UNIVERSITY OF PUERTO RICO
MEDICAL SCIENCES CAMPUS
SCHOOL OF MEDICINE

PHYSIOLOGY DEPARTMENT

COURSE DESCRIPTION

COURSE TITLE: RENAL PHYSIOLOGY AND BODY FLUIDS

COURSE CODE: FISA 8516

CREDIT HOURS: 36 HOURS

COURSE DURATION**:** **18 WEEKS**

NUMBER OF STUDENTS: 1-10

COORDINATOR NAME: NELSON ESCOBALES, PH.D.

COORDINATOR OFFICE HOURS: **MONDAY-FRIDAY, 9:00AM-5:00PM**

COORDINATOR OFFICE: A-680

COURSE HOURS: 9:00AM-11:00AM

WHEN WILL BE OFFERED: ____ QUATERLY _**X**_ SEMESTER
____ YEAR ___ SUMMER

PREREQUISITE: FISA 8541, FISA 8543

COURSE JUSTIFICATION: **This course is designed to offer students the basic concepts of renal physiology, emphasizing on the human kidney. An understanding of kidney function is critical to comprehend the integrated function of the human body.**

The course consists of 14 hours of lectures, 14 hours for the discussion of research papers in the area of renal physiology, 6 hours of independent study, and 2 hours for the examination for a total of 36 hours/semester or two credits.

COURSE DESCRIPTION: **The course presents fundamental aspects of renal physiology. These include: the distribution of body fluids, glomerular filtration, the control of sodium and water balance and its regulation by the endocrine system, acid-base balance and the kidney, and potassium balance. In addition, participating students will make presentations on published work in the area of renal physiology.**

COURSE OBJECTIVES AND EXPECTED OUTCOMES:

1. **Demonstrate knowledge on the composition and volume of body fluids compartments, the forces responsible for the movement of water across the plasma membrane and the capillary membrane, and how these compartments and its composition are affected by pathophysiologic disturbances.**
2. **Describe the microanatomy of the nephron and the renal corpuscle, the vasculature responsible for blood perfusion, and its renal innervations.**
3. **Explain the basic mechanisms of renal function: filtration, reabsorption and secretion.**
4. **Demonstrate knowledge on the structure of the ultrafiltration membrane, the forces involved in plasma ultrafiltration, the factors determining the movements of solute particles across the ultrafiltration membrane, , the use of inulin and creatinine to estimate glomerular filtration (GFR) using the clearance concept.**
5. **Describe the basic process of reabsorption in the nephron using glucose as a model substance.**
6. **Describe the basic process of secretion in the nephron using p-aminohippuric acid as a model substance.**
7. **Demonstrate knowledge on hemodynamic aspects of renal physiology: the autoregulation of renal blood flow (RBF) and GFR, the control of renal blood perfusion and distribution, and the relation between sodium transport and oxygen consumption by the kidney.**
8. **Demonstrate knowledge on the mechanisms involved in the renal handling of sodium and water by the kidney. This includes the segmental analysis of sodium and water transport, and how these variables are affected by alterations in ECFV and blood pressure.**
9. **Describe the main hormones involved in the control of sodium balance and the role of the "effective circulating volume" (ECV) in determining sodium balance.**
10. **Demonstrate knowledge on the mechanisms used by the kidney to promote acid-base balance: the reabsorption of filtered bicarbonate, the reclamation of the bicarbonate used in the buffering of fixed acid, and the excretion of fixed acid through titratable acidity and ammonium.**
11. **Describe the basic alterations of acid-base balance and how they are compensated.**
12. **Describe the renal processes responsible for maintaining potassium balance. This includes segmental analysis of potassium transport by the nephron, its hormonal regulation, and control by physicochemical factors such as acid-base disturbances.**

The students should provide proficiency with the course objectives, that will be measured by analysis, integration and comparison of the above mentioned concepts, that will be evaluated through multiple choice questions, essay exams, term papers, presentations and/or publications.

COURSE TOPICS AND TIME DISTRIBUTION:

1. COMPOSITION AND DYNAMICS OF BODY FLUID COMPARTMENTS
    A. ECFV
    B. ICFV
    C. OSMOTIC WATER FLOW
    D. BODY FLUID COMPARTMENT DISTRIBUTION AND DISTURBANCES

2. RENAL ANATOMY
    A. GENERAL
    B. ULTRASTRUCTURE AND THE NEPHRON

3. GLOMERULAR FILTRATION
    A. DYNAMICS OF SYSTEMIC CAPILLARY FILTRATION
    B. DYNAMICS OF GLOMERULAR CAPILLARY FILTRATION
    C. DETERMINATION OF GLOMERULAR FILTRATION RATE
    D. FACTORS AFFECTING GFR
    E. DETRMINATION OF GFR USING INULIN AND CREATININE
    F. CLINICAL AND EXPERIMENTAL RELEVANCE OF GFR DETERMINATION AND THE EFFECT OF AGING.

4. RENAL REABSORPTION AND SECRETION
    A. PRINCIPLES FOR THE REABSORPTION OF SODIUM AND WATER IN THE NEPHRON
    B. RENAL HANDLING OF GLUCOSE
    C. RENAL HANDLING OF P-AMINOHIPPURIC ACID
    D. USE OF CLEARANCE DETERMINATION TO ASSESS THE RENAL HANDLING OF A SUBSTANCE
5. RENAL HEMODYNAMICS
    A. AUTOREGULATION OF RBF AND GFR
    B. CONTROL OF BLOOD FLOW DISTRIBUTION IN THE KIDNEY
    C. DETERMINANTS OF RENAL AEROBIC METABOLISM

6. SODIUM AND WATER BALANCE
    A. SEGMENTAL ANALYSIS OF SODIUM TRANSPORT
    B. EFFECT OF DIURETICS
    C. DISTURBANCES OF SODIUM BALANCE
    D. THE CONTROL OF THE EFFECTIVE CIRCULATING VOLUME
        I. SYMPATHETIC NERVOUS SYSTEM
        II. ATRIAL NATRIURETIC HORMONE
        III. ADH

7. CONCENTRATION AND DILUTION OF URINE
    A. CORTICOPAPILLARY SOLUTE GRADIENT
    B. COUNTERCURRENT MULTIPLIER MECHANISM IN HENLE'S LOOP
    C. ADH ACTION AND ITS REGULATION
    D. ROLE OF UREA
    E. THE VASA RECTA
    F. SUMMARY OF WATER HANDLING BY THE NEPHRON IN CONDITIONS OF WATER DEFICITS AND WATER EXCESS.

8. ROLE OF THE KIDNEYS IN ACID-BASE BALANCE
    A. RESPONSE OF THE BODY TO ACID-BASE BALANCE DISTURBANCES: FIXED VS VOLATILE ACIDS
    B. RENAL MECHANISMS IN ACID-BASE BALANCE
        I. REABSORPTION OF FILTERED BICARBONATE
        II. RECLAMATION OF BICARBONATE USED IN BUFFERING FIXED ACIDS
        III. EXCRETION OF FIXED ACID: TITRATABLE ACIDