SAURASHTRA UNIVERSITY

RAJKOT – INDIA

Accredited Grade A by NAAC (CGPA 3.05)

CURRICULUM FOR

UGC - B.Voc. under National Skills Qualification Framework(NSQF)

Bachelor of Vocation – Medical Laboratory and Molecular Diagnostics Technology

(B.Voc.- MLMDT)

(Sanctioned to Shree Manibhai Virani & Smt. Navalben Virani Science College-Rajkot)

(Semester V and Semester VI)

Effective From June – 2016

B. Voc.- Medical Laboratory and Molecular Diagnostics Technology (Semester –V)

Sr. No.	Paper No.	Subject	Component	Credit
1	MLMDT 5.1	Molecular biology and rDNA technology	Skill	05
2	MLMDT 5.2	Clinical genetics	Skill	05
3	MLMDT 5.3	Quality Laboratory management and Medical Ethics	Skill	05
4	MLMDT 5.4	Practical	Skill	12
5	MLMDT 5.5	Hospital / Private Pathology Laboratory internship & report submission	Skill	03
Total Credits of Semester - V				**30**

MLMDT 5.1 : Molecular Biology and r-DNA Technology

Unit	Topic	Detail	Marks	Min Lec.
1	Genetic code and Chromatin structure	Biochemical elucidation of codon, properties of genetic code, Wobble hypothesis, cracking of genetic code. DNA binding protein – Histones and non- histones proteins, structure and types of binding motifs with example, Supercoiling of DNA, positive and negative supercoiling.		6
2	Replication of DNA	Concept of replication, uni- and bi- directional Replication, rolling circle model and D- loop model for replication. Initiation, elongation and termination of replication. Enzymes and accessory proteins; Fidelity. Telomerases: mechanism, maintenance of integrity and role in cancer		8
3	Transcription	Definition, Initiation, Elongation, termination Post Transcriptional Modifications Processing of hn RNA, tRNA, rRNA; 5'Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing; mRNA stability.		8
4	Translation	Translation machinery; Ribosomes, ER, Composition and assembly; Termination codons; Mechanism of initiation, elongation and termination; Co- and post-translational modifications. Transport: Transport of proteins and molecular chaperones; Protein stability; Protein turnover and degradation.		10
5	Gene regulation and Mutation	Operator, promoter, regulator, terminator, TATA box, CAT box. Operator concept- Lactose and Tryptophan operons. Introduction and Types of Mutation, Suppression of Mutation. Mutagens: Introduction, Types and Properties. DNA Damage, Repair, and Recombination. Transposable elements and Retrotransposons.		8

6	Introduction and Application of rDNA technology	Steps involved in rDNA technology, isolation of DNA from different sources, concept of restriction modification, restriction endonucleases, Introduction of vector and host. Introduction to generation of genomic and cDNA libraries. Improvement of plant, animals and microbes. Gene therapy, pharmaceutical products and molecular diagnostics, Molecular pharming. Metagenomics, Metabolic engineering.		6
7	Gene amplification through PCR and Types	Polymerase Chain Reaction: Principle, methodology, primer designing, types of polymerase and factors affecting PCR, advantages, limitations and application PCR. Variants of PCR: Reverse Transcriptase PCR, Real Time PCR, Inverse PCR, anchored PCR, nested PCR, hot start PCR, multiplex PCR, touchdown PCR, ARMS (amplification refractive mutation system) PCR		7
8	DNA fingerprinting methods	Methodology and application of DNA fingerprinting methods (RFLP with probe introduction, RAPD, AFLP, SSR, SCAR, DGGE). Principle methodology and types of DNA sequencing (Sanger Coulson method, Maxam-Gilbert method, Pyrosequencing)		7
		Total	**100**	**60**

Student Seminar – 5 Lectures
Expert Talk – 5 Lectures
Student Test – 5 Lectures
Total Lectures **60 + 15 = 75**

Reference Books:

Sr. No	Title	Author	Publisher
1	Gene VIII (2004) and Gene IX (2008).	B. Lewin	Oxford
2	Molecular biology of The Cell	Alberts et al.	Garland science
3	Cell and molecular Biology, Concepts and experiments	Gerald Karp	Wiley
4	Lehninger Principles of Biochemistry	Nelson LD and Cox	WH Freeman
5	Molecular Biology of the Cell	Lodish et al.,	WH Freeman
6	Principle of gene manipulation	Old and Primerose	Blackwell
7	Gene cloning	T.A. Brown	Nelson Thornes
8	Recombinant DNA	Watson et. al.	WH Freeman

