**UNIVERSITY OF PAPUA NEW GUINEA**  
**SCHOOL OF MEDICINE AND HEALTH SCIENCES**  
**DIVISION OF BASIC MEDICAL SCIENCES**  
**DISCIPLINE OF BIOCHEMISTRY AND MOLECULAR BIOLOGY**  
**BACHELOR IN MEDICAL LABORATORY SCIENCES – BMLS YEAR 3**

**CLINICAL BIOCHEMISTRY – 1:**  
**FIRST SEMESTER: 2010**

**COURSE CODE:** 2.34803 **CREDIT POINTS:** = 3  
(Two lectures, a tutorial and three hours practical each week)

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**AM = Assoc Prof. A. Masta;**  
**VJT = Assoc Prof. V. J. Temple**  
**GG = Mr. G. Gerega;**  
**NW = Mr. Nigani Willie;**

Assessment at end of semester:  
Practical classes and Assignments (60%); Examination (40%)
CLINICAL BIOCHEMISTRY – II

SECOND SEMESTER: 2010

CREDIT POINTS = 3
COURSE CODE: 2.34804

(Two lectures, a tutorial and three hours practical – attachment at the PMGH Clinical Chemistry Laboratory each week)

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Quality Assurance in Clinical Chemistry: Mr. G. Gerega
Quality Laboratory procedures, Quality Control, Quality Assessment, Quality Improvement and Quality Planning; Control of Pre-analytical and Analytical variables; Specimen Collection and Processing; Factors affecting composition of body fluid; Control Materials/Charts. Establishment and uses of reference values; SI units; Safety Issues

Fluids and Electrolytes: Assoc. Prof. V. J. Temple
Define electrolytes and fluids balance. Major electrolytes in plasma; Distribution of electrolytes & H₂O in intra and extracellular fluids (extra and intracellular compartmentalization); Importance of Na⁺, K⁺, HCO₃⁻, Mg²⁺ and other ions, Osmolality/osmotic controls, chloride shift in red cells, sodium/water cycle balance; Disorders of fluid & electrolyte absorption. Renin-Angiotensin-Aldosterone system; Control of ADH secretion; Hypothalamic Regulation of water balance, causes of depletion & excess of H₂O; Pathophysiology of Hyponatraemia in SIADH. Hyponatraemia and Hypokalemia (causes); Determinants of Renin release & control of ECF volume and osmotic pressure; Atrial Natriuretic peptide (ANP): effects on Na⁺ and H₂O

Renal Function: Assoc. Prof. V. J. Temple
Functions of the Kidney – to include endocrine links in the kidney and hydrogen ion excretion in the kidney; Test for Glomerular function: to include understanding of Clearance, Creatinine Clearance, collection of urine, Serum Creatinine and Urea, Proteinuria; Renal Tubular Function: to include Tubular dysfunction, Investigation of tubular function – osmolality measurements in plasma and urine, water deprivation test, acid load test, specific proteinuria, glycosuria, aminoaciduria; Specific Tubular defects: Renal stones, urinalysis; Acute Renal Failure – an overview and Post-renal obstruction, Renal (nephron damage); Chronic Renal Failure – an overview: to include – sodium and water metabolism, potassium metabolism, acid-base balance, calcium, and phosphate metabolism.

Gastric, Pancreatic & Intestinal Function: Assoc. Prof. A. Masta
Gastrointestinal hormones (Gastrin, CCK, Secretin, VIP, GIP, others); Enzyme of the Gastrointestinal system; Enzymes of the Gastric content, Pancreatic enzymes, enzymes of the Intestinal Mucosa; Gastric Function Tests (Gastric residue and its components); Tests for Pancreatic Exocrine function (Secretin test, Secretin-CCK test, Trysin and Chymotrypsin in stool); Gastric, pancreatic & intestinal Diseases (major gastric diseases, pancreatic/intestinal diseases, mal-digestion & mal-absorption).
Lipids and Lipoproteins – Diagnostic significance: Mr. G. Gerega
Overview: Malabsorption of lipids. The interrelationship between plasma Lipids, Lipoproteins and Apolipoproteins; Disorders in plasma Lipoproteins; Hyperlipoproteinemia / Hypolipoproteinemia; Methods for investigating plasma Lipoprotein disorders; The Basic Principles of methods for Lipid and Lipoprotein diagnostic tests

Carbohydrate Homeostasis: Assoc Prof. V. J. Temple
Glucose homeostasis: to include the following – the need for glucose; disposal of high glucose intake (role of insulin). Glucose homeostasis during fasting: to include role of the liver (utilization of hepatic glycogen – role of glucagon); the skeletal muscle; Gluconeogenesis; regulation of Gluconeogenesis; Hyperglycemia and Hypoglycemia – to include effect of the insulin counter-regulatory hormones; Diabetes mellitus: IDDM and NIDDM – Overview. Diagnosis of Diabetes mellitus: to include urine testing, blood glucose (random blood glucose, fasting blood glucose, Oral Glucose Tolerance Test – to include interpretation of OGTT); Monitoring of DM: to include long-term indices of diabetic control; glycated hemoglobin; fructosamine; microalbuminuria. Laboratory investigation of hypoglycemia: to include blood glucose; plasma insulin; insulin/glucose ratio; plasma C-peptide.

