RESTRUCTURED CURRICULUM PHASE IV
EFFECTIVE FROM 2012-13

M.Sc., Biomedical Instrumentation Science

**SEMESTER-I**

<table>
<thead>
<tr>
<th>S.No</th>
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<tr>
<td></td>
<td>MAJOR CORE (MC)PAPERS</td>
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<tr>
<td>1</td>
<td>Tools and Techniques in Cell Biology</td>
<td>5</td>
<td>4</td>
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<td>2</td>
<td>Tools and Techniques in Medical Biochemistry</td>
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<td>3</td>
<td>Principles and Practice of Hematology</td>
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<td>4</td>
<td>Diagnostic Microbiology</td>
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<td>5</td>
<td>Hematology and Cell Biology - Lab course</td>
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<td>Medical Biochemistry and Microbiology - Lab course</td>
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**SEMESTER –II**

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<td>MAJOR CORE (MC)PAPERS</td>
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<td>1</td>
<td>Stem cell Technology</td>
<td>5</td>
<td>4</td>
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<td>Separation techniques for Bio molecules</td>
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<td>3</td>
<td>r-DNA technology</td>
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<td>4</td>
<td>Separation Techniques for biomolecules - Lab course</td>
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<td>r-DNA technology - Lab course</td>
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<td>ELECTIVE SUBJECTS(ES) PAPER</td>
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<td>Applied Electronics in instrumentation Science/Therapeutic drug monitor (Not more than 2 papers at a time)</td>
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**SUMMER TRAINING**

3 to 4 weeks  1
BI 1814 - TOOLS AND TECHNIQUES IN CELL BIOLOGY

SEMESTER: I  CREDIT : 04
CATEGOR: MC  NO. OF HOURS / WEEK : 05

Objectives: To study the techniques of Cell and Molecular biology and describe their implications in Biomedical Sciences.

UNIT I: MICROSCOPY


UNIT II: CELL STRUCTURE


UNIT III: CYTOCHEMICAL TECHNIQUES


UNIT IV: CYTOPHOTOMETRY AND FLOW CYTOMETRY


UNIT V: DNA DIAGNOSTIC SYSTEMS

Hybridization probes, PCR, DNA fingerprinting, DNA Microarray, FISH Technique, Molecular diagnosis of genetic diseases. Biothesiometric technique, Auto analyzer, LASER.

REFERENCES:
6. PHI Learning Pvt Limited
Objectives: To allow the students to get acquainted with the tasks and work of clinical biochemical laboratories and the uses of biochemical methods for the diagnosis and monitoring of pathological status condition.

Unit I
Automation and practices of clinical biochemistry: Laboratory safety – toxic chemicals and biohazards, Automation in clinical laboratory- Analyzers. Computers in clinical laboratory. Precision, reliability, reproducibility and other factors in quality control. Normal values in health and diseases, Specimen collection and processing (blood, urine, feces and CSF), storage of specimens.


Unit III

UNIT IV:
Disorders of Amino Acid Metabolism: Metabolic disorders of amino acids, Congenital AA disease - basic knowledge and possible treatment Plasma lipids and lipoprotein abnormalities: hypercholesterolemia- lipidosis and hypolipoproteinemias, Taysach s and Niemann picks diseases. Dyslipoproteinaemia, Vitamins (fat soluble and water soluble and their deficiency disorders), Disorders of erythrocyte metabolism- Hemoglobin and Myoglobin - hemoglobinopathies, thalassemias and anemias. Disorders of nucleic acid metabolism-hypo and hyperuricemia, gout. orotaciduria. aminoacidurias, organic acidurias. Paediatric clinical chemistry- diseases of the newborn and the complications. Porphyrrins, Porphyrias,
**Unit V**  
Renal function tests, Liver function tests, Gastrointestinal function tests, Pancreatic function test, Thyroid function tests.

**REFERENCES:**
BI 1816 - PRINCIPLES AND PRACTICE OF HEMATOLOGY

SEMESTER : I CREDITS : 04
CATEGORY : MC NO. OF HOURS / WEEK : 05

Objectives: To understand the mechanism of blood formation and their abnormalities in various types of disorders.