MLMDT 5.2 : Clinical Genetics				
Unit	**Topic**	**Detail**	**Marks**	**Min Lec.**
1	Fundamentals of Genetics	Introduction, Significance of genetics, Mendel's principle of inheritance (Experimental material, Laws formulated with reference to Mono- and Di-hybrid crosses, Test cross, Back cross) and Applications using Punnet square and Probability method; Mendel's principle in Human genetics		10
2	Cell cycle	Cell cycle and cell divisions Mitosis, meiosis, errors in cell division		6
3	Linkage and Crossing over	Introduction, Chromosome theory of Linkage Crossing over - Introduction, Theories on the mechanism of crossing over and Types of Crossing over. Quantitative genetics, Polygenic inheritance, Gene and genotype frequency, Hardy-Weinberg law and its significance		8
4	Human Chromosomes and Abnormalities	Chromosomal architecture and Karyotyping (Morphology, classification and organization, structural and functional gene). ISCN nomenclature system Numerical chromosomal abnormalities (Aneuploidy , Euploidy and polyploidy) Structural chromosomal abnormalities (Translocations, Inversions, Deletions, Insertions Duplications, Dicentric and Isochromosomes, Ring chromosomes, Chromosomes breaks, gaps and fragile sites, Marker chromosomes) Application of cytogenetic investigations to clinical practice		12
5	Cytogenetics of Pregnancy, cancer and cell lines	Prenatal diagnosis Amniotic fluid cell culture Chorionic villus sampling and culture Establishing fibroblast culture Cytogenetic analysis of human sperm, oocyte and embryo Chromosomal abnormalities in malignant disease (CML, AML, ALL etc.,) Cytogenetic characterization of Various cell lines Collection, transport and storage of samples for cytogenetic analysis, Lymphocyte culture		10

6	Chromosomal staining, banding and FISH techniques	Giemsa banding Quinacrine banding Constitutive heterochromatin banding Other banding Techniques Applications of fluorescence *in situ* hybridization to chromosome analysis		8
7	Microscopic and Image analysis system for Cytogenetic study	Light microscopy, Fluorescence microscopy and Phase contrast Microscopy Charge-coupled device cameras, Image analysis systems Interpretation and reporting of chromosomal analysis Mode of Inheritance, Human pedigree analysis and genetic counseling.		6
		Total	**100**	**60**

Student Seminar – 5 Lectures
Expert Talk – 5 Lectures
Student Test – 5 Lectures
Total Lectures **60 + 15 = 75**

Reference Books:

Sr. No	Title	Author	Publisher
1	Human Cytogenetics	D. E. Rooney	Oxford University Press
2	Essential of Human Genetics	S. M. Bhatnagar	Orient longman
3	Genetics in Medicine	Thompson and Thompson	Saunders
4	Essential of Modern Genetics	V C Shah	
5	Clinical genetics	Keya Lahiri	Jaypee
6	Genetics in clinical practice-Symptoms, diagnosis and therapy	Jayesh Sheth	Jaypee

MLMDT 5.3 : Quality Laboratory management and Medical Ethics				
Unit	**Topic**	**Detail**	**Marks**	**Min Lec.**
1	Introduction	Organization and operation of laboratory, Establishing a healthcare Lab., structure, staffing, training & continuous education to staff Point of care testing		5
2	Total quality management	TQM frame work, Selection of test & interpretation of result, Cost of test, reference ranges for quantitative tests		5
3	Quality assurance, Quality control, SOP	Essential elements of QA program IQC, EQC, Accuracy, Precision, Standard deviation, Levy-jennings chart, Gaussian curve, kusum chart, important features of SOPs, Intra and extra laboratory precision monitoring using controls current trends for accreditation		7
4	Laboratory set up and safety	Various types of labs, standard lab Set up, Equipping a laboratory, basic equipments and instruments, reagents, placing order, Budgeting, documentation. Chemical, microbial hazards, decontamination, disinfection, fire safety, responsibility of lab Worker, first aid kit., confidentiality of reports, authenticity		7
5	Introduction to Medical Ethics	Principle of ethics General application of ethical principles Collection of information Collection of specimen Reporting of results		8
6	Medical Records and Code of ethics	Storage and retention of medical records Access to medical records Financial arrangements and organizational matter Human dignity and human rights Confidentiality maintenance Obligations to the Public and Profession		10
7	Informed Consent and Research Ethics	Research on human subjects Getting informed consent Medical research on animal		8
8	Legal and Ethical Issues in medical laboratory and Some special applications	Error in diagnosis Malpractice in medical laboratory How to prevent medical liability cases Clinical pathology, anatomical pathology, histopathology, transfusion medicine, molecular genetics, Reproductive technology		10