Liver Function Tests: Mr. G. Gerega
Liver function tests (LFTs) and their significance; Biochemical parameters for LFTs – Bilirubin, AST, ALT, ALP, Total Protein, Albumin, GGTP, 5’-Nucleotidase, Prothrombin time. Significance and critical assessment of each parameter used. Answers to two frequently asked questions about LFTs; Hyperbilirubinemia and Jaundice – Laboratory assessment

Thyroid Hormones & Thyroid Function Tests: Assoc Prof. V. J. Temple
Secretions of Thyroid Gland. Thyroid Hormongenesis (secretion & formation in thyroid cell); Structures & functions of Thyroid hormones & Iodinated Metabolites; Synthesis of iodine-containing thyroid hormone, metabolism of Iodine; Biological actions of thyroid hormones, transport (role of Thyroglobulin & albumin) & metabolism; Regulation of TSH; Clinical significant of Thyroid hormones; Hypothyroidism; Hyperthyroidism; Goiter (Iodine - deficiency & treatment; Evaluation methods for thyroid functions; Inherited defects of thyroid hormones

Parathyroid Hormones: Assoc Prof. A. Masta
Functions of parathyroid gland (PTH); Secretions and functions of Calcitonin; Paget’s disease; Clinical significance of Parathyroid hormones; Hypoparathyroidism; Hyperparathyroidism; Cretinism

Diagnostic Test for Gonadal Function: Assoc Prof. V. J. Temple
Hormone-Receptor Interactions. Mechanism of action of Lipophilic hormones (with special reference to Steroid hormones). Hormone Response Element (HRE); Sex Steroid Hormones; Hypothalamic – Pituitary – Gonadal Axis. Male Gonadal function; Disorders of Male Sex Hormones; Female Gonadal function; Disorders of Female Sex Hormones; The Andrenal Screen in Female; Endocrine Investigation in the Sub-fertile Female

Diagnostic Tests for Adrenal Function – Diagnostic tests: Mr. G. Gerega
Some causes and consequences of Adrenal Insufficiency (Adrenocortical Hypo-function): Adrenal insufficiency or (Adrenocortical insufficiency), Primary, Secondary, or Tertiary, Primary adrenocortical insufficiency, or Addison's disease, (insufficient hormone production, congenital adrenal hyperplasia (CAH), enzyme inhibitors (e.g., Metyrapone), or cytotoxic
agents (e.g., mitotane); Secondary adrenal insufficiency; Tertiary adrenal insufficiency; Biochemical features of Adrenal Insufficiency (Hyponatremia, Hyperkalemia and Elevated serum urea); Screening and Diagnosis test for Adrenocortical Insufficiency (Failure); Definitive test for the Diagnosis of the condition: The short Cosyntropin (also called Synacthen, Cortrosyn or Tetracosactrin); Prolonged Cosyntropin-stimulation (Rose) test. Diagnosis of Secondary Adrenocortical Insufficiency; Depot (long) Synacthen Test;

**Nucleic Acid biochemistry and Diagnostic Application: Assoc Prof A. Masta**

Review Nuclei Acid/Composition and Structure. Review DNA replication, transcription and protein synthesis. Nucleic Acid Enzymes: Tools for Molecular Biology (restriction enzymes, DNA polymerase, DNA ligase, reverse transcriptase). Developments in molecular biology and DNA recombinant technology (nucleic and hybridization, DNA sequencing, RFLP, DNA amplification); Polymerase Chain Reaction (PCR) and its Applications. Techniques used in detection of Genetic Variation. Diagnostic Application (detection of infectious agents, genetic diseases, HLA typing, malignant genes/cells, forensic medicine)

**Tumor Markers: Assoc Prof. A. Masta**

Some of the most commonly measured tumor markers; Human Chorionic Gonadotropin (HCG); Alpha-Fetoprotein (AFP); Lactate Dehydrogenase (LDH); Prostate-Specific Antigen (PSA); Prostatic Acid Phosphatase (PAP); Carcinoembryonic Antigen (CEA); Neuron-Specific Enolase (NSE). Other tumor markers of importance: CA 125; CA 19-9; CA 15-3; CA 27-29

**Clinical Enzymology: Assoc Prof. V. J. Temple / Mr. N. Willlie**

Enzymes of clinical interest: Acid phosphatase (ACP); Transaminases: Alanine aminotransferase (ALT, old name is SGPT); Aspartate aminotransferase (AST, old name is SGOT); Alpha-Amylase (AMS); Alkaline phosphatase (ALP); Creatine kinase (CK); Gamma-Glutamyl-transferase (GGT); Enzymes in Liver function test – See Lecture notes on Liver Function Test (Term 2, 2001) for the significance of the enzymes in the diagnosis of LFT. Glucose 6-phosphate dehydrogenase (G6PD); Lactate dehydrogenase (LDH or LD); Lipase (LPS); Plasma cholinesterase; Enzymology and a Heart Attack (MI); Summary of some of the most important clinical enzymes.

**Porphyrans and Porphyrin Disorders (Porphyrias): Mr. G. Gerega**

Porphyrans and their significance; Biosynthesis of Porphyrin and Heme – an overview; Types of Porphyria (to include erythropoietic and hepatic); Porphyrin disorders (Porphyrias) – AIP, HC VP, and PCT; Diagnosis of Porphyrias. Limitations in the diagnosis of porphyrias

**Assessment: Projects, Class Assignments and PMGH Attachment (60%); Examination (40%)**

**Recommended Textbooks:**