Endocrine Function, Homeostasis, and Metabolism Module- Year 2 Semester 1

Credits – 7

Duration: 07 Weeks (35 days)

Topic	Objectives	Time	Department	T/L activity
	Student should be able to:			
2007-2/SBM-8/1 Introduction	1. Explain the significance of homeostasis. 2. Explain the role of the Endocrine system in relation to homeostasis and metabolism 3. Understand the importance of endocrinology in Medicine	1 hr 1 hr	Biochemistry Medicine	Lecture 1 hr Lecture 1 hr
2007-2/SBM-8/2 Homeostasis	1. Explain the term "internal environment" 2. Explain the role of organ systems in maintaining homeostasis 3. Explain the characteristics of feedback systems Recall from Foundation Module 2008-1/SBM 1/12 b			Recall based on already provided questions
2007-2/SBM-8/3 Body Fluids **a. Body fluid compartments**	1. Recall the composition of the body in terms of body water, lean body mass and body fat and describe variations in body composition with age and sex. 2. Recall the body fluid compartments and state the percentages of water, concentration of electrolytes and osmolalities of each compartment 3. List the routes of fluid intake and output and recognize that in health, intake equals output. 4. Recognize that the regulatory mechanisms are adjusted to maintain the internal environment constant (homeostasis) 5 Explain the basis for compartmentalization in terms of the following: cell membrane structure and permeability characteristics osmosis, diffusion and facilitated diffusion, and active transport			Recall from Foundation Module
b. Neurohumoral regulation of ECF volume	1 Recall the regulatory mechanisms which maintain extracellular fluid (ECF) Volume with reference to: renin- angiotensin -aldosterone mechanism , osmo receptors and antidiuratic hormone (ADH), thirst mechanism, atrial natriuretic peptide (ANP), low pressure stretch receptors ("volume reflex")			Recall from CVS and Excretion & Reproduction Modules
2007-2/SBM-8/4 **2007-2/CLM-8/1** **a pH** **.** Concept of pH . Buffers . Regulation of pH	1. Recall the terms pH and buffers. 2. State the normal body pH and variations in health 3. Explain the terms acidosis, alkalosis, acidaemia and alkalaemia 4. Explain the basis of the Henderson-Hasselbalch equation 5. Explain the term acid-base buffer system 6. Explain the function of the following buffer systems bicarbonate, phosphate, protein , ammonia	2 hr +3 hr	Biochemistry Obj 1 to 6	Lecture 2 hr Practical 3 hr

b. Acid Base Balance **Anion gap** **c. Electrolyte imbalance and its effects**	1. Explain the terms: respiratory acidosis and alkalosis, metabolic acidosis and lkalosis, indicate the causes of each abnormality and explain the basis of the pH-bicarbonate diagram 2 Be able to calculate the normal anion gap List causes of raised anion gap metabolic acidosis. List causes of normal anion gap metabolic acidosis State the compensatory mechanisms that occur in the above conditions. Explain the basis of clinical effects in the conditions listed Describe the causes and effects of Hypo and hypernatraemia Hypo and hyperkalaemia Hypo and hypercalcaemia Hypo and hypermagnaesemia	1 hr 2 hr	Anestheseology Anestheseology	Lecture 1 hr Lecture 2 hr
2007-2/SBM-8/5 **Thermoregulation** **a. Introduction**	1. Recognise that man is a homeothermic animal. 2. Explain what is meant by normal body temperature. 3.State the methods and the sites of measurement of core and superficial temperatures of the body. 4. Describe the routes of heat gain and heat loss 5. Discuss the factors affecting heat gain and heat loss State the percentages of heat loss from the different routes in a thermoneutral environment and discuss the changes that take place in different thermal environments.	1 hr	Physiology	Lecture 1 hr
b. Mechanisms of regulation of body temperature	1. Explain the role of sweating, vasodilatation and shivering in maintaining body temperature. 2 Explain the role of non-shivering thermogenesis in heat balance in infants. 3. Describe the role of behavioral factors in the control of body temperature. 4. Explain the role of the hypothalamus in body temperature regulation.	2 hr	Physiology	Lecture 2 hr
2007-2/CLM-8/2 **c. Measurement of body temperature**	1. Measure oral and axillary temperature using a clinical thermometer 2.Measure temperature at different sites (ear drum, axilla, skin	2 hr	Physiology	Practical 2 hr 3 groups
2007-2/SBM-8/5 **2007-2/CLM-8/3** **d. Structure and function of the skin**	1 Describe the structure of the skin 2 Correlate the structure of the skin with its function. 3.Identify the layers of skin, under the light microscope. 4.List cell types found in epidermis and describe their functions, including: keratinocytes, melanoytes, Langerhan cells, and Merkel cells. 5. Compare thick skin and thin skin giving examples 6.Describe the appendages of the skin.	1 hr + 3 hr	Anatomy	Lecture 1 hr Practical 3 hr 3 grouips