Student Seminar – 5 Lectures
Expert Talk – 5 Lectures
Student Test – 5 Lectures
Total Lectures **60 + 15 = 75**

Reference Books:

Sr. No	Title	Author	Publisher
1	Clinical diagnosis and management by laboratory methods	John Bernard Henry	Saunders
2	Textbook of medical laboratory technology	Praful Godkar	Bhalani
3	Manual of laboratory safety	Najat Rashid	Jaypee
4	Concise book of medical laboratory technology-Methods and interpretations	Ramnik Sood	Jaypee
5	Intervention and Reflection: Basic Issues in Medical Ethics, 9th Edition (2011)	Ronald Munson	Saunders
6	Bioethics- an introduction to the history, methods and practice	Nancy Jecker	Jones and Bartlett

MLMDT 5.4 : Practical	
Paper	**Marks**
MLMDT 5.1	**100**
MLMDT 5.2	**100**
MLMDT 5.3	**50**
MLMDT 5.5	**50**
Total	**300**

B. Voc.- Medical Laboratory and Molecular Diagnostics Technology (Semester –VI)

Sr. No.	Paper No.	Subject	Component	Credit
1	MLMDT 6.1	Therapeutic Drug monitoring and toxicology	Skill	05
2	MLMDT 6.2	Molecular diagnostics	Skill	05
3	MLMDT 6.3	Small Research Projects / Dissertation based on Diagnostic techniques/Research Proposal/Review writing	Skill	09
4	MLMDT 6.4	Practical	Skill	08
5	GMLMDT 6.5	Molecular Tools in Forensic Sciences	Skill & Gen. Education	03
	Total Credits of Semester - VI			**30**

MLMDT 6.1 : Therapeutic Drug monitoring and toxicology				
Unit	**Topic**	**Detail**	**Marks**	**Min Lec.**
1	Introduction	Purpose of TDM, channels of drug administrations, bioavailability, factors affecting bioavailability and action of drugs, Drug interactions		8
2	Analytical Techniques	immunoassay, gas chromatography, HPLC, mass spectrometry, Capillary electrophoresis for drugs, other analytical techniques		10
3	Factors affecting Therapeutic Drug monitoring	hemolysis, high bilirubin, lipemia, mechanism of interference, interference of various agents, detection and correction of interfering agent, removal of interfering agent		10
4	Screening of drugs of abuse	Drugs of abuse General aspects of the mechanism of action Cocaine, Opiates,Amphetamines Barbiturates,Marijuana etc.		8
4	Therapeutic drug monitoring	Introduction, pharmacokinetics, cardiotropics, anticonvulsants, antiasthamtics, anti-inflammatory drugs, antidepressants		8
5	Environmental carcinogen detection methods	Environmental carcinogens, methods for detection-ELISA, WESTERN blotting Detection of oncogenic proteins in body fluids and cells		8
6	Toxicology	Toxins and acute poisoning. Cyanide, carbon monoxide, alcohol, mercury, arsenic etc. Side effects & toxic effects, classification of Adverse drug reaction, toxicity studies, first aid treatment in toxicology		8
		Total	**100**	**60**

Student Seminar – 5 Lectures
Expert Talk – 5 Lectures
Student Test – 5 Lectures
Total Lectures **60 + 15 = 75**

Reference Books:

Sr. No	Title	Author	Publisher
1	Clinical diagnosis and management by laboratory methods	John Bernard henry	Saunders
2	Textbook of medical laboratory technology	Praful Godkar	Bhalani
3	Examination and board review-Pharmacology	Bertam Katzung	Lange
4	Essentials of medical pharmacology	KD Tripathi	Jaypee

