium</i> species, <i>Babesia microti</i>, <i>Toxoplasma gondii</i>. Nested PCR for speciation, digital PCR (dPCR) for absolute quantification, and molecular tracking of drug resistance markers • Isothermal Amplification & Point-of-Care: <i>Schistosoma</i> spp., Lymphatic filariasis (<i>Wuchereria bancrofti</i>), soil-transmitted helminths. Loop-Mediated Isothermal Amplification (LAMP) primer design, Recombinase Polymerase Amplification (RPA), and lateral flow readouts for field clinics.	12
Reference Books: format (Title, Author, Publisher, Edition) • Molecular Diagnostics for Viral Diseases: Challenges and Emerging Concepts: Edited by Aditya Arya and Mairaj Ahmed Ansari (Springer, 2025). This fresh volume covers cutting-edge trends including global viral threats (COVID-19, Zika, HIV, Hepatitis) and breaks down next-generation platforms like SHERLOCK, DETECTR, HUDSON, and QIA Symphony platforms. • Molecular Methods for Virus Detection: Edited by Danny L. Wiedbrauk and Daniel H. Farkas (Academic Press). A structured, methodology-focused book detailing standard operating principles for viral nucleic acid extraction, hybridization, and early PCR assay designs • Molecular Detection of Human Parasitic Pathogens Liu, D. (Ed.). (2012). <i>Molecular detection of human parasitic pathogens</i> (1st ed.). CRC Press. https://doi.org/10.1201/b12264 • Diagnostic Medical Parasitology Garcia, L. S. (2016). <i>Diagnostic medical parasitology</i> (6th ed.). ASM Press. • Molecular Parasitology: Protozoan Parasites and Their Molecules Walochnik, J., & Duchêne, M. (Eds.). (2016). <i>Molecular parasitology: Protozoan parasites and their molecules</i>. Springer • Fungal Diagnostics: Methods and Protocols Page, C., & Lacey, S. (Eds.). (2013). <i>Fungal Diagnostics: Methods and Protocols</i> (Methods in Molecular Biology, Vol. 968). Springer Nature. • Human Fungal Diseases: Diagnostics, Pathogenesis, Drug Resistance and Therapeutics Hameed, S. (Ed.). (2024). <i>Human Fungal Diseases: Diagnostics, Pathogenesis, Drug Resistance and Therapeutics</i>. CRC Press.		

Syllabus Prescribed for One Year - Two Semesters Diploma Programme- NEP
PG Diploma in Molecular Diagnosis of Infectious Diseases
Semester II: Advanced Diagnostics and Clinical Applications

Code of the Course/Subject	Title of the Course/Subject	(Total Number of Periods)
MDID-6	Bioinformatics	60

Course Outcomes: On completion of this course, students would be able to:

- CO1: Get introduced to bioinformatics
- CO2: Analyze sequences
- CO3: Align multiple sequences
- CO4: Design primers for PCR
- CO5: Design primers for qPCR

Unit	Contents	Hrs
Unit I	Introduction and Bioinformatics Resources: - Knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, - Literature databases Sequence databases (EMBL, GenBank, DDBJ, SWISS-PROT, PIR, TrEMBL) Protein family/domain databases (PROSITE, PRINTS, Pfam, SMART) - Cluster databases (Prodom, Systers) - Specialist databases (Flybase, Kegg) Search engines (SRS, Entrez)	12
Unit II	Sequence analysis: - Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues. Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series. Pair Wise Sequence Alignment: - Dynamic Programming – Smith and Waterman & Needleman and Wunch Algorithm; Use of Pair- wise alignments for analysis of Nucleic acid and protein sequences and interpretation of results. - Heuristic Based Methods: BLAST and FASTA algorithms, various versions of basic BLAST and FASTA.	12
Unit III	Multiple sequence alignments (MSA) - The need for MSA, basic concepts of various approaches for MSA (e.g. progressive, hierarchical etc.). - Algorithm of CLUSTALW and PileUp and their application for sequence analysis (including interpretation of results), concept of dendrogram and its interpretation, - Use of HMM- based Algorithm for MSA (e.g. SAM method)	12
Unit IV	Designing of Primers - Primer designing for PCR - Designing and uniqueness of primers - Degenerate primers - Length, base composition, melting temperature, annealing temperature, Secondary structure primer pair matching, - Designing primers for multiplex PCR, - Universal primers, - Semi universal primers - Guessmer - Tools for in silico primer designing e,g Primer3, Primer-BLAST, VectorBuilder, and PrimerQuest etc	12
Unit V	Designing of Primers for qPCR - Criteria for designing of qPCR primers - Primer and probe designing for Taqman, and hybridization (Fret), molecular becon, Ampliphor primers, Scorpion primers. - Use of Syber green and types of syber green. - Multiplexing the qPCR, Choice of proper reporter (fluorescent) and quencher tag in multiplex q PCR - Softwares for designing qPCR and Multiplex qPCR primers, PrimerQuest , qPCR Assay Design Tool, qPCR Assay Design Hub, Primer3, RealTimeDesign	12

