

**Shree Manibhai Virani and Smt. Navalben Virani Science College
(Autonomous), Rajkot
Affiliated to Saurashtra University, Rajkot**

**Syllabus – B. Voc. Medical Laboratory and Molecular Diagnostic Technology
Semester III-IV
For Students Admitted from A.Y. 2017-2018 & Onwards
SEMESTER III**

17VMLGC06	Core 1: Endocrinology	04 hrs/wk	04 Credits
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Objectives:

To enable the students to

1. Understand the role of endocrine system in homeostasis
2. Describe different classes of hormones
3. Understand molecular, biochemical and physiological effects of hormones
4. Learn pathophysiological basis and consequences of specific endocrine disorders

Unit 1: Introduction to Endocrinology (09 hrs)

- Overview of endocrine system- Endocrine gland, Exocrine and paracrine glands
- Chemical nature of hormones and its classification
- Mode of hormone action-receptors
- Role of secondary Messengers-cAMP, GMP
- Hormone analysis: Direct and Indirect ELISA, Chemiluminescence assay

Unit 2: Hypothalamus and pituitary gland (10 hrs)

- Anatomy and functions of hypothalamus
- TRH, GHRH, GnRH, CRH, Somatostatin, dopamine
- Pituitary gland- Anatomy and functions-GH, Prolactin, FSH, LH, ADH
- Neurohypophyseal hormones
- Pineal gland- Anatomy and functions and overview of diseases related to hormones of this gland

Unit 3: Thyroid and parathyroid glands (10hrs)

- Anatomy and functions of thyroid gland
- Role and regulation of thyroid hormones
- Pathophysiology of the thyroid hormones-Diseases related to this gland
- Anatomy and functions of parathyroid gland
- Role of parathyroid hormones

Unit 4: Adrenal gland

(09 hrs)

- Anatomy and functions of adrenal gland
- Role and regulations of Adrenocortical hormones
- Pathophysiology of these hormones- Addison's disease, Cushing's syndrome
- Role and regulations of Adrenal medulla hormones

Unit 5: Gastrointestinal and Reproductive hormones

(10 hrs)

- Cell types: Islets of Langerhans of pancreas
- Functions of insulin, glucagon, somatostatin and polypeptide
- Functions of gastrointestinal hormones- Gastrin, CCK, Secretin
- Male and female reproductive hormones: Testosterone, Estrogen, Progesterone
- Functions, regulation and Pathophysiology related to reproductive hormones

Text Books

1. Mala Dharmalingam, Textbook of endocrinology; Jaypee
2. M N Chatterjea, Textbook of medical biochemistry; Jaypee
3. Francis Greenspan, Basic and clinical endocrinology; Prentice-Hall

Reference Books:

1. Ramnik Sood, Concise book of medical laboratory technology-Methods and interpretations; Jaypee
2. Arthur Guyton and Hall, **Textbook of Medical Physiology**; W.B. Saunders publishing company limited
3. Sujit Chaudhari, **Concise Medical Physiology**; Central publishing company limited.

17VMLGC07	Core 7: Clinical Biochemistry	04 hrs/wk	04 Credits
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Objectives:

To enable the students to

1. Understand the pathophysiology of important metabolic diseases
2. Correlate the signs and symptoms of diseases with biochemical physiological phenomena
3. Learn biochemical parameters for diagnosis and management of patients

Unit 1: Disorders of carbohydrate metabolism (10hrs)

- Introduction to Hyperglycemia as a metabolic defect
- Diabetes mellitus: Types, causes, risk factors
- Symptoms, complications of diabetes mellitus and Laboratory diagnosis
- Introduction to Hypoglycemia as a metabolic defect
- Causes symptoms and diagnosis

Unit 2: Disorders of lipid metabolism (10hrs)

- Hypercholesterolemia
- Coronary artery disease-Atherosclerosis: Causes, risk factors
- Pathogenesis, symptoms and Laboratory diagnosis
- Fatty liver- Types, Causes, risk factors, diagnosis

Unit 3: Disorders of protein and nucleic acid metabolism (09 hrs)

Causes, Symptoms and Diagnosis of:

- Phenyl ketoneuria and alkaptonuria
- Maple syrup urine disease
- Hyperuricemia- Gout
- Lesch- Nyhan syndrome

Unit 4: Liver function and renal function test (10hrs)

- Functions of liver
- Overview of Diseases of liver - Jaundice, hepatitis, cirrhosis
- Liver function tests and their significance -plasma proteins, bilirubin, SGPT, SGOT, Alkaline phosphatase, gamma glutamyl transferase, Prothrombin time
- Overview of Diseases of Kidney - Glomerulonephritis, nephrotic syndrome, diabetic nephropathy
- Renal function tests, their significance and standards - GFR, Urine analysis, serum urea, creatinine

Unit 5: Disorders of Calcium, Phosphate and Magnesium homeostasis

(09 hrs)

- Distribution, functions and regulation of Ca, PO₄ and Mg (in brief)
- Disorders of Ca, PO₄ and Mg homeostasis
- Metabolic bone disease: Causes, clinical features and diagnosis of Osteoarthritis, Osteoporosis, Rickettsia
- Markers of bone diseases