	7. Name and state the functions of the sensory receptors of the skin.			
2007-2/SBM-8/6 **Role of Vitamins and Minerals in metabolism**	1. Describe the role of fat-soluble vitamins in various biochemical reactions. 2. Describe the role of water-soluble vitamins as cofactors of metabolic events. 3. Describe the role of minerals in various functions. E.g.: Structural (Ca, P),membrane (Na, K), Catalytic: as prosthetic groups in enzymes (Fe, Cu), regulatory Ca, Se	4 hr	Biochemistry	Lecture 4 hr
2007-2/SBM-8/7 **2007-2/CLM-8/4** **Functional organization of the endocrine system** a. General characteristics; chemical messengers b. Structure of hormones	1. Recognise that the endocrine system is concerned with regulation of different metabolic functions of the body. 2.Recognise that there is a close interaction between the two control systems of the body, viz. the nervous system and the endocrine system. 3. Define the term 'hormone'. 4. List the biochemical types of hormones. 5. What is a signal transduction pathway ? 6. Explain hormone-receptor interaction and list the sites of hormone receptors. 7. Explain the mode of actions of a steroid hormone and a peptide hormone. 8. Explain giving examples the terms: local hormones and general hormones. 9. Explain the terms first messenger and second messenger and explain the role of G proteins, cyclic AMP, cyclic GMP, Tyrosine kinase, Ca2+, and other second messenger systems in controlling cell function. 10. List the hormones of the following: Hypothalamus, Pituitary, Thyroid, Parathyroid, Adrenal cortex and medulla, Gonads and placenta, Endocrine pancreas Gastrointestinal system, Kidney, Heart and vascular endothelium, Pineal gland	5 hr	Biochemsitry	Lecture 3 hr SGD 2 hr
c. Basic structure and development of endocrine organs	**Endocrine System** 1. State the differences between exocrine and endocrine glands. **Pituitary gland** 1. Describe the development of the pituitary gland. 2. State the component parts of the pituitary gland. 3. Describe the hypothalamo- hypophysio portal system. 4. Describe the neurovascular connections between hypothalamus and pituitary. 5. Describe and identify the light microscopic appearance of the pituitary gland. 6. State the cell types and the functions of the cells in the in the anterior and posterior pituitary. **Thyroid Gland** 1. Describe the development of the thyroid gland 2. Describe the gross anatomy of the thyroid gland 3. Describe and identify the light microscopic appearance of the thyroid gland 4. Describe the blood supply of the thyroid gland **Adrenal Gland** 1. Describe the development of the adrenal gland	6 hr	Anatomy	Lecture 3 hr + Practical 3 hr 3 groups**.**