UNIT I: Components of the blood


UNIT II: Red cell Disorder


UNIT III: Coagulation system

Clinical Hematological features of the various sickle diseases-screening for sickle cell anemia time and thrombin time, Bleeding time (Duke’s Method), clotting time (Lee-White Method, Capillary Method), Clot Retraction and lysis time, Prothrombin time, Plasma Recalcification time, Protamine Sulfate test, Fibrinogen determination. Mechanism of coagulation of blood.

UNIT IV: Hemogram


UNIT V: Special hematological tests


REFERENCES:

BI 1817- DIAGNOSTIC MICROBIOLOGY

SEMESTER: 1 CREDITS : 04
CATEGORY: MC NO. OF HOURS/WEEKS : 05

Objectives: Diagnostic microbiology is a specialty in the sciences which focuses on applying microbiology to medical diagnosis. The students gain knowledge which allows them access to a variety of equipment which they can use to identify and study the organisms they encounter, handle diagnostic testing for hospitals and also work in research and development, helping to develop new diagnostic techniques and treatments for microbial infection.

UNIT I: Basic Medical Microbiology - Microbial Taxonomy- Bacterial Genetics, Metabolism, and Structure- Host-Microorganism Interactions-Innate defenses of the body-transmission- parasite survival strategies and infection. Infective syndromes.

UNIT II: General Principles in Clinical Microbiology : Safety & Specimen Management, Approaches to Diagnosis of Infectious Diseases- Role of Microscopy- Traditional Cultivation and Identification- Nucleic Acid-Based Analytic Methods For Microbial Identification And Characterization- Immunochemical Methods Used for Organism Detection- Serologic Diagnosis of Infectious Diseases

UNIT III: Antimicrobial Activity and chemotherapy: Selective toxicity-discovery and design of antimicrobial agents-Principles of Antimicrobial Action & Resistance-classification- Laboratory Methods and Strategies for Antimicrobial Susceptibility Testing- uses and abuses(case studies)

UNIT VI: Vaccination: types, strategies. Community based control vaccination- factors affecting the success of vaccination- passive immunization with antibody- non-specific cellular immunostimulation- Correction of host immunodeficiency

UNIT V: Clinical Laboratory Management –common nosomial infection-causes-sources and routes of transmission- Laboratory Physical Design, Management, and Organization- Quality in the Clinical Microbiology Laboratory- Infection Control- Sentinel Laboratory Response to Bioterrorism

REFERENCES:

BI 1818 - HEMATOLOGY AND CELL BIOLOGY- LAB COURSE

SEMESTER : I
CATEGORY : MC
CREDIT : 02
NO. OF HOURS / WEEK : 05

Objectives: To provide a detailed understanding of clinical features and laboratory diagnosis hematological diseases

To enable students acquire diagnostic skills in recent developments in cell biology

UNIT I: HAEMOGRAM

Clotting time, Bleeding time, Hemoglobin estimation, Erythrocyte Sedimentation Rate, Packed cell volume, MCV.

UNIT II: COMPLETE BLOOD COUNT

Prothrombin time, Differential count, Total Red Blood cell count, Total white blood cell, Platelet count, Eosinophilic count, Reticulocyte count, Specific gravity of blood & plasma.

UNIT III: SPECIAL INVESTIGATIONS:


UNIT IV: CYTOGENETIC TECHNIQUES

Lencocyte culture, Metaphase Chromosomes - Preparation from human blood, Banding techniques, Karyotyping - Identification of Chromosome abnormalities - Silver staining techniques
Karyotyping of Chromosomes
Cell Viability Count- Tryphan Blue Dye Exclusion Assay

UNIT V: Demonstration

Hybridization probes,- FISHtechnique-, flow cytometry and cell sorting

REFERENCE:

3. Robert H. Carman, Medical Laboratory Technology, 1999, CMAI, Canada
BI 1819- MEDICAL BIOCHEMISTRY AND MICROBIOLOGY - LAB COURSE

SEMESTER : I  
CATEGORY : MC 
CREDIT : 02  
NO. OF HOURS / WEEK : 05

Objectives: To allow the students to get acquainted with medical laboratories and the uses of biochemical methods for the diagnosis and monitoring of pathological status condition.

To impart skills on the important microbiological techniques used in clinical diagnosis

COLLECTION OF SAMPLES

Capillary blood, venous blood, saliva, urine. Laboratory visits

UNIT I: SERUM ANALYSIS I

Estimation of Blood Sugar – GOD-POD METHOD
Estimation of Total Protein – Lowry’s Method & Biuret’s Method
Estimation of Total Cholesterol – CHOD Method
Estimation of Urea in blood – Berthelot Method

UNIT II: ENZYME ASSAYS

Assay of the activity of Serum Glutamate Oxaloacetate transaminase (kinetic method)
Assay of the activity of Serum glutamate Pyruvate transaminase (kinetic method)
Assay of the activity Lactate Dehydrogenase
Assay of the activity of Cholinesterase

UNIT III: (I) HORMONES AND URINE ANALYSIS

TSH
Estimation of Creatinine in Urine- Alkaline Picrate Method.

(ii) Biochemical Preparations
Cytochrome C, Urease from horse gram. Casein and lactalbumin from milk

UNIT IV: STAINING AND CULTURE TECHNIQUES

Preparation of media and reagents- Sterilization, Serial dilution Method, Media preparation; Plating Techniques - Pour plate, Spread Plate and Streak Plate. Simple staining and Gram’s staining.

UNIT V: IDENTIFICATION AND ISOLATION OF MICROORGANISMS

Isolation of microorganisms from clinically important specimens.

Isolation and identification of bacteria and fungi. Antibiotic sensitivity test- Antimicrobial assay-MIC
REFERENCES:
5. Guinesekaran, P, 1996. Laboratory ManuelinMicrobiology, NewAge international, India.

BI 2812- STEM CELL TECHNOLOGY

SEMESTER : II CREDITS : 04
CATEGORY : MC NO. OF HOURS / WEEK : 05

Objective- To provide knowledge on the recent developments in stem cell technology to meet the present needs and demands.

UNIT I: The nature of stem cells, adult stem cells, fetal tissue stem cells, nuclear transfer stem cells, embryonic stem cells- human cloning. The dividing cells - the cell cycle, stimulating cell division- molecular biology of cell division.

UNIT II: Egg specific functions- structure of the human egg, egg growth, oocyte meiosis- Molecular mei biology of oocyte meiosis. Assisted reproductive technologies- IVM, IVF, METHODS- ICST, GIFT, and ZIFT. The activated egg- Spontaneous egg activation- artificial egg activation- egg activation by sperm- egg activation in IN VITRO fertilization- egg activation following nuclear transplantation- molecular biology of egg activation- Cleavage of human eggs.

UNIT III: The zygote, blastomeric cleavage, the first, second and fragmented cleavages, the third, fourth, & Fifth cleavages- Development of tissue culture media, molecular biology of blastomeric cleavage- Blastocyst and inner cell mass cells. Organogenesis. Parthenotes - androgenotes, gynogenotes, haplodand diploidparthenotes. Basic nuclear transfertechology -
transfer of nuclei into frog eggs. Development potential of transplanted nuclei – Transcription, gene expression and translation reprogramming a nucleus.

**UNIT IV:** Tissue engineering-biomaterials. scaffolds-for skin graft, bone graft -human and pig. Stem cell engineering-division of stem cells-properties of stem cells-growing ESCS in laboratories. Esc.-Differentiation of adult cells- C. elegans, Zebra fish and frog. Potential therapeutic applications of stem cells.


**References**


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**BI 2813 - SEPARATION TECHNIQUES FOR BIOMOLECULES**

**SEMESTER:** II  
**CREDITS:** 04  
**CATEGORY:** MC  
**NO. OF HOURS / WEEK:** 05

**Objective:** To impart knowledge on the different techniques involved in the separation of biomolecules whereby the students can apply it in clinical research.

**UNIT I: Basic principles and concepts**

General principles of Chromatography, Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process, concept, Theory and equipment by different techniques and various Detectors – Applications – Distillation- Crystallization.
UNIT II: Chromatographic techniques
Analytical techniques for biomolecule separation: Paper Chromatography (PC), Thin Layer Chromatography (TLC), Ion Exchange Chromatography, Gel Exclusion Chromatography (GLC), Affinity Chromatography, Gas liquid chromatography (GLC), High Performance Liquid Chromatography (HPLC) & detectors, Fast performance Liquid Chromatography (FPLC) –Supercritical Fluid Chromatography (SFC), Instrumentation and application.

UNIT III: Electrophoretic techniques
General Principles of Electrophoresis – SDS PAGE- Isoelectric focusing- 2D gel electrophoresis- Immuno electrophoresis & types of immune electrophoresis, Densitometry & its applications,- PCR- Western blotting - Adsorption spectrophotometer - Fluorescence Spectrophotometer.


UNIT V: Centrifugation techniques
Centrifugation: General Principle, techniques working mechanism, preparative, analytical and ultracentrifuges, applications of centrifugation different methods of centrifugation techniques (zonal, differential, density gradient and isopycnic centrifugation). ultracentrifugation. Types of rotors. Differential centrifugation and density gradient centrifugation.

REFERENCES:
BI 2814 - RECOMBINANT DNA TECHNOLOGY

Objective: To provide updated information on the tools and techniques involved in Genetic Engineering giving detailed knowledge on its applications in the field of Life sciences and to give an insight to molecular techniques involved in Medical diagnostics and therapy.


UNIT III: Cloning Methodologies-Insertion of Foreign DNA into Host Cells; Transformation ;Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; Phage display; Principles in maximizing gene expression.

UNIT IV: PCR and Its Applications-Primer design; Fidelity of thermo stable enzymes; Types of PCR – PCR in gene recombination ;Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection. DNA profiling in forensic science, DNA footprinting, Reporter Genes, Selectable markers. Human Genome Project.

UNIT V: DNA Sequencing methods;RNA sequencing; Chemical Synthesis of oligonucleotides; Restriction mapping and Gene mapping. Introduction of DNA into mammalian cells; Transfection techniques; Recombinant Therapeutic proteins; Gene silencing techniques; Gene knockouts and Gene Therapy; Disease model; Somatic and germ-line therapy- in vivo and ex-vivo; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays. Bioethics – GMOs, Biotechnology and Biosafety- IPR, IPP.

REFERENCES:

BI 2815  -SEPARATION TECHNIQUES FOR BIOMOLECULES LAB COURSE

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**Objective:** To enable the students to develop basic techniques involved in analysis of biomolecules.

**UNIT I: PAPER CHROMATOGRAPHY & THIN LAYER CHROMATOGRAPHY**

One Dimensional Chromatography (Separation of amino acids)
Separation of Phenolic compounds by TLC.

**UNIT II: COLUMN CHROMATOGRAPHY**

Separation of Plant pigments using column Chromatography.
Gel Filtration Chromatography
Affinity Chromatography.
Ion exchange chromatography (IgG separation)

**UNIT III: SPECTROPHOTOMETRY**

Estimation of Chlorophyll.
Estimation of EPS
Spectrophotometric quantification of nucleic acids.

**UNIT IV: PROTEIN STUDIES**

Serum Protein Electrophoresis.
Protein Isolation from Animal Tissues and purification techniques- SDS PAGE
ELISA
Western Blotting
UNIT V: DEMONSTRATION:-
High Performance Liquid Chromatography
Gas Chromatography,
Separation of Cell Organelles- Differential Centrifugation

REFERENCES:

BI 2816 - R-DNA TECHNOLOGY LAB COURSE

| SEMESTER | II       | CREDITS : 04 |
| CATEGORY  | MC (P)   | NO. OF HOURS / WEEK : 04 |

Objective: To enable the student to acquire the technical skill in the field of rDNA technology.

UNIT I: ISOLATION TECHNIQUES
Isolation of DNA from Liver tissues
RNA isolation from Human blood
Isolation of plasmid DNA from bacteria

UNIT II: SEPARATION AND QUANTIFICATION TECHNIQUES
Agarose Gel Electrophoresis- EtBr Staining
Restriction Digestion
Quantification of DNA and RNA

UNIT III: MOLECULAR TECHNIQUES
DNA Mutagenesis
RFLP
Reverse Transcriptase PCR (RT-PCR)

UNIT IV: PCR
PCR Amplification
RAPD

UNIT V: DNA FINGERPRINTING
Human DNA fingerprinting – VNTR/Alu typing
Human sex determination-PCR method
BI 2955 - APPLIED ELECTRONICS IN INSTRUMENTATION SCIENCE

SEMESTER: II  CREDITS : 03
CATEGORY: ES  NO. OF HOURS/ WEEKS : 04

Objectives: The subject deals with Electrical transducers, Electronic instrumentation for signal condition of processing, Micro-processors and Micro-controllers, PC based instrumentation systems, Power Electronics and Data transmission, Bio-instrumentation, Process control and Intelligent instrumentation. The students are provided and in-depth knowledge of AE & I to meet the present and future demands for the market of professionals.