Text Books:

1. M N Chatterjea, Textbook of medical biochemistry; Jaypee
2. Chawla, Ranjna, Practical Clinical Biochemistry including methods and interpretation; Jaypee
3. Mehta SK, Textbook of Medical Biochemistry; Campus Books International

Reference Books:

1. G P Talwar. TB of Biochemistry and Human Biology; Prentice Hall publications
2. J L Jain. Fundamentals of Biochemistry; S Chand publications
3. Mehta SK, Basic Medical Biochemistry; Campus Books International

17VMLGC08	Core 5-Analytical Techniques	04 hrs/wk	04 Credits
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Objectives:

To enable the students to

1. Understand the basic principle and working of various analytical instruments
2. Learn the applications of various techniques with advantages and disadvantages
3. Learn the operation of automated instruments

Unit 1: Spectrophotometric Techniques

(10 hrs)

- Basic definition of Electromagnetic radiation and its interaction with matter, electromagnetic spectra, Extinction coefficient
- Beer-Lambert's law and their limitations. Instrumentation, principle, components and applications of Colorimeter
- Principle and applications of UV-Visible Spectrophotometer
- End Point Reaction methods (Fixed time methods), Rate of reaction methods (Continuous monitoring methods), Visible-kinetic methods (Non enzymatic and Enzymatic), UV-Kinetic methods
- Flame photometer- Principle, Instrumentation and applications

Unit 2: Chromatographic Techniques and pH measurement

(10 hrs)

- Basic principles of chromatography (Distribution coefficient, stationary phase, mobile phase, eluent, eluate, retention time)
- Principle and working of Paper chromatography, TLC, Column chromatography
- Ion exchange chromatography and Affinity chromatography
- Definition and brief explanation of pH and pOH, methods to determine pH
- Principle, instrumentation and working of a pH meter

Unit 3: Electrophoretic techniques and Centrifugation

(10 hrs)

- General principles and factors affecting electrophoretic mobility
- Gels: agarose gel, polyacrylamide gel
- Principle and working of agarose gel electrophoresis and SDS PAGE
- Centrifugation: Introduction to terms such as Centrifugal force, Centripetal force, rpm and RCF. Factors affecting sedimentation
- Types of centrifuges: Preparative (Table top centrifuge, High speed centrifuge) and analytical

Unit 4: Microscopy

(09 hrs)

- Microscopy: Introduction and Types
- Principle, Construction and working of Bright field Microscopy, Dark field Microscopy
- Fluorescent Microscopy and Phase Contrast Microscopy
- Electron microscope- Types- TEM and SEM, Construction, Working and applications
- Introduction to Advanced Microscopic techniques: AFM, Confocal microscopy

Unit 5: Automation

(09 hrs)

- Introduction to automation and their advantages
- Biochemistry analyzer: Continuous flow analyzer, Multi-channel continuous flow analyzer: Principle and instrumentation
- Discrete autoanalyzer, Types: Semi automated analyzer and fully automated analyzer. Batch analyzer, Random Access Analyzer; Principle and instrumentation, Advantages
- Hematology analyzer: Introduction, Principle, Instrumentation and types, Applications
- Care and maintenance of sophisticated instruments

Text Books:

1. Wilson and Walker. **Principles and Techniques of Biochemistry and Molecular Biology.**
2. Upadhyay and Nath, **Biophysical Biochemistry**
3. Praful Godkar, **A Textbook on Medical Laboratory Technology;** Bhalani Publication
4. Bernard Henry, **Clinical Diagnosis and Management By Laboratory Methods,** W B Saunders

Reference Books:

1. D. Frifelder, **Physical Biochemistry;** W. H. Freeman and Co
2. Vanholde K.E. **Physical Biochemistry;** Practice Hall Inc. New Jersey

17VMLSC07	Core Skill 5: Clinical Biochemistry Practical	06 hrs/wk	06 Credits
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Objectives:

The course will enable the student to

1. Estimate the biochemical parameters
2. Analyze the biochemical investigations to develop clinical diagnosis
3. Operate basic and advanced instruments in the laboratory

List of Practical

1. Estimation of Glucose
2. Estimation of Urea
3. Estimation of Creatinine
4. Estimation of Uric acid
5. Estimation of Total protein and Albumin
6. Estimation of Triglyceride
7. Estimation of Total Cholesterol
8. Estimation of LDL and HDL Cholesterol
9. Estimation of Total Bilirubin & Direct Bilirubin
10. Estimation of SGPT
11. Estimation of SGOT
12. Estimation of Alkaline Phosphatase
13. Estimation of LDH

Reference Books:

1. Praful Godkar, **A Textbook of Medical Laboratory Technology**; Bhalani Publication
2. Shankara, YM Shivaraja; Ganesh, MK; Shivashankara, A R, **Laboratory Manual For Practical Biochemistry**; Jaypee Brothers Medical Publishers (P) Ltd.
3. Jones, Evangeline. **Manual of Practical Medical Biochemistry**; Jaypee Brothers Medical Publishers (P) Ltd.
4. Sawhney S.K., Singh, R. (2005). **Introductory Practical Biochemistry**; Alpha Science International.

17VMLSC08	Core Skill 6: Endocrinology and Analytical Techniques Practical	09 hrs/wk	09 Credits
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Objectives:

The course will enable the student to

1. Diagnose endocrine disorders through hormone assays
2. Understand principle of major instruments
3. Perform analytical techniques using various instruments
4. Use the automated instruments
5. Learn the use and maintenance of the instruments

List of Practical

1. Direct immunoenzymatic determination of Triiodothyronine (T3) in human serum or plasma.
2. Direct immunoenzymatic determination of thyroxine (T4) in human serum or plasma.
3. Direct immunoenzymatic determination of TSH in human serum or plasma
4. Estimation of absorption spectra using colorimeter
5. Operation of spectrophotometer
6. Determination of Na⁺ and K⁺ in serum using flame photometry-Demo
7. Separation of biological compounds by TLC
8. Separation of biological compounds by Paper chromatography
9. Calibration of pH meter and pH measurement
10. Operation of centrifuge
11. Separation of DNA using Agarose gel electrophoresis technique
12. Separation of given protein using SDS PAGE
13. Operation of a semi-automated analyzer
14. Operation of a fully automated analyzer
15. Operation of hematology analyzer

Reference Books:

1. Shankara, YM Shivaraja; Ganesh, MK; Shivashankara, AR. **Laboratory Manual For Practical Biochemistry**; Jaypee Brothers Medical Publishers (P) Ltd.
2. Jayaraman, J. **Laboratory Manual In Biochemistry**; New Age International Publishers
3. P. Palanivelu. **Analytical Biochemistry and Separation Techniques, Lab manual**; Twenty first Century Publications

SEMESTER – IV

17VMLGC09	Core 9: Blood Bank and Histopathology Techniques	04 hrs/wk	04 Credits
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Objectives:

To enable the students to

1. Understand the importance of blood bank and its functions
2. Learn the blood bank set up and various investigations
3. Learn the significance of histological diagnosis
4. Study the tissue processing steps

Unit 1: Concept of Blood Groups (09 hrs)

- Overview of immunohematology, Antigens and antibodies in blood
- ABO blood group system and ABO variants
- Rh blood group system, other important blood group systems
- Important techniques in blood bank -Blood grouping, Cross matching, Coomb's test, Antibody screening
- Issue of blood in emergency life saving situation and in neonate and infants

Unit 2: Blood Banking (10 hrs)

- Functions of blood bank, Blood bank set up, Documentation & records in blood bank
- Blood donor- screening criteria, collection of blood and post collection processing.
- Various anticoagulants, Storage, Preservation and transportation of blood
- Quality assurance in blood bank
- Biomedical waste management

Unit: 3 Blood transfusion practice and HLA system (10 hrs)

- Blood components separation: Types and indications (red cells, white cells, platelets, coagulation factors, FFP, Cryoprecipitate etc.) Apheresis procedures
- Transfusion transmitted diseases and Blood Transfusion Reactions, Its investigation
- Hemolytic Disease of newborn
- HLA gene products, Clinical significance of HLA system
- Techniques of histocompatibility testing

Unit 4: Introduction to Histopathology and Basic steps (10hrs)

- Overview of histopathology
- Tissue Processing steps: Fixation of tissues, decalcifications, Embedding in wax

- Microtomy- Different types of microtome, preparation of sections
- Staining and Mounting of slides for microscopic observation
- Automated tissue processor - components, working & precautions during use

Unit 5: Staining Methods and ImmunoHistochemistry

(09hrs)

- Types of Stains used in histopathology labs
- Hematoxylin - Types, methods of preparation,
- Eosin - method of preparation, Hematoxylin & Eosin stain staining method
- Special stains: Reticulin staining, PAS staining, Connective tissue staining
- Overview of Immunohistochemistry: Principle and Steps of IHC, immunohistochemical stains
- Exfoliative Cytology- Introduction, types of samples for cytology, Papanicolaou method

Text Books:

1. Praful Godkar, Text Book of Medical Laboratory Technology; Bhalani
2. Anthony Britten, Blood transfusion a basic text; AITBS
3. John Bancroft, Manual of histological techniques and their diagnostic application; Churchill livinstone

Reference Books:

1. Bernard Henry, Clinical Diagnosis and Management By Laboratory Methods, W B Saunders
2. Satish Gupte, A textbook of blood bank and transfusion medicine; Jaypee
3. Denise Harmening, Modern blood banking and transfusion practice; Jaypee

17VMLGC10	Core 10: Medical Microbiology	04 hrs/wk	04 Credits
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Objectives: To enable the students to

1. Understand the infection cycle
2. Learn various bacterial, viral and fungal infections
3. Identify the causative agent of disease through symptoms and lab tests
4. Learn the methods of biomedical waste disposal

Unit 1: Gram positive Cocci and Bacilli (10 hrs)

- Overview on Disease cycle, Routes of transmission of infection, Virulence
- Gram Positive Cocci: *Staphylococci, Pneumococci, Streptococci*
Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis
- Gram negative Cocci: *Neisseria gonorrhoeae, Neisseria meningitides*
Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis
- Gram Positive bacilli: *Corynebacteria, Mycobacteria*
Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis
- Gram Positive bacilli: *Clostridia, Bacillus*
Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis

Unit 2: Gram negative bacilli (10 hrs)

- Enterobacteriaceae- *E.coli, Salmonella typhi, Shigella dysenteriae*- Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis
- Proteus, Klebsiella- Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis
- Pseudomonas, Vibrio- Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis
- Bordetella, Haemophilus - Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis
- Spirochetes – *Treponema pallidum, Leptospira*- Morphology, cultural and biochemical characteristics and pathogenesis of the disease, Laboratory diagnosis

Unit 3: Viral diseases (10 hrs)

- General properties of viruses and Classification
- Causes, pathogenesis (overview) and laboratory diagnosis of
 1. Adenovirus – HIV
 2. Paramyxovirus/ orthomyxovirus- Influenza
 3. Pox Virus
 4. Chikunguniya, Dengue
 5. Herpes Virus

Unit 4: Fungal diseases**(09 hrs)**

- General Characteristics and classification of pathogenic fungi
- Superficial fungal infections- Dermatophytes, Aspergillosis
- Deep fungal infections- Candidiasis
- Opportunistic fungal infection
- Mycotoxins

Unit 5: Collection and Transport of Specimen and biomedical waste disposal (09 hrs)

- Methods of various pathological samples collection(Urine, Feces, Sputum, Pus, Body fluids, Swab, Blood), Rejection criteria
- Identification of microbes from specimen by Rapid methods of identification and PCR based molecular diagnostic methods
- Bio medical waste disposal regulations
- Classification of bio medical waste
- Disposal criteria for various types of bio medical waste

Text Book:

1. Anantnarayan R and Panikar CKJ: Text book of Microbiology, Orient Blackswan Pvt. Ltd.
2. Richard V. Goering: Mims' Medical Microbiology, 5th Edition, Saunders, an imprint Elsevier ltd.
3. Murray, Patrick R.: Medical Microbiology, Elsevier ltd.

Reference Book:

- 1 Prescott & Dunn's: Microbiology. CBS Publishers & Distributors.
- 2 Broude AI: Medical Microbiology and Infectious Diseases, WB Saunders Co.
- 3 Jawetz, Melnick & Adelberg's: Medical Microbiology, 26th Edition, Mc Graw Hill Companies, a LANGE medical book.
- 4 Chapel and Haeney: Essentials of Clinical Immunology, Blackwell Scientific Publications.
- 5 Forbes BA, Sahm DF and Weissfeld AS: Bailey & Scott's Diagnostic Microbiology, Mosby

17VMLGC11	Core 11: Immunology	04 hrs/wk	04 Credits
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Objectives:

To enable the student to

1. Demonstrate a comprehensive and practical understanding of basic immunological principles involved in protection mechanism.
2. Differentiate between innate and adaptive immunity, primary and secondary responses and identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses.
3. Differentiate between humoral and cell mediated immunity.
4. Discuss Dysfunctional immunity and its consequences, Process of infection and vaccination
5. Principle and applications of various immune reactions in research and diagnosis

Unit 1: Introduction to immune system and immune response (10 hrs)

- Innate and adaptive immunity
- Cells and tissues of immune system
- Humoral and cell mediated immune response
- Active and passive immune response, primary and secondary immune response
- Antigen: Immunogenicity versus antigenicity
- Properties of immunogen, Hapten, adjuvants, epitopes

Unit 2: Antibody and MHC (09 hrs)

- Basic structure of antibody
- Major classes and their biological activity
- Introduction to Isotypic, Allotypic and Idiotypic Determinants
- Overview of monoclonal antibody
- Major histocompatibility complex-MHC
Structure and properties of class I and II MHC, Peptide binding by MHC molecules

Unit 3: Antigen processing, Complement system and serological reactions (10 hrs)

- Overview of Antigen processing and presentation:
 1. Cytosolic pathway for endogenous antigen
 2. Endocytic pathway for exogenous antigen
- Complement system: Classical and alternate pathway of complement activation, Formation of membrane attack complex (MAC) and physiological significance
- Antigen- antibody reactions
- Precipitation reactions and Agglutination reactions
- Overview of Radioimmunoassay and ELISA

Unit 4: Immune system in health and disease

(10 hrs)

- Hypersensitivity reactions
- Type I to Type IV reactions
- Autoimmune diseases: Hashimoto's Thyroiditis, Autoimmune Anaemia's, Goodpasture's Syndrome, Insulin Dependent Diabetes Mellitus, Graves Disease, Myasthenia Gravis, Multiple Sclerosis, Rheumatoid Arthritis
- Immunodeficiency diseases: Severely Combined Immuno Deficiency Disease and AIDS
- Overview of transplantation immunity

Unit 5: Vaccine

(09 hrs)

- Active and passive immunization,
- Designing of vaccine for active immunization
- Live attenuated vaccine, Inactivated vaccine
- DNA vaccine, Recombinant vector vaccine
- Introduction to Immunotherapy

Text Books:

- J.Kuby, R. A. Goldsby, T.J.Kindt , B.A. Osborne (2013). Immunology 7th edition. W.H. Freeman and Company , New York
- R. M. Atlas (2015). Principles of Microbiology. 2nd edition. Wm.C.Brown Publishers
- Prescott, Harley, Klein (2007). Microbiology 5th edition. McGraw-Hill Publishers
- P.M. Lyolyard , A. Whelan, M.W. Fanger. (2011) Instant Notes in Immunology. 3rd edition. Garland Science Taylor and Francis Group, Newyork

Reference Books:

- C.A.Janeway, P.Travers, M. Walport, M.J. Shlomchick. (2005). Immunology – the immune system in health and Diseases. 6th edition. Garland Science Taylor and Francis Group, Newyork

17VMLSC10	Core Skill 8: Blood Bank and Histopathology Practical	06 hrs/wk	06 Credits
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Objectives:

To enable the student to

1. Acquire the skill of doing blood grouping
2. Perform the cross matching and Coomb's test
3. Perform the histological techniques

List of practical:

1. Determine Criteria for blood donors
2. ABO blood grouping by slide method
3. ABO blood grouping by tube method
4. Rh typing
5. Du variant test
6. Cross matching
7. Direct Coomb's test
8. Indirect Coomb's test
9. Storage of blood and blood components
10. Fixation of tissues
11. Decalcification
12. Tissue processing
13. Embedding and block making
14. Microtomy
15. Staining of the section and observation

Reference Books:

1. Prasad, S. R.; Sinha, Aruna (Foreword). **Practical Histology for Medical Students;** Jaypee Brothers Medical Publishers (P) Ltd.
2. Satish Gupte, A textbook of blood bank and transfusion medicine; Jaypee

17VMLSC11	Core Skill 9: Medical Microbiology and Immunology Practical	09 hrs/wk	09 Credits
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Objectives:

To enable the students to

1. Isolate the pathogenic bacteria from the clinical specimen
2. Identify the pathogen by morphological, cultural and biochemical characteristics
3. Study the antibiotic susceptibility test for causative agent
4. Learn the immunodiagnostic techniques through antigen antibody reactions

List of Practical:

1. Isolation and Identification of pathogen from clinical samples like urine, pus, blood etc. (*E. coli*, *Salmonella spp.*, *Pseudomonas spp.*, *Proteus spp.*, *Shigella spp.*, *Staphylococcus spp* and *Streptococcus spp*)
2. Antibiotic sensitivity test
3. One step test for HBsAg
4. Slide test for C-reactive protein
5. Widal test for typhoid
6. Slide test for rheumatoid Factors
7. Rapid immunoconcentration test for HIV 1 and HIV 2 antibodies
8. Pregnancy Test
9. Malaria Antibody Detection test
10. Malaria antigen detection test
11. Dengue detection test
12. RPR Test (Rapid Plasma Reagin Test)
13. ELISA test for diagnosis of HIV/Hepatitis/any other disease

Reference Books:

1. Praful Godkar, **Text Book of Medical Laboratory Technology**; Bhalani
2. Bernard Henry, **Clinical Diagnosis and Management By Laboratory Methods**, W B Saunders
3. Jawetz, Melnick & Adelberg's: **Medical Microbiology**, 26th Edition, Mc Graw Hill Companies, a LANGE medical book
4. Chapel and Haeney: **Essentials of Clinical Immunology**, Blackwell Scientific Publications

SEMESTER V

17VMLGC12	Core 12 : Molecular Biology	5 hrs/wk	5 Credits
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Objective:

To enable the student to

1. Understand the structure of genetic material
2. Learn the concept of gene, genome and its organization
3. Describe the process of replication, transcription and translation
4. Understand the gene regulation

Unit 1: DNA structure (09 hrs)

- DNA as genetic material
- DNA structure- Watson and Crick double helical structure, alternative forms of DNA structure
- Gene structure: Split nature, Gene family, Over lapping genes, cryptic genes
- Genome organization

Unit 2: Replication (09 hrs)

- Concept of replication, modes of replication, overview of mitochondrial replication
- Enzymes involved in replication
- Process of replication: Initiation, elongation and termination
- Telomerase: mechanism, maintenance of integrity and its role in ageing and cancer

Unit 3: Transcription (10 hrs)

- Overview of transcription
- Transcription in eukaryotes
- Post transcriptional modification: Capping, tailing, intron splicing
- Transcription of tRNA and rRNA

Unit 4: Translation (10 hrs)

- Translation machinery: Genetic code, ribosomes, role of mRNA, rRNA and tRNA
- Translation in eukaryotes
- Post-translational modifications
- Protein sorting, targeting and trafficking in eukaryotic cell

Unit 5: Regulation of gene expression (10 hrs)

- Gene regulation in eukaryote- Cell cycle
- Gene silencing, antisense RNA and RNA interference (Overview)
- Mutation: Mutagen, types of mutation
- DNA repair mechanism

Text Books:

1. Alberts et al. Molecular biology of The Cell Garland science
2. Nelson LD and Cox Lehninger Principles of Biochemistry, WH Freeman
3. Lodish et al., Molecular Biology of the Cell WH Freeman