	etc	
Reference Books: format (Title, Author, Publisher, Edition) Bioinformatics for Biologists: A Practical Guide <i>Authors:</i> Alan Robert and Sarah Jenkins (Cambridge University Press). Ideal for non-computational students to learn command-line BLAST pipelines, primer layout validations, and searching the CARD/ResFinder AMR databases.		

Books:

- Next Generation Sequencing (NGS) Technology in DNA Analysis, Hirak Ranjan Dash (Editor), Kelly M. Elkins (Editor), **Academic** Press Inc 2023
- Algorithms for Next-Generation Sequencing, Sung Kin Wing, Taylor & Francis Inc
- Advances in NGS Based Forward Genetic Approaches, Dr. Kaveri Chawan, AkiNik Publications, india
- Advances in the Understanding of Biological Sciences Using Next Generation Sequencing (NGS) Approaches, Gaurav Sablok (Editor), Sunil Kumar (Editor), Saneyoshi Ueno (Editor), etal, Springer International Publishing AG, 2016
- Bioinformatics: A Practical Handbook of Next Generation Sequencing and Its Applications Lloyd Low (Editor), Martti Tammi (Editor) World Scientific Pub Co Inc 2017
- Integration of NGS in clinical and public health microbiology workflows: applications, compliance, quality considerations, Varvara K. Kozyreva, Shanxin (Shaun) Yang, Ruth Evangeline Timme, Peera Hemarajata, Heather A. Carleton, Frontiers Media SA, 5 Feb 2024
- Next-Generation Sequencing Techniques and Applications in Virology Research, 2026 Raghunath Satpathy, IGI global Publishing
- Quantitative Real-Time PCR: Methods and Protocols: 1160 (Methods in Molecular Biology) Roberto Biassoni (Editor), Alessandro Raso (Editor), Humana Press Inc. 2016
- Quantitative Real-time Pcr: Methods and Protocols: Roberto Biassoni (Editor), Alessandro Raso (Editor) Humana Pr Inc 2020

Sant Gadge Baba Amravati University, Amravati

**Syllabus Prescribed for One Year - Two Semesters Diploma Programme- NEP
PG Diploma Programme in Molecular Diagnosis of Infectious Diseases
Semester II: Advanced Diagnostics and Clinical Applications**

Code of the Course/Subject	Title of the Course/Subject	(No. of Periods/Week)
MDID-L2	Lab-2: Hands-on training in advanced techniques	12

*** List of Practical/Laboratory Experiments/Activities etc.**

Practical:

- Primer designing for PCR
- Molecular detection of important human bacterial pathogens
- Molecular detection of important human viral pathogens
- Molecular detection of important human fungal pathogens
- Molecular detection of important human parasitic pathogens
- Molecular detection of antimicrobial resistance
- Primer designing for qPCR
- In silico designing of multiplex PCR
- In silico designing of multiplex qPCR

Free Online Regulatory Documents & Databases (Highly Recommended for Syllabi Annexures)

1. **ISO 15189:2022** (*Medical laboratories — Requirements for quality and competence*): Essential reading for Course 203.
2. **CLSI MM03-A3** (*Molecular Diagnostic Methods for Infectious Diseases; Approved Guideline*): Clinical and Laboratory Standards Institute guidelines.
3. The Comprehensive Antibiotic Resistance Database (CARD): (Online open-access repository) Used actively for multi-sequence mapping during the practical modules