	2. Describe the gross anatomy of the adrenal gland 3. Describe the light microscopic appearence of the adrenal gland 4. Describe the blood supply of the adrenal gland **Endocrine Pancreas (Islets of Langerhans)** 1. Recall the gross anatomy and the blood supply of the pancreas 2. Recall the light microscopic appearence of the pancreas 3. State the different cell types, present in the islets of Langerhans and their functions 4 State the development of islets of Langerhans			
2007-2/SBM-8/8 Imaging of the endocrine system	Be aware that endocrine organs can be imaged for evaluation of structure and function	2 hr	Radiology	Lecture demonstration 2 hr
2007-2/SBM-8/9 Measurement of Endocrine Function a. Quantitative tests b. Functions of target organs c. Suppression and stimulation tests **2007-2/CLM-8/5 Basis of Testing endocrine function**	List the biochemical investigations used to asses the functions of the endocrine organs List dynamic endocrine tests Be able to interpret the results of the above tests **Student should be able to:** 1. List the tests which are based on a. negative feedback mechanism b. measurement of serum levels of the hormones c. measurement of by-products of hormones 2. Explain the physiological basis of interpretation of the above tests	2 hr 3 hr	Medicine NMU	Lecture demonstration 2 hr 3 hr Practical Demonstration
2007-2/SBM-8/10 Pituitary and hypothalamus a. Structure and relations b. Hormones - biochemistry c. physiology - control	**Student should be able to:** **Hypothalamus** 1. Recognise that the hypothalamic factors/hormones are synthesised in hypothalamic neurones, transported via axons and secreted at nerve endings in posterior pituitary. 2. List the hypothalamic releasing factors/ hormones involved in regulating the secretions of the anterior pituitary gland.. 3. Describe the functions of each of these hormones. 4. Explain the mechanisms of regulation of the hypothalamic hormones. 5. Describe the modes of transport of these hormones in the blood. **Pitutary (Anterior and Posterior)** 6. Describe the function of the hypothalamo-hypophysial portal system. 7. State the different types of cells responsible for their secretion.	2 hr	Biochemistry	Lecture 2 hr

	8. Describe their actions on target tissues, glands and organs. 9. Describe the regulation of secretion of Anterior pituitary hormones 10. Describe the role of somatomedins in mediating the actions of growth hormone.	2 hr	Physiology	Lecture 2 hr
	11 List the hormones of the posterior pituitary gland 12 Describe their synthesis and transport to the post pituitary gland 13 Describe their actions on target tissues, glands and organs 14 Describe the regulation of these hormones	1 hr	Physiology	Lecture 1 hr
2007-2/SBM-8/11 **Hypopituitarism and hyperpituitarism**	1 Describe the effects of hypo and hyper secretion of the hormones secreted by the pituitary gland 2 Describe the effects of the enlargement of the gland	2 hr	Physiology	Lecture 2 hr
2007-2/SBM-8/12 **Thyroid** a. Functional anatomy b. Biochemistry of thyroid hormones c. hypothalamic-pituitary-thyroid axis	1 Recall the gross anatomy of the thyroid gland 2. Recall the microscopic anatomy of the thyroid gland 3. Recall the structural differences in the thyroid gland in relation to the state of activity 4. List the hormones secreted 5. Describe the steps involved in the synthesis and storage of thyroid hormones. 6. Describe the process of release of thyroid hormone into the blood. 7. List the proteins that bind thyroid hormones in plasma. 8. State the relationship between bound and free thyroid hormonesinblood. 9. Explain the mechanism of action of thyroid hormones at a cellular level. 10. Describe how thyroid hormones are catabolised. 11. Explain the mechanisms by which the secretion of thyroid hormones is regulated 12. Describe the actions of thyroid hormones on metabolism, development and on organs and systems**.**	2 hr 1 hr	Biochemistry Physiology	Lecture 2h Lecture -1 hr
2007-2/SBM-8/13 **Derangement of thyroid function**	Physiological basis in hyper and hypo function of the thyroid gland List the anti thyroid substances that effect the thyroid function and describe their mechanism of action	1 hr	Physiology	Lecture 1 hr
2007-2/SBM-8/14 **2007-2/CLM-8/6** **Thyroid function Tests**	Interpret deranged thyroid function test results (T3 T4 TSH, Iodine up take studies)		NMU	Lecture 1 hr Practical 2 hr
2007-2/SBM-8/15 **Parathyroid** **a.** Functional anatomy b. Functions of parathormone, calcitonin, 1-25 DHCC Derangement of calcium and vitamin D metabolism and effects on bone	**Parathyroid** 1. Describe the role of the parathyroid hormone in calcium, phosphate and bone metabolism. 2. Describe the interaction of parathyroid hormone with calcitonin and 1,25-dihydroxycholecalciferol. 3. Describe the effects of parathyroid hormone on the kidneys bone intestine 4. Describe the control of parathyroid hormone secretion Describe the clinical features and their physiological basis in hyper and hypo function			Recall From Locomotion Module