Reference Books:

1. B. Lewin Gene VIII (2004) and Gene IX (2008). Oxford
2. Gerald Karp Cell and molecular Biology, Concepts and experiments Wiley

17VMLGC13	Core 13: Clinical Genetics	5 hrs/wk	5 Credits
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Objectives:

To enable the student to

1. Understand the fundamentals of genetics
2. Learn the concept of inheritance
3. Describe the chromosome and its abnormality
4. Understand the concept of cytogenetics
5. Learn the genetic counselling

Unit 1: Fundamentals of Genetics

- Introduction, Significance of genetics, Mendel's principle of inheritance (Test cross, Back cross)
- Mendel's principle in Human genetics
- Sex linked inheritance, Human pedigree analysis
- Gene interactions-allelic and nonallelic
- Concept of maternal inheritance and linked disorders

Unit 2: Human Chromosomes and Abnormalities

- Structure of human chromosome: Euchromatin and heterochromatin
- Introduction and types of chromosomal aberration
- Numerical chromosomal abnormalities
- Structural chromosomal abnormalities
- Major syndromes (Down's, Patau, Klinefelter, Turner's, Edward, Cri du chat)

Unit 3: Clinical Cytogenetics

- Cytogenetics of infertility, factors affecting fertility
- Cytogenetics of abortion, introduction of teratogen
- Cancer cytogenetics: Regulation of cell cycle
- Karyotyping, Chromosomal staining, banding
- Prenatal Genetic Disease Diagnosis

Unit 4: Genetic assessment and counseling

- Introduction to risk assessment
- Causes and factors for seeking counselling
- Principles of genetic counselling
- Psychological aspects of genetic counselling
- Ethical and legal issues in genetic counselling

Unit 5: Treatment of genetic disorders

- Introduction of Gene therapy
- Types of gene therapy
- Potential applications of gene therapy in major genetic disorders
- Gene therapy of cancer
- Potential of stem cells in treatment of genetic disorders

Text Books:

1. D. E. Rooney, Human Cytogenetics; Oxford University Press
2. S. M. Bhatnagar Essential of Human Genetics Orient Longman
3. Thompson and Thompson Genetics in Medicine Saunders

Reference Books:

1. JL Hamerton (2013) Human Cytogenetics: Clinical Cytogenetics, Academic Press
2. S Gersen and MB Keagel (2013) The Principles of Clinical Cytogenetics, Springer Science and Buisness Media Publication

17VMLSC13	Core Skill 11: Molecular biology and Clinical Genetics Practical	12 hrs/wk	12 Credits
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Objective:

To enable the student to

1. Isolate the DNA from bacteria
2. Solve the problems related to Mendel's principle
3. Analyze the karyotype
4. Understand pedigree analysis

Practical:

1. Isolation of DNA from bacteria
2. Spectrophotometric estimation of DNA
3. Agarose gel electrophoresis
4. Ultraviolet radiation mutagenesis
5. SDS-PAGE
6. Problems solving by Mendelian principles
7. Problems related to the Hardy–Weinberg principle
8. Karyotyping of normal human being
9. Karyotyping of genetic diseases like Down's syndrome, Klinefelter's syndrome etc.
10. Pedigree analysis

Text Books:

1. Keya Lahiri, Clinical genetics ;Jaypee
2. V C Shah, Essential of Modern Genetics; Jaypee

17VMLGC14	Core 14: Therapeutic Drug Monitoring and Toxicology	3+2 hrs/wk	5 Credits
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Objective:

To enable the student to:

1. Understand the concept of pharmacokinetics
2. Learn the importance of TDM
3. Learn the screening of certain drugs
4. Understand the toxins and its effects

Unit 1: Introduction to pharmacokinetics (10 hrs)

- Biological half life, area under curve
- Apparent volume of distribution, concept of drug clearance
- Drug disposition, and physiological factor related to absorption
- Drug Distribution and metabolism

Unit 2: Introduction to Therapeutic Drug Monitoring (10 hrs)

- Purpose of TDM
- Channels of drug administrations
- Bioavailability, factors affecting bioavailability and action of drugs
- Drug interactions

Unit 3: Factors affecting Therapeutic Drug monitoring (09 hrs)

- Hemolysis, high bilirubin, lipemia
- Interference of various agents
- Mechanism of interference
- Detection and correction of interfering agent
- Removal of interfering agent

Unit 4: Screening of drugs of abuse and TDM of certain drugs (10 hrs)

- Drugs of abuse
- General aspects of the mechanism of action
- Cocaine, Opiates, Amphetamines Barbiturates, Marijuana etc.
- TDM of Cardiotropics, anticonvulsants, antiasthamtics, anti-inflammatory drugs, antidepressants

Unit 5: Toxicology**(09 hrs)**

- 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

Text Books:

1. John Bernard Henry, Clinical diagnosis and management by laboratory methods ;
Saunders
2. Praful Godkar Textbook of medical laboratory technology Bhalani

Reference Books:

1. Bertam Katzung Examination and board review-Pharmacology Lange
2. KD Tripathi, Essentials of medical pharmacology; Jaypee