MLMDT 6.2 : Molecular Diagnostics				
Unit	**Topic**	**Detail**	**Marks**	**Min Lec.**
1	Introduction	Role of molecular diagnostics in present diagnostic area Benefits of molecular diagnostics over serological diagnostics test Ethical issues related to molecular diagnostics, role of Molecular diagnostics in Blood banking, Basic techniques used in molecular diagnostics, future of molecular diagnostics.		10
2	Sophisticated Techniques	Detection of gene mutation: Hybridization-Based Methods- Sequencing (Polymerization)-Based Methods – Cleavage Methods Detection of SNPs using agarose based and PCR based methods		14
3	Viral Diseases	Molecular diagnostic of various viral diseases: HIV type -1, HIV type –II, HPV, Herpes, Various hepatitis strains, Influenza (H1N1), sample preparation, various steps required for viral infection analysis and Viral load monitoring		8
4	Infectious diseases	Molecular diagnostics of bacterial infections: Mycobacterium tuberculosis, Pathogenic E Coli, sample preparation and pathogen detection. parasitic diseases - Neiseria gonorrhoeae, malaria.		10
5	Genetic disorders and inborn errors of metabolism	Monogenetic disorder – e.g. Cystic fibrosis etc. Epigenetic disorder – e.g. Cancer etc. Polygenetic disorder – e.g. Diabetes, Triple repeat, Obesity, etc. Inborn error of metabolism: Lipidosis-, Lysosomal storage disorders-, glycogen storage disorders- Gaucher and Pompe; mucopolysaccharidoses- Hunter and Hurler.		10
6	Neuronal Defects	Haemoglobinopathies, Neuro-degenerative disorders: Parkinson’s, Alzheimer and Meningitis.		8
		Total	**100**	**60**

Student Seminar – 5 Lectures
Expert Talk – 5 Lectures
Student Test – 5 Lectures
Total Lectures 60 + 15 = 75

Reference Books:

Sr. No	Title	Author	Publisher
1	Molecular Diagnostics: Current Technology and Applications	Juluri R Rao, Colin Craig Fleming	Horizon Scientific Press
2	Medical Diagnostics and Procedures:	M. Singh	Narosa
3	Genetic Analysis of Complex Disease	Jonathan L. Haines Margaret A. Pericak	John Willey
4	Techniques in diagnostic Human Biochemical Genetics	Frist A. Homes.	Wiley-Blackwell

MLMDT 6.4 : Practical	
Paper	**Marks**
MLMDT 6.1	**50**
MLMDT 6.2	**100**
MLMDT 6.3	**100**
GMLMDT 6.5	**50**
Total	**300**

GMLMDT 6.5 : Molecular Tools in Forensic Sciences				
Unit	**Topic**	**Detail**	**Marks**	**Min Lec.**
1	Introduction	History and Development of Forensic Science, Definition of Forensic Science, Scope of Forensic Science, Need of Forensic Science, Basic Principles of Forensic Science, Tools and Techniques of Forensic Science		10
2	General Methods of Investigation	Narco analysis: History, Importance as an investigative tool, methods as use of drugs, Hypnosis etc. Limitations and legal aspects Brain fingerprinting: Concepts, History, Significance, method, future perspective of the technique, limitations. Criminal Profiling: Introduction, Importance, Profile of the victim and culprit, investigative strategy, crime scene characteristics, limitations.		12
3	Biologic evidence	Importance, nature, location, collection, evaluation and tests for identification of Hair and Fibres, saliva, sweat, urine, blood, fecal matter, vaginal secretions and tests for their identification Blood grouping from stains of blood, semen, saliva and other body fluids by Absorption-inhibition, Absorption-elution and mixed agglutination techniques, determination of secretor/non-secretor status.		12
4	DNA Profiling	Introduction, History of DNA Typing DNA typing systems- RFLP analysis, PCR amplifications, sequence polymorphism. Analysis of SNP, Y- STR. Mitochondrial DNA, Allele frequency determination, match probability- database, quality control, certification and accreditation. Forensic Significance of DNA profiling: Applications in disputed paternity cases, child swapping, missing person's identity Status of development of DNA profiling in India and abroad. New and future technologies: DNA chips Limitations of DNA profiling.		12
5	Emerging Forensic Techniques	PCR, Terminal Restriction Fragment Length Polymorphism (TRFLP), Amplified Fragment Length Polymorphism (AFLP), Single Stranded		14

		Conformation Polymorphism Analysis (SSCP), Thermal and Denaturating Gradient Gel Electrophoresis (TGGE, DGGE), Amplified Ribosomal DNA Restriction Analysis (ARDRA), Randomly Amplified Polymorphic DNA (RAPD). Non-PCR DNA Fingerprinting Techniques with Applicability in Forensic Studies- Restriction Fragment Length Polymorphisms (RFLP) and Ribotyping.		
		Total	**100**	**60**

Student Seminar – 5 Lectures
Expert Talk – 5 Lectures
Student Test – 5 Lectures
Total Lectures **60 + 15 = 75**

Reference Books:

Sr. No	**Title**	**Author**	**Publisher**
1	Methods of Forensic Science	Curry, A. S.	Interscience, New York
2	Forensic Biology	Chowdhari, S.	B P R & D, Govt of India
3	Forensic Science Hand book	Richard saferstein	Prentice Hall