	of the parathyroid gland Describe the derangements of vitamin D and Calcium metabolism			
2007-2/SBM-8/16 **Adrenal cortex** a. Functional anatomy b. Biochemistry of hormones c. Hypothalamo-pituitary-adrenal cortical axis	1. Recall the development of the adrenal gland 2.Recall the gross anatomy of the adrenal gland 3. Recall the blood supply of the adrenal gland 4.Recall the microscopic anatomy of the adrenal gland 5. List the hormones secreted by each layer of the adrenal cortex 6. Describe the regulation of secretion of adrenocortical hormones 7. Describe how they are transported in blood 8.State the cyclical pattern of secretion of glucocorticoids and their regulatory hormones. 9.Describe the effects of each of the adrenocortical hormones	2 hr	Physiology	Lecture 2 hr
2007-2/SBM-8/18 **Endocrinology of control of blood pressure**	Explain how endocrine dysfunction leads to abnormal blood pressure			Recal from CVS Module
2007-2/SBM-8/19 **Adrenal medulla** **a.** Functional anatomy b. Biochemistry of horones	1. List the catecholamines secreted by the adrenal medulla and outline the steps in their biosynthesis 2. Describe the actions of the catecholamines including the effect on metabolism. 3. List the principal metabolites of adrenaline and noradrenaline 1.List the stimuli which increase adrenal medullary secretions 2.Recall the features of the 'fight or flight' reaction 3.Discuss the interaction between the adrenal medullary hormones and the sympathetic nervous system	1 hr 1 hr	Biochemistry Physiology	Lecture 1 hr Lecture 1 hr
2007-2/SBM-8/17 **Derangement of adrenal function**	Describe the clinical features and their physiological basis in hyper and hypo function of the adrenal gland	2 hr	Medicine	Lecture demonstration 2 hr
2007-2/SBM-8/20 **Endocrine pancreas** a. Functional anatomy b. Hormones	1.Recall the gross anatomy of the pancreas 2.Recall the functional components of the pancreas 3.Recall the blood supply of the pancreas 4.Recall the microscopic anatomy of the pancreas 5.Recall the features of islets of Langerhans 6.Recall the embryological origin of islets of Langerhans 7.List the hormones secreted by the pancreatic islets 8List the steps involved in the biosynthesis and secretion of insulin 9.Describe the insulin receptor. 10 Describe the effects of insulin on the cell. 11 List the cells which do not require insulin for glucose uptake 12 Describe the effects of insulin on carbohydrate, fat and protein metabolism and growth	7 hr	Biochemistry	Lecture 2 hr CCR 5 hrs 2+2+1 hrs