SEMESTER VI

17VMLGC15	Core 15 : Molecular Diagnostics	4 hrs/wk	4 Credits
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Objectives:

To enable the student to

1. Understand the concepts in molecular diagnostics that provide the foundation for implementing and adapting new techniques and assays
2. Become familiar with basic molecular techniques.
3. Learn to apply molecular diagnostic techniques in the diagnosis of microbiological and genetic disorders
4. Learn the tumor markers for the diagnosis of cancer

Unit 1: Introduction

(09 hrs)

- Role of molecular diagnostics in present diagnostic area
- Benefits of molecular diagnostics over serological diagnostics test
- Role of Molecular diagnostics in Blood banking
- Basic techniques used in molecular diagnostics
- Future of molecular diagnostics

Unit 2: Nucleic acid amplification methods

(10 hrs)

- Polymerase Chain Reaction: Principle and components of PCR: 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
- NASBA-Nucleic Acid Sequence Based Amplification, LAMP-Loop Mediated isothermal Amplification, LCR- Ligase Chain Reaction

Unit 3: Advanced Diagnostic Techniques

(10 hrs)

- Hybridization based Methods- RFLP, Allele specific oligonucleotide hybridization
- Oligonucleotide ligation assay (OLA)
- Mutation detection by SSCP-single strand conformation polymorphism, Heteroduplex analysis
- Principle methodology and types of DNA sequencing (Sanger Coulson method, Maxam-Gilbert method, Pyrosequencing)
- Introduction to NGS-Next Generation Sequencing

Unit 4: Molecular diagnosis of infectious diseases

(10 hrs)

- Molecular diagnosis of various viral diseases: HIV type -1, HIV type –II, HPV, Herpes
- Various Hepatitis strains, Influenza (H1N1)
- Varioust steps required for viral infection analysis and Viral load monitoring
- Molecular diagnosis of bacterial infections: *Mycobacterium tuberculosis*, Pathogenic *E Coli*, *Neiseria gonorrhoeae* (identification based on 16S rRNA sequences- Amplified Ribosomal DNA Restriction analysis (ARDRA)-Culture independent analysis of bacteria- DGGE and TRFLP)
- Molecular diagnosis of Parasitic diseases – malaria

Unit 5: Tumor and Cancer markers

(09 hrs)

- Overview of Oncogene, morphological and biochemical difference between normal and tumor cells
- Introduction to tumor markers and its clinical applications
- Enzymes as tumor markers
- Clinically important cancer markers: Prostate specific antigens (PSA), Oncofetal antigens, Alpha feto protein (AFP), Carcino embryonic antigen (CEA), Squamous cell carcinoma (SCC) antigen, Carbohydrate markers (brief introduction) Bladder cancer markers (introduction in brief) Bladder tumor antigen (BTA), Fibrin- Fibrinogen degradation product (FDP), Nuclear matrix protein (NMP22)
- Biomarkers still in research (introduction in brief)- Telomeres, TRAP assay, hyaluronic acid and Hyaluronidase

Text Books:

1. Juluri R Rao, Colin Craig Fleming, Molecular Diagnostics: Current Technology and Applications; Horizon Scientific Press
2. Frist A. Homes; Techniques in diagnostic Human Biochemical Genetics; Wiley-Blackwell
3. M. Singh, Medical Diagnostics and Procedures; Narosa

Reference Books:

1. L Buckingham (2011) **Molecular Diagnostics: Fundamentals, Methods and Clinical Applications**, FA Davis Company Publication, 2nd Edition
2. Jonathan L. Haines Margaret A. Pericak, Genetic Analysis of Complex Disease; John Willey

17VMLGC16	Core 16 : Molecular Tools in Forensic Sciences	3 hrs/wk	3 Credits
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Course Objectives:

To enable the student to

1. Understand the importance of forensic science
2. Learn various methods of crime investigation
3. Learn forensic applications of molecular techniques
4. Understand the emerging techniques in forensic science

Unit 1: Introduction to forensic science (09 hrs)

- History and Development of Forensic Science, Definition of Forensic Science
- Scope of Forensic Science
- Need of Forensic Science
- Basic Principles of Forensic Science

Unit 2: General Methods of Investigation (10 hrs)

- Investigation of crime scene: steps involved in investigation—securing the scene
- Documentation and markings, chain of custody, sketching the scene, photography-videography of scene
- Types of Searching, collection of evidence, preservation and packaging of evidences
- Types of evidences- biological, chemical, physical
- Digital – corpus delicti and modus operandi

Unit 3: Biological evidence (10 hrs)

- 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. Fingerprints and analysis of them.
- Forensic Medicine – post mortem evidences, signs of toxins, asphyxia, drowning etc.

