1. COURSE NAME & CREDIT LOAD
COURSE CODE: NTD 205
COURSE TITLE: Human Physiology
NUMBER OF CREDITS: 3 Credits/Compulsory
COURSE DURATION: three hours per week for 15 weeks
As taught in 2010/11 Session

Courseware developed by Clara R. B. OGUNTONA
B. Sc. Biochemistry (Rosario, Argentina), M. Sc. Human Biology (Loughborough, UK) Ph D Community Nutrition (Ibadan, Nigeria)
Email: claraoguntona@yahoo.co.uk
Office Location: COLAMRUD Building, FST location
Consultation Hours: 12 noon – 2 pm, Tuesdays and Thursdays

2. LECTURER DETAILS
As above

3. COURSE DETAILS

3.1 **Human Physiology**
Basic knowledge of the functioning of the normal human body. This is prerequisite to an understanding of the role of nutrients in normal individuals. It is also basic to the study of child development and family studies. Examples of abnormal functioning are given to understand normal functioning.

3.2 Course Content
Water balance, body fluids constituents. Exchange between fluid compartments. Acid-base balance enzymes. Carbohydrates, proteins, fats and their metabolism. Methods of investigating intermediary metabolism. Muscles and muscles contraction. Blood and other body fluid circulation. Oxygen transport, haemoglobin, respiration. Digestive system. Digestion. Absorption. Urine formation and kidney function. Hormones. Homeostasis control. Physiology of pregnancy. Human Growth and development.

3.3 Course Justification
Human Physiology attempts to explain the specific characteristics and mechanisms of the human body that makes it a living being. The very fact that humans remain alive is beyond self control, for hunger determines the seeking of food and fear makes humans look for refuge and so on. Thus the human being is actually an automaton. These special attributes permit humans to exist under widely varying conditions that otherwise would make life impossible.

3.4 Course Objectives
The general objective of the course is to enable students acquire the basic knowledge in the functioning of the normal human body. This is basic to the understanding of the functioning of the various organs and systems of the body which allows a proper study of Nutrition and courses like Growth and Development of the Young Child.
At the end of the course students would be able to

- Understand the principles that regulate the movement of molecules across membranes
- Follow the path of food components through the digestive system
- Understand how the cell obtains the energy to perform its functions
- Explain the functioning of the circulatory system

- Have a good grasp of the transport of Oxygen and CO_2
- Discuss the formation of urine and the functioning of the kidney
- Understand de role of hormones
- Have a basic knowledge of the physiology of pregnancy

3.5 Course Requirements

Students are expected to attend 70 % of course activities to qualify to write the final exam. There will be two continuous assessment tests. The students are also encouraged to study the human body model and three classes (3 hours) would be devoted to this activity.

3.6 Grading Method

ITEM	**SCORE (%)**
Attendance to classes	3
Attendance to lab practicals	3
1st CAT	12
2nd CAT	12
Final Exam	70
Total	100

3.7 Course Delivery Strategies

The course objectives will be delivered through the traditional face to face weekly lecture on the designed topics. The previous lecture would be summarized on consecutive lectures. There would be tutorials with the help of the human body model in the Nutrition Laboratory. Whenever possible IT material would be used to illustrate the lectures. Two Cat tests would be conducted and attendance recorded.

4.0 Lecture Content

Week 1. The role of water in the body. Properties and movement

Objective: Students will have a good grasp of the role of water in the body.

Description:

1st hour: Revision of basic concepts. Water content in the body. Water distribution among compartments. Movement of water across membranes. Characteristics of the water molecule. Solutions, suspensions, colloidal state.