	13 Explain the control of insulin secretion 14 Describe the functions and regulation of secretion of glucagons 15. Describe the physiological effects of somatostatin and pancreatic polypeptide			
2007-2/SBM-8/21 **Glucose homeostasis**	1.Explain the role of liver, intestines, kidney, brain, adipose tissue and muscles in glucose homeostasis 2 Discuss the role of hormones in glucose homeostasis	2 hr	Biochemistry	Lecture 2 hr
2007-2/SBM-8/22 **Molecular basis of glucose homeostasis**	Describe the mode of action of insulin, insulin receptor and glucose transpoters	1 hr	Biochemistry	Lecture 1 hr
2007-2/CLM-8/7 **Glucose Measurement**	1. Measure glucose in blood and urine	3 hr	Biochemistry	Practical 3 hr
2007-2/SBM-8/23 **Derangement of glucose metabolism**	1.Describe the causes of hyper and hypoglycaemia 2.Describe the effects of hyper and hypoglyaemia on different organs and tissues	1 hr	Biochemistry	Lecture 1h
2007-2/SBM-8/24 **2007-2/CLM-8/8** **Derangement of Glucose homeostasis**	Define and explain, Impaired glucose tolerance Impaired fasting glucose Diabetes, Diabetic ketoacidosis Describe the laboratory diagnosis of the above conditions Describe the oral glucose tolerance test Describe the significance of the analysis of glycated Hb in blood and microalbumin in urine	2 + 2 + 3 hr	Biochemistry	Lecture 2 hr SGD 2 hr Practical 3h
2007-2/CLM-8/9 **Tests for glucose homeostasis**	Interpretation of laboratory reports	2 hr	Biochemistry	Practical 2 hr
2007-2/SBM-8/25 **Gonadal Hormones**	1 Recall the gonadal hormones and state the sources from which they are secreted. 2 Recall the effects of Testosterone, , Oestrogens and Progesterone on primary and secondary sexual organs and the rest of the body			Recall from the Excretion and Reproduction Module
2007-2/SBM-8/26 **Other hormones**	1. Describe the role of the gut, kidney, heart, pineal gland and vascular endothelium as endocrine organs	3 hr	Physiology	Lecture 3 hrs
2007-2/SBM-8/27 **Endocrine function and dysfunction**	Round up on endocrine function Round up on endocrine dysfunction	2 hr 1 hr	Physiology Medicine	2 hr SGD 1 hr Lecture
2007-2/SBM-8/28 **2007-2/CLM-8/10** **Disorders of lipid metabolism,** **Mechanisms of dyslipidaemias** **Classification** **Effects on target organs**	Describe the derangements of lipid metabolism, and their molecular basis Classify the lipid disorders according to the molecular defect Describe the effects on target organs	2+2 hr	Biochemistry	Lecture 2 hr Practical 2 hr

2007-2/SBM-8/29 **2007-2/CLM-8/11** **Obesity**	Impact of obesity on health Know the Prevalence Describe the biology of obesity, brown adipose tissue (BAT) and white adipose tissue (WAT)- Distribution, Cells & fat, Thermogenesis in BAT) Adipocyte function- Energy regulation via endocrine, paracrine and autocrine signals (Signals include: Leptins, Agouti, Eicosanoids, Angiotensin II), Leptin concentration & Obesity Other protein signals Eg. Adiponectin, Resistin, IL-6 , TNFa Adiponectin & resistin and insulin sensitivity /resistance Distribution of fat in the body- Central distribution, Peripheral distribution, Waist: hip circumference Treatment- Role of dietary composition, Effect of exercise Prevention Complications of obesity	3+2 hr	Biochemistry	Lecture 3 hr Practical 2 hr
2007-2/SBM-8/30 **DNA Organization and Replication**	1. Describe the organization of DNA 2 Describe the process of replication.	2 hr	Biochemistry	Lecture 2 h
2007-2/SBM-8/31 **RNA Organization & Transcription**	1. Describe the organization of RNA 2 Describe the process of transcription.	1 hr	Biochemistry	Lecture 1 hr
2007-2/SBM-8/32 **Regulation of gene expression**	1. Explain why regulated expression of genes is required. 2. Describe how the gene expression is regulated	1 hr	Biochemistry	Lecture 1 hr
2007-2/SBM-8/33 **Protein synthesis And effect of antibiotics on protein synthesis**	1. Describe the properties of the genetic code. 2. Describe the steps involved in protein synthesis. 3. List the differences between prokaryotic and eukaryotic protein synthesis. 5. Explain the effect of antibiotics on protein synthesis	3 hr	Biochemistry	Lectures 2 + 1 h
2007-2/SBM-8/34 **Post translational Modifications**	1.Describe the post-translational modifications that occur on nascent proteins 2 . State the importance of these modifications **3.** Describe the relevance of these modifications in the formation of functional proteins	2 hr	Biochemistry	Lecture 2 hr
2007-2/SBM-8/35 **Gene expression**	1. Explain how the information required for life is carried in genes.	2 hr	Biochemistry	SGD 2 hr
2007-2/SBM-8/36 **Inborn errors of**	Explain the genetic causes of inborn errors	1 hr	Biochemistry	Lecture 1 hr