Unit 4: DNA Profiling (10 hrs)

- Introduction, DNA typing systems- RFLP analysis, PCR amplifications, sequence polymorphism. Analysis of Y- STR
- Terminal Restriction Fragment Length Polymorphism (TRFLP), Amplified Fragment Length Polymorphism (AFLP), Randomly Amplified Polymorphic DNA (RAPD)
- Mitochondrial DNA, match probability- database
- Non-PCR DNA Fingerprinting Techniques

- Forensic Significance of DNA profiling: Applications in disputed paternity cases, child swapping, missing person's identity

Unit 5: Emerging Forensic Techniques

(09 hrs)

- 3D record of crime scene, digital methods of evidence analysis
- Comparison microscope, IBIS, AFIS, ESDA, XRF, EDXRF, Tensile strength measurement
- bioinformatics- DNA sequencing and digital matching –NCBI
- Digital Forensics- Recovery of data, Mobile phone forensics – cell analysis and call records, Image enhancement and findings, data recovery from broken storage devices, restoration of metal serial numbers – chemical etching, email lookup, android locations etc

Text Books:

1. Curry, A. S Methods of Forensic Science Interscience, New York
2. Chowdhari, S Forensic Biology B P R & D, Govt of India
3. Richard saferstein, Forensic Science Hand book; Prentice Hall

17VMLGC17	Core 17 : Quality Laboratory Management System	3+2 hrs/wk	5 Credits
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Objective:

To enable the student to

1. Learn the total quality management in the laboratory
2. Understand the importance of QA and QC
3. Learn the regulations in TQM
4. Understand medical ethics and its importance

Unit 1: Introduction to Total Quality Management (09 hrs)

- TQM : Concept, application and importance in Clinical laboratories
- Introduction to Quality practices and its applications
- Management of quality and its tools
- Regulatory accreditation authorities and their control
- Point of care testing

Unit 2: Quality assurance and Quality control (10 hrs)

- Quality Assurance : Introduction and Principles
- Quality control: Introduction and Principles
- Good Clinical Lab Practices and its importance (ICMR)
- Testing, interpretation of results: Accuracy, Precision & Robustness
- Good Documentation practices : Report writing

Unit 3: Laboratory set up and safety (10 hrs)

- Standard Laboratories and its types
- Equipments and instruments in laboratory
- Procurement in Lab : Budget & Purchasing orders
- Laboratory safety : Chemical and microbial hazards Fire and Radiation
- Decontamination and disinfection : Rules and regulations

Unit 4: Introduction to Medical Ethics (10 hrs)

- Principles of ethics and its application
- Collection of information
- Confidentiality & Human dignity and human rights
- Obligations to the Public and Profession
- Reporting of results and Audits, Archival of lab records

Unit 5: Informed Consent and Research Ethics (09 hrs)

- Research on human subjects
- Informed consents; an overview
- Principles of ethics in research
- Vital role of Animal Ethics Committee in India

Text Books:

1. Praful Godkar Textbook of medical laboratory technology Bhalani
2. Najat Rashid Manual of laboratory safety Jaypee
3. Ronald Munson Intervention and Reflection: Basic Issues in Medical Ethics, 9th Edition (2011) Saunders

Reference Books:

1. John Bernard Henry Clinical diagnosis and management by laboratory methods Saunders
2. Nancy Jecker Bioethics- an introduction to the history, methods and practice Jones and Bartlett

17VMLSC14	Core Skill 13: Molecular Diagnostics Practical	6 hrs/wk	6 Credits
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Objective:

To be able to

1. Learn the molecular techniques for diagnosis
2. Operate the advanced instruments
3. Study mutation detection

List of Practical:

1. Isolation of genomic DNA from peripheral blood
2. Capillary gel electrophoresis
3. Southern hybridization
4. Restriction Fragment Length Polymorphism study
5. Isolation of RNA
6. Plasmid isolation
7. Standard PCR
8. RT-PCR
9. Multiplex PCR
10. Mutation detection by SSCP
11. Western blotting

Reference Books:

1. Molecular Diagnostics: Fundamentals, Methods & Clinical applications (2007). Lele Buckingham and Maribeth L. Flaws.
2. Fundamentals of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders Group.
3. Molecular Diagnostics for the Clinical Laboratorian 2Ed. 2006, W.B. Coleman. Humana Press
4. Molecular Cloning: Laboratory Manual (2001) Sambrook, J., Russell, D.W., Sambrook, J.
5. Analyzing DNA. A Laboratory Manual (1997) Edited by Bruce Birren, Eric D Green, Sue Klapholz, Richard M. Myers and Jane Roskams, Cold Spring Harbor Laboratory Press.

17VMLSC15	Core Skill 14: Molecular Tools in Forensic Science Practical	3 hrs/wk	3 Credits
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Objective:

To enable the student to

1. Perform and analyze fingerprints from various surfaces
2. Perform DNA fingerprinting
3. Analyze the crime scene
4. Perform the blood grouping various biological sources

Practical List:

1. Lifting and analysis of fingerprints from porous surface
2. Lifting and analysis of fingerprints from non- porous surface
3. Email header analysis
4. Finding cause of death from given photographs
5. Sketching of a crime scene
6. Blood grouping by absorption- inhibition method
7. Searching for evidences in demo crime scene
8. DNA fingerprinting

Reference Books:

1. Richard saferstein, Forensic Science Hand book; Prentice Hall
2. Curry, A. S Methods of Forensic Science Interscience, New York
3. Chowdhari, S Forensic Biology B P R & D, Govt of India