2nd hour: Thermal properties of water. Water density. Specific Heat Capacity. Density and viscosity. Surface Tension. Dissociation of water and the pH scale. Osmotic pressure. Osmosis in human cells. Water balance. Role of the hypothalamus, the rennin-angiotension-aldosterone system and the kidney

Study Questions:

1. How much water is there in the Intracellular fluid?
2. Discuss filtration power and osmotic pressure in the movement of water
3. Why is water such a special molecule?
4. Compare water characteristics with such of similar molecules
5. Explain how a red blood cell will behave when submerged in solutions of different concentrations

Reading List:
1. http://www.biology-questions-and-answers.com/water-properties-and-mineral-salts.html
2. http://encyclopedia2.thefreedictionary.com/properties+of+water
3. Guyton, A. C. 1986 Text Book of Medical Physiology. W.B. Saunders Company. Philadelphia

Week 2: Maintenance of electrolyte balance. Electrolyte composition of body fluids Acid-balance control. The digestive system: introduction
Objective: students will grasp important physiological concepts as stated above
Description:
1st Hour: Concept of neutrality within compartments. Concentrations of electrolytes in plasma, interstitial and intracellular fluid. The role of the kidney in the maintenance of electrolyte balance. Sodium, Chloride, Potassium, Calcium and Magnesium. Control of the concentration of H^+ ions. Acidosis. Acid-base buffers. Respiratory regulation of pH. Renal regulation of pH.
2nd Hour: Supply of organic and inorganic nutrients. Energy needs. Mineral and vitamin needs of the body. Importance of digestion. Mechanical and Chemical digestion. Mechanical digestion: movements of the GIT. Chemical digestion: hydrolytic reactions to release simple nutrients for absorption. Digestion in the mouth. Role of teeth. Role of salivary glands and saliva.
3rd Hour: Laboratory introduction of model, location of organs of the digestive system

Study Questions:
1. Where is potassium reabsorbed in the kidney?
2. Discuss the role of aldosterone in the kidney
3. What is the most important characteristic of the reabsorption of Ca++ in the kidney?
4. What is the pH of the Extracellular fluid? How did you arrive at this figure?
5. It is said that digestion starts in the mouth, explain why?

Reading List:
1. http://www.wisegeek.com/what-is-electrolyte-balance.htm
2. http://www.nanocal.com/electrolyte_balance.htm
3. http://www.nanocal.com/fluid_regulation.htm
4. http://medicinenet.com/electrolytes/article.htm
5. Guyton, A. C. 1986 Text Book of Medical Physiology. W.B. Saunders Company. Philadelphia

Week 3: Organs of the digestive system and their functions in digestion
Objective: To understand the function and working of the different organs that constitutes the digestive system
Description:
1st Hour: Action of salivary amylase, duration of the effect. Other function of saliva. Formation of the bolus. Passage through pharynx. Structure and functions of the esophagus. Peristalsis. The stomach. Regions and structure of the stomach. Gastric mucosa. Secretions of the gastric mucosa. The pH of the stomach. Role of acidity. Secretion of Pepsinogen, mucin and HCl and their functions. Control of gastric secretions. Motility of the stomach. Stomach sphincters.
2nd Hour: The small intestine. Structure and divisions. Origin of enzymes acting in the small intestine. Pancreatic juice and intestinal juice. Bile production and functions. Enzymes secreted by the pancreas and functions. Enzymes secreted by the small intestine and their functions. Hormones regulating the release of enzymes: Pancreozymin, secretin and enterocrinin.
3rd hour: Laboratory study of model and tutorial.

Study Questions:

1. How is the food stopped from entering the trachea?
2. Describe the wall of the esophagus
3. What is peristalsis?
4. What is the function of the HCl acid secreted in the stomach?
5. Describe the secretions taking place in the stomach

Reading List

1. http://biology.clc.vc.edu/courses/bio105/digestiv.htm
2. http://digestive.niddk.nih.gov/ddiseases/pubs/yrdd/Your_Digestive_Sys.pdf

Week 4: The digestive system continues
Objectives: the same as in week 3 plus to get a good grasp of the digestion and absorption of nutrients.
Description:
1st Hour: Nervous control of the pancreas and small intestine. The process of absorption. Peristalsis and segmentation. Formation of chyle. Intestinal mucosa structure. Villi structure. Digestion inside intestinal cells. Fate of lipids, carbohydrates and proteins. Factors affecting absorption of nutrients and water.
2nd Hour: The large intestine. Structure and functions. Intestinal microbes. The role of fibre in the diet. The liver. Structure. Blood supply. Formation of bile. Gall bladder function. Metabolism of carbohydrates, proteins and fat. The role of the liver in the metabolism of iron. Detoxification.
3rd Hour: CD on the structure and functioning of the digestive system. Tutorial.