metabolism **Basis of inborn errors of metabolism**				
2007-2/SBM-8/37 **Derangements of amino acid metabolism**	Explain the phenylalanine metabolism and its derangements List the types of amino acidurias Describe their effects on normal function	1 hr	Biochemistry	Lecture 1 hr
2007-2/SBM-8/38 **Derangements of carbohydrate metabolism**	Describe the causes and effects of the derangements of fructose and galactose metabolism Describe the causes and effects of the derangements glycogen metabolism Describe the effects of such derangements on organs and tissues	1 hr	Biochemistry	Lecture 1 hr
2007-2/SBM-8/39 **Derangements of lysosomal function And mucopoly-saccharide metabolism**	Describe the molecular basis of the derangement of lysosomal function. Describe the different types of mucopolysaccharides, their metabolism, derangements in metabolism, and methods of detection of such changes Describe the effect on tissues and organs.	1 hr	Biochemistry	Lecture 1 hr
2007-2/SBM-8/40 **Derangements in porphyrin synthesis**	Describe the derangement in porphyrin synthesis and their effects	1 hr	Biochemistry	Lecture 1 hr
2007-2/SBM-8/41 **Derangements in Nucleic acid metabolism**	Explain how the normal metabolism of nucleic acids can be deranged Explain the effect of the accumulation of adenosine/deoxyadenosine, uric acid, xanthine and hypoxanthine in blood	2 hr	Biochemistry	Lecture 1 hr
2007-2/SBM-8/42 **Molecular methods in Medicine**	Describe the basis of the laboratory diagnostic methods available for perinatal detection of IEM Describe the basis of methods available for screening for defective genes	5 hr	Biochemistry	Lecture 5 hr
2007-2/CLM-8/12 **Molecular methods in Medicine**	Describe how DNA is isolated from tissues for genetic analysis	3 hr	Biochemistry	Practical 3 hr
2007-2/SBM-8/43 **Production of hormones by recombinant DNA technology**	Describe the basis of the method involved in the production of human insulin by recombinant DNA technology	2 hr	Biochemistry	Lecture 2 hr
2007-2/SBM-8/44 **Roundup on molecular biology**	Objective Nos. 2007-2/SBM-8/42 & .2007-2/SBM-8/43	2 hr	Biochemistry	SGD 2 hr

Endocrine, Homeostasis & Metabolism Module – (Year 2 Semester 1)
Module Summary

	Lectures (hrs)	PD (hrs)	SGD (hrs)	CCR (hrs)	Total (hrs)
Anatomy	4	6			10
Physiology	15	2	2		19
Biochemistry	56	18	6	5	29
Radiology	2				2
Medicine	6				6
Anestheseology	3				3
NMU		3			3
Total	**86**	**29**	**8**	**5**	**72**

Names and departments of the teachers involved in the teaching programme:

Department of Anatomy
Prof. M. Chandrasekera
Dr. Deepthi Nanayakkara

Department of Biochemistry
Prof. R. Sivakanesan
Dr. P.H.P. Fernando
Dr. HKI Perera
Dr. S.B.P. Athauda
Dr. Shirani Ranasinghe
Dr. Kalana Prasad

Department of Medicine
Dr A Medagama

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Dr. Badra Hewavitharana

Department of Physiology
Dr. Jayantha Rajaratne
Dr. Anula Kariyawasam
Dr. Shamila Rajaratne

Examination Format

Module	Credits	Total duration of examination	MCQ	SAQ	OSPE
Endocrine function, homeostasis and metabolism	7	4	1	1 ½	1 ½