

**SYLLABI & COURSES OF STUDIES**  
**FOR**  
**M.PHIL CHEMICAL PATHOLOGY**

## **A. MAJOR(COMPULSORY )COURSE:**

▪ MCQs Papers	150 Marks	150 Items	3 Hours
▪ SEQs Papers	150 Marks	15 Items	3 Hours
▪ Viva voce&			
▪ Practical Examination =	100 Marks		
▪ <b>Total</b>	=	<b>100 marks</b>	

## **B. OBJECTIVES OF THE COURSE**

The objectives of the 2 years training programme in M.Phil. Chemical Pathology are:

- To teach the basic concepts and principals essential for chemical pathology laboratory practices.
- To teach Clinical Interpretation of the laboratory test results and Pathophysiology of associated disease states.
- To train the student to operate various Instruments & procedures in the laboratory.
- To develop in the students concepts of Quality Assurance in Laboratory work and to teach its practical applications.
- To teach lab management, including workload assessment, cost assessment, troubleshooting and development of SOPs & IPPs for the lab.
- To teach concepts, methodology & purpose of research work, preparing demand for carrying out research and writing synopsis & thesis.

## **C. FINAL TARGETS**

At the end of 2 years of training programme the trainee should be able to:

- Carry out the correct technique of collection & handling of various specimens.
- Comprehend the significance of patient preparation, sample requirement for a particular test & analyte stability to produce quality results.
- Operate independently Instruments & procedures used in Chemical Pathology lab.
- Perform different assays on semiautomatic & automatic instruments with achievable analytical accuracy & reproducibility.
- Understand and implement Quality Control procedures in the lab.
- Interpret critically the results of lab investigations in the context of the clinical profile.
- Do trouble shooting of pre-analytical, analytical and post-analytical errors.
- Carry out lab management including development of SOPs & IPPs.

## **D. CONTENTS OF THE MAJOR COURSE**

### **UNIT I**

#### **BASIC PRINCIPLES AND PRACTICE OF CLINICAL CHEMISTRY**

##### **1. Hazards in Chemical Pathology Lab and Safety Procedures.**

The course includes hazards from dangerous chemicals, Infection hazards, apparatus and building hazards, with special emphasis on safety guidelines procedures and first aid treatment.

##### **2. Specimen Collection and Handling**

The course includes requirements for request forms, collection of blood & various body fluids, description of vacuum tubes used for phlebotomy, effect of anticoagulants, stability studies and interference studies (physiological and biological factors affecting the analytes).

##### **3. Basic Laboratory Techniques and Equipment**

The course includes study of:

- Components, Principles, Operation and Maintenance of Basic Laboratory Equipment including Centrifuge, balances, automatic pipettes, water bath, incubators, refrigerator, freezer, glass and plastic ware, deionizer, distillation plant etc.
- Structure of SI Units, conversion factors from old system of units to SI Units, Units in clinical enzymology and Standardized reporting of lab results.

##### **4. Instrumentation**

- Description of features, principles, working and maintenance of major instruments
- Comparison of different instruments and criteria for selecting an analyzer according to work load, utilization of reagents, technologists available and labour costs with special emphasis on different techniques in Spectrophotometry, Mass spectrometry, Fluorometry, nephelometry, turbidimetry, Electrolyte analyzers, Acid Base & Gas analyzers, Electrophoresis, Chromatography, radioimmunoassays, ELIZA and PCR.

##### **5. Quality Control and Reference Ranges**

The course includes:

- Concept of Quality control (QC), Explanations of terminology used in QC e.g. Accuracy, precision, specificity & sensitivity, procedures to asses QC e.g. Levy-Jenning charts, Cusum plots etc. and rules applied to QC data e.g. Westgard's rules

- Advantages and disadvantages of various control materials
- Assessment of various techniques for determining reference ranges and reportable ranges
- External quality assessment, proficiency testing programme, identification of sources of analytical and pre analytical errors.

## **6. Lab Management**

- Review of laboratory and hospital organizations, attendance in departmental meetings, discussion about day to day management, job description, scheduling workload, selection of instruments and procedures, troubleshooting and risk management
- Awareness of certification and accreditation programs and preparation of standard operating procedures, Human resource management, Financial, space and facility management.

# **UNIT II**

## **CRITICAL CORRELATIONS AND ANALYTICAL PROCEDURES**

### **1. Carbohydrates**

- Carbohydrate metabolism, maintenance of extra cellular glucose, Hormones concerned with glucose metabolism with special emphasis on Insulin
- The disorders of carbohydrate metabolism, hyperglycemia, diabetes mellitus and hypoglycemia
- Investigation of disorders of carbohydrate metabolism, estimation of glucose in serum and other body fluids, Glycosylated Haemoglobin, Insulin and insulin antibodies
- Inborn errors of metabolism, Glycogen storage diseases.

### **2. Lipids**

- Plasma lipids, lipoprotein metabolism, disorders of lipid metabolism, investigation of lipid disorders
- Analytical techniques available for estimation of Cholesterol, Triglycerides, HDL-C, LDL-C, with special emphasis on standardisation, precision and current recommendations on detection of lipemia
- Problems arising in determination of reference ranges for lipid profile
- Clinical significance of lipoproteins and hyperlipoproteinemia.

### **3. Protein**

- Plasma Proteins, Inflammatory response, Acute phase proteins
- Immune response, Disorders of B-cells & T-cells
- Immunoglobulins and complement proteins
- Methods of assessing Proteins in serum, urine & other body fluids
- Indications of Protein, albumin & globulin estimation, Protein Electrophoresis normal pattern and changes in disease states

### **4. Plasma Enzymes**

- Assessment of cell damage and proliferation
- Abnormal plasma enzyme activities, enzyme kinetics, enzyme pattern in diseases, with special emphasis on Myocardial infarction, liver and bone diseases
- Estimation of Transaminases, LDH, CK, CKMB, ALP, ACP, GGT, cholinesterase, acid phosphatase and amylase in serum and other body fluids.

### **5. Intestinal Absorption; Gastric and Pancreatic Functions**

- Normal digestion and absorption including Gastric & Pancreatic function
- Special emphasis on differential diagnosis and investigation of Malabsorption Syndrome, Steatorrhoea and failure of absorption of specific substances.

### **6. Liver and Gall Stones**

- Function of Liver, diseases of liver with special emphasis on Hepatitis, Cirrhosis, Cholestasis and liver failure, Bilirubin, Jaundice and metabolic disorders of liver
- Investigations of liver diseases
- Formation and detection of Bile acids and Gall stones.

### **7. Renal function, Uric Acid and Renal Calculi**

- Renal Physiology, clinical syndromes associated with kidneys
- Acute and chronic renal failure, Uraemia and Nephrotic Syndrome with special emphasis on Pathophysiology and Investigations of renal diseases, oliguria, polyuria, renal calculi
- Urate metabolism, Hyperuricemia, Gout, and Hypouricemia, Clearance studies, dialysis and renal transplantation.

### **8. Electrolyte and Water Metabolism**

- Water and Sodium balance, hormones associated with it i.e. , Aldosterone, Renin-Angiotensin and Antidiuretic hormone

- Relationship between Hydrogen and Potassium ions
- Disturbances & Investigations of water and electrolyte balance, measurement of serum electrolytes and urinary & intestinal losses.

### **9. Acid Base Balance and Blood Gases**

- Hydrogen ion homeostasis, buffer systems
- Disturbances of hydrogen ion, acid base balance and investigations of Acidosis and Alkalosis
- Blood Gas estimations, Arterial pH and pCO<sub>2</sub> estimations

### **10. Calcium, Phosphate and Magnesium metabolism**

- Factors effecting total plasma Calcium, Parathyroid hormone, Calcitonin, Vitamin D
- Disorders of Calcium Metabolism, Hypocalcaemia, Hypercalcaemia
- Tests for diagnosis of calcium disorders
- Abnormalities of Phosphate and Magnesium metabolism.

### **11. Haem and Iron Metabolism**

- Biosynthesis of Haemoglobin
- Disorders of Haem synthesis, various types and investigations of Porphyrias
- Iron metabolism, absorption, excretion and transport, factors effecting plasma iron concentration
- Estimation of serum iron, TIBC, Ferritin and investigation of Anaemia.

### **12. Endocrinology**

- General endocrine functions, hormones and their mechanism of action, regulation and receptors
- The endocrine functions and regulation of hypothalamus, pituitary gland, adrenal cortex, thyroid, parathyroid and gonadal hormones
- Assessment of pituitary, adrenal and thyroid functions by dynamic function tests
- Effects of abnormal levels of cortisol, aldosterone, rennin angiotensin, catecholamines, serotonin, thyroid hormones and gonadal hormones including infertility evaluation and assessment in male and female
- Clinical usefulness of urinary free cortisol, testosterone, DHEAS, androstenedione, sensitive TSH and free T<sub>4</sub> and T<sub>3</sub> tests, stimulation and suppression tests
- Laboratory investigation of patients with hypothyroidism, hyperthyroidism, Cushing's syndrome, Addison's disease, Conn's syndrome, pheochromocytoma, hirsutism, infertility, congenital adrenal hyperplasia and prolactinoma

### **13. Inborn Errors of Metabolism**

- General principles of inheritance
- Diseases due to inborn errors of metabolism
- Disorder of amino acid metabolism
- Disorders of carbohydrate & lipid metabolism
- Disorders of transport mechanism and storage defects with special emphasis on clinical importance, diagnosis and screening of inborn errors of metabolism and neonatal screening, techniques for detection of inborn errors of metabolism

### **14. Tumour markers**

- Definition, classification and distribution of tumour markers
- Proteins, enzymes, hormones, oncofetal antigens, carbohydrates etc.
- Hormonal effect of tumours in non-endocrine tissues
- Non hormonal peptides as indicators of malignancy
- Desirable features of a tumour marker
- Clinical usefulness and tests for common tumour markers e.g. AFP, CEA, HCG, PSA, PAP, HIAA, HVA, CA125, CA19-9, catecholamines and immunoglobulins

### **15. Pregnancy and fetal assessment**

- Physiological changes seen in pregnancy
- Role of lab in assessment of fetal lung maturity
- Clinical usefulness of HCG assays in normal pregnancy
- Maternal serum screening for open neural tube defects and Down syndrome including tests for amniotic fluid L/S ratio, AF, serum HCG glucose challenge tests
- Screening guidelines for different diseases.

### **16. The Cerebrospinal fluid and other body fluid**

- Examination of CSF and other body fluids with special emphasis on biochemical estimations, measurement of total proteins, individual CSF protein concentration and abnormal CSF protein synthesis

### **17. Therapeutic Drug Monitoring and Toxicology**

- Basic concepts of monitoring drug treatment
- Factors affecting plasma concentration and its relation with cellular effects

- Indications for measuring drug concentrations to monitor treatment
- Monitoring side effects of drug treatment and investigation of known or suspected over dosage
- Analytical technique, advancements and application, screening procedures for detection of drugs, drugs of abuse e.g. amphetamine, barbiturates, cannabis, cocaine etc.

## **Practical Training in Chemical Pathology**

- Practical competencies in preparation of solutions, use of pipettes, balance, volumetric flasks and other standard glass ware.
- Use of PH meter, centrifuge, UV, VIS, Spectrophotometer, automated chemistry analyzer, atomic absorption spectrophotometry, chromatography, ELISA, electrophoresis and ion selective electrodes analyzer.
- Practical competence, performance, methodology and interpretation of all tests performed by semi automated and automated analyzer.
- Calibration/Maintenance/Quality control of all laboratory procedures.
- Preparation of the standard curve.
- Mathematical calculation used in the laboratory.
- All end point estimations (all basic parameters e.g. glucose, urea, uric acid, creatinine, cholesterol, triglycerides, plasma proteins and bilirubin estimation).
- All enzyme assays in laboratory diagnostics (e.g. Serum Transaminases, Serum Phosphatases, amylase, LDH, GGT and CPK).
- Serum electrolyte estimation (e.g. K, Na, Ca and phosphate)
- Urine chemical examination.
- Estimation of other parameters by immunoassay techniques (e.g. Hepatitis B viral antigens and antibodies, Hepatitis C viral antibodies, Thyroid profile, FSH, LH etc).
- Estimation of blood gases.
- Sample Collection.
- Reference ranges and conversion factors.
- Preparation of the Standard operating procedures (SOPs).



## **1<sup>st</sup> Minor Course:**

### **General Pathology**

1st Minor=100 Marks      100 Items                      2 Hours

## **2nd Minor (Elective) Course:**

2nd Minor=100 Marks      100 Items                      2 Hours

One elective course shall be selected from the following:

- Haematology
- Microbiology
- Immunology/Serology
- Morbid anatomy & Histopathology

## **Thesis:**

Thesis Examination = 200 Marks

## Recommended Books

Short Text Books of Chemical Pathology (Hodder & Stoughton London)	Baron
Clinical Chemistry and Metabolic Medicine	Martin a crook
Clinical Chemistry	Michael I. Bishop
Tietz Applied Laboratory Medicine	Mitchell G Scott
Clinical Diagnosis by Laboratory Examination (Appleton-Century Crafts Inc. New York).	Kolmer
Clinical Chemistry in Practical Medicine (Livingston, Edinburgh.)	Stewart and Dunlop
Varley's Practical Clinical Biochemistry	Alan H Gowaenlock
Clinical Chemistry and Molecular Diagnostics	Norbert W. Teitz
Clinical Chemistry	William J Marshal
Henry's Clinical Diagnosis and Management by Laboratory Methods	Richard A Mcpherson