Study Questions:

1. Explain the factors that affect absorption of nutrients such as vitamin B_{12}, iron, glucose, etc.
2. The small intestine has three segments, which are these and what are the functions of each segment?
3. Is fibre an essential in the diet?
4. Discuss the functions of the bile
5. How is the liver involved in detoxification?

Reading List:

Hunt, S. M. and Groff, J. L. 1990. The Digestive System: Mechanism for Nourishing the Body in: Advanced Nutrition and Human Metabolism. West Publishing Co. St. Paul.
http://science.nationalgeographic.com/science/health-and-humanbody/human-body/digestive-system-article.html

Week 5: The Circulatory System. Blood and its functions.
Objective: To understand the role of the blood cells in the transport of oxygen, nutrients and wastes, coagulation and defense.
Description:
1st Hour: Blood, functions and constituents. Normal blood volume. Plasma. Plasma proteins. Red blood cells(RBCs), normal values. Function and structure. Life span. Production of RBCs during the life span. Regulation of erythropoiesis. Nutrients needed for normal erythropoiesis. Fate of RBCs. Anaemias.
2nd Hour: White Blood Cells. Normal values. Granulocytes. Agranular leucocytes. Functions. Relative numbers of different types. Platelets. Structure and normal values. Plasma: chemical composition and

description of substances in Plasma. Plasma proteins. Non-protein nitrogenous substances in plasma. Other constituents of plasma.
3rd Hour: Laboratory identification of organs of the circulatory system and tutorial.

Study Questions:

1. Which are the normal blood volumes for women and men?
2. Where are blood cells produced?
3. How does the shape of RBCs help its function?
4. Explain the functions of the different plasma proteins
5. Which of the white blood cells have phagocytic properties?

Reading List:
Guyton, A. C. 1986. Text Book of Medical Physiology. W. B. Saunders Co. Philadelphia
Bianco, C. How blood works? Assessed July 2011.
http://science.howstuffworks.com/environmental/life/human-biology/blood.htm

Week 6: Blood Plasma. Circulation
Objective: To acquire knowledge about the role of plasma proteins. To understand the role of the heart in circulation and understand what blood pressure is and how it is generated
1st Hour: Chemical composition of plasma. Water. Albumins, Globulins, Fibrinogen. Non-protein nitrogenous substances. Regulatory substances. Respiratory gases. Electrolytes
2nd Hour: The heart. Structure. Arteries and veins linking the heart to the systemic circulation. The cardiac cycle. Systole. Diastole. The aorta. Pulmonary veins and arteries. Valves. Cardiac output.
3rd Hour: The cardiac impulse. Normal ECG. Blood pressure.

Study Questions:
1. Discuss the functions of albumins and globulins
2. Which is the largest chamber in the heart?
3. How is the blood stopped of going back?
4. What is the normal cardiac output in an athlete?
5. Which are the only arteries carrying deoxygenated blood?

Reading List:
Guyton, A. C. 1986. Text Book of Medical Physiology. W. B. Saunders Co. Philadelphia
http://www.fi.edu/learn/heart
http://www.pbs.org/wgbh/nova/body/map-human

Week 7: Blood Pressure. Blood vessels. Tissue fluid and lymph. Interchange between blood and tissue fluid.
Objectives: Students would be conversant on the regulation of blood pressure. The interchange between blood and tissue fluid would help to understand some of the nutrition problems due to deficiencies.
1st Hour: Generation of blood pressure. Pressure inside the heart chambers. Pressure inside the aorta and pulmonary arteries. Vasoconstriction and vasodilation. Normal blood pressure. Blood vessels. Types of arteries. Arterioles. Capillaries. Venules. Veins. Lymphatic vessels.
2nd Hour: Filtration pressure. Coloidal osmotic pressure. Origin of lymphatic fluid. The lymphatic system. Lymphatic Nodules. Lymphatic organs
3rd Hour: Revision.