UNIT I: ELECTRONICS

UNIT II: Transducers and Electrodes: Different types of transducers and their selection for Biomedical applications, Electrode theory, different types of electrodes Hydrogen Calomel, Ag-AgCl, pH, PO2 Pco2 electrodes, selection criteria of electrodes. Cardiovascular measurement: The heart and other cardio systems, Measurement of Blood Pressure, Blood flow, Cardiac output and Cardiac rate, Electrocardiography, Phonocardiography, Ballistocardiography, Plethysmography, Magnet – Cardiography, Cardiac pace-maker, computer applications.

UNIT III: INSTRUMENTATION IN DRUG ANALYSIS

Medical Imaging: Ultrasound imaging, Radiography and applications.  
Biotelemetry: Transmission and Reception aspects of Biological signals via long distances.  
Absence of Patient Care Monitoring.  

UNIT V: APPLIED INSTRUMENTATION-II: Analytical methods of measurement - pH, conductivity, viscosity, density, humidity and moisture. Industrial gas analysis such as oxygen, carbon dioxide, methane, carbon monoxide, Zirconia probe oxygen analyzer, paramagnetic oxygen analyzer.  
Recorders- Moving coil, Magnetic tape, U-V recorder, X-Y recorder, Digital recorder  

References:  
1. Murty -Transducers & Instrumentation, Dr. S.PHI, Delhi’85.  
2. Patranabis D- Principles of Industrial Instrumentation –, TMH.  
3. Singh: Industrial Instrumentation and Control, 2/e - TMH  
7. Sawhney,K. – A Course in Electrical electronic measurement in instrumentation; DhanpatRai& sons publishers  
8. Jain—Digital Electronics, 2/e,TMH  
9. Kalsi—Electronic Instrumentation , TMH  
10. Malvino& Leach – Digital Principles & Application , 5/e,TMH  
11. Helric A.D & Cooper W.D—Modern Electronic Instrumentation & Measuring  
12. Webster J S – Medical Instrumentation – Application and Design  
13. Cromwell L – Biomedical Instrumentation and Measurement, Pearson  
16. Carr – Introduction to Biomedical Equipment Technology 4/e – Pearson  

BI 2956 - THERAPEUTIC DRUG MONITORING  

SEMESTER : II  
CREDITS : 03  
CATEGORY : ES  
NO. OF HOURS / WEEK : 04  

Objectives: To make the student understand the use of serum drug measurements as an aid to the management of patients receiving drugs, which is important for the optimization of therapy of drugs whose desired (or toxic) effect cannot be assessed clinically. The students get exposed to the various techniques involved in TDM and the various instruments used in the process.
UNIT I: PRINCIPLES OF THERAPEUTIC DRUG MONITORING


Guidelines for routine therapeutic monitoring.

UNIT II: RATIONALE OF THERAPEUTIC DRUG MONITORING


UNIT III: DETERMINATION & INTERPRETATION OF PLASMA CONCENTRATION OF DRUGS

Bio-availability of drugs- Antiasthmatics- Theophylline, Antibiotics, Anticonvulsants- Carbamezepine, Phenobarbitone, Antidepressants- Lithium, Cardioactive drugs- Digoxin; Controlling therapy by measurement of plasma concentrations.

UNIT IV: ACUTE POISONING AND EMERGENCY METHODS


UNIT V: DRUGS OF ABUSE

Drug dependence, Principal effects, Classification of drugs of abuse, stimulants, Depressants, Hallucinogens, Rationale of Drug abuse screening, Analysis and Screening techniques.

REFERENCES:

6 Wong, S H Y 2003. Therapeutic Drug Monitoring and Toxicology by Liquid Chromatography, Publishers Marcel Decker, UK.
7. Steven H Y Wong, Arving Sunshine, Irving Sunshine, 1999, Handbook of Analytical Therapeutic Drug Monitoring and Toxicology, CRC Press, USA.
8. Walker, S W. 2005. Recent Developments in Therapeutic Drug Monitoring and Clinical Toxicology. Publisher: Marcel Dekker, UK.