Study Questions:
1. What is the pressure inside the right ventricle during systole?
2. What is responsible of the colloidal osmotic pressure?
3. Where does the lymphatic system joins the systemic circulation?
4. What are the differences and similarities between veins and arteries?
5. Which are the forces responsible for the blood return to the heart?

Reading List:
Guyton, A. C. 1986. Text Book of Medical Physiology. W. B. Saunders Co. Philadelphia
http://www.fi.edu/learn/heart/vessels/vessels.html
http://www.innerbody.com/image/card05.html
http://anatowiki.wetpaint.com/page/Lymphatic+system

8th Week: CAT
This is conducted with the class divided in 5 or 6 groups given the number of students usually enrolled for the course. It is done with a multiple choice type of test, and each group gets a different set of questions.

Week 9. Transport of Respiratory Gases. Haemoglobins. Factors affecting transport of gases.
Objectives: Students would understand how oxygen is supplied to the tissues and the factors that affect this process.

1st Hour: Structure of normal Haemoglobin. Site of transport of oxygen. Process of Haemoglobin loading and unloading. Partial pressure of oxygen in the lungs. Effect of temperature, carbon monoxide, carbondioxide tension. Myoglobin. Foetal Haemoglobin.
2nd Hour: Abnormal haemoglobin variants. Talassemia major and minor. Sickle cell haemoglobin. Consequences. Carriage of CO_2
3rd Hour: Tutorial on the genetic bases of abnormal haemoglobins

Study Questions:
1. What state of oxidation does the iron have to be for Haemoglobin to transport oxygen?
2. How saturated with oxygen is haemoglobin in deoxygenated blood?
3. How does smoking affect the oxygenation of blood?
4. How does foetal haemoglobin differ from the normal adult one?
5. What is the difference between normal haemoglobin and sickle cell haemoglobin?

Reading List:
1. Guyton, A. C. 1986. Text Book of Medical Physiology. W. B. Saunders Co. Philadelphia
2. www.medicinenet.com/hemoglobin/article.htm

Week 10. Urine formation and kidney function. The kidney. Blood supply to the kidney. The nephron. Functions. Reabsorption of blood constituents. Secretion. Formation of urine. Regulation of nephron function.
Objectives: to have a clear understanding of the functions of the kidney

1st Hour: Excretion of metabolic waste. Location of the kidneys. Structure of the kidneys. Blood supply, irrigation of the kidneys. Afferent and Efferent arterioles. Types of nephrons. Parts of the nephrons.
2nd Hour: Composition of the glomerular filtrate. Secretion. Selective reabsorption. Diagram of the nephron and the composition of the filtrate. Action of ADH. Regulation of nephrons function.
3rd Hour: Tutorial to discuss the mechanism of urine formation.

Study Questions
1. What is the main difference between afferent and efferent arterioles?
2. How many types of nephrons are there?
3. Desert animals are known to have one type of nephrons, which one?
4. How does ADH work? In which part of the nephrons?
5. What is the countercurrent mechanism?

Reading List:
Guyton, A. C. 1986. Text Book of Medical Physiology. W. B. Saunders Co. Philadelphia
http://www.nsbri.org/HumanPhysSpace/focus4/ep-urine.html

Week 11. The Endocrine System. Hormones. Control of Hormone Secretion Rate: the role of Negative Feedback. Homeostasis Control
Objectives: Hormones are responsible for the control of different metabolic functions of the body, therefore an understanding of their mode of action is vital to understand the utilization of nutrients.

1st Hour: The most important endocrine glands and their hormones. Anterior and posterior pituitary gland. Adrenal cortex. Thyroid gland. Islets of Langerhams in the Pancreas. Ovaries. Testes. Parathyroid gland. Placenta. Chemistry of the hormones. Mechanism of action.
2nd Hour: Glucagon. Insulin. Thyroxine. Parathohormone. Growth Hormone. Epinephrine and Norepinephrine. Cortisol, etc.
3rd Hour: Tutorial on the action of the different hormones.

Study Questions:
1. Explain the feedback mechanism of hormone release
2. Which hormones are produced in the Islets of Langerhams?
3. Which are the functions of thyroxine?
4. What hormone/s are said to be anabolic?
5. How is the secretion of insulin controlled?

Reading List:
Guyton, A. C. 1986. Text Book of Medical Physiology. W. B. Saunders Co. Philadelphia
http://www.endocrineweb.com
http://en.wikipedia.org/wiki/List_of_human_hormones

Week 12. Physiology of pregnancy. Changes in Maternal Physiology during pregnancy. Hormonal Changes. Blood changes.

Objectives: Important knowledge to understand the role of nutrition during pregnancy, given that in countries like Nigeria, undernutrition is still a problem endangering the lives of future generations.

1st Hour: Changes in hormone concentrations during pregnancy. Resistance to insulin. Changes in blood and other fluids. Haemodilution. Changes in renal flow. Weight gain. Nutrient needs during pregnancy. RDAs. Physiological adaptations during pregnancy
2nd Hour: Iodine deficiency during pregnancy and its consequences. Obesity and pregnancy. Gestational Diabetes. Intra uterine growth retardation. Foetal origin of chronic diseases.
3rd Hour: Revision.
Study Questions:
1. What is the recommended weight gain for women with normal BMI at conception?
2. What is considered a normal haemoglobin value for pregnant women? Why?
3. What is the normal weight of the placenta at birth?
4. What is the recommendation for energy intake during pregnancy?
5. Is there a need to eat for two during pregnancy?

Reading List:
Allen L. 2001. Pregnancy and Lactation In: Present Knowledge in Nutrition. Bowman, B. A. and Russell, R. M. Editors. ILSI Press. Washington
King, J.C. 2000. Physiology of pregnancy and lactation. Am.J.Clin. Nutr. 71(suppl):1218S-1225S

Week 13 Second CAT. As before students are divided in groups for this purpose.

Week 14. Human Growth and Development. Growht and Functional development of the foetus. Growth and development of the child. Behavioural growth Periods of rapid growth: in utero, infancy, childhood and adolescence.
1st Hour: Development of the organ systems. The circulatory system. The respiratory system. The gastrointestinal tract. The kidneys. Foetal metabolism.
2nd Hour: Adjustment to extrauterine life. Growth and development of the child. Physical development. Physiological development. Growth charts. Childhood. Adolescent growth spurt.
3rd Hour: Tutorial
Study Questions:
1. How is the acidity of the infants' stomach comparing with that of an adult?
2. When is the myelinization of nerves completed?
3. When does the foetus produce urine?
4. What is the main source of energy for the foetus?
5. Does the new born have proteolytic enzymes?

Reading List:
Guyton, A. C. 1986. Text Book of Medical Physiology. W. B. Saunders Co. Philadelphia
Guthrie, H.A. and Picciano, M. F. 1995. Human Nutrition. Mc Graw-Hill. Boston

Week 15 Revision Exercise
Objective: Students will revise all the topics covered with special reference to the Study Questions and CAT.

Study Questions:

Explain the importance of a large surface area to volume ratio in the red blood cells.
Why is the cardiac output higher in athletes?
Where are the semilunar valves?
Is there any opening between left and right sides of the heart?
How do you calculate filtration pressure at the venular end of the capillaries?
Which are the components of the Extracellular fluid compartment?
Discuss the role of ADH?
Name the buffers of physiological importance
What is the main function of leucocytes?
What happens to the red blood cells after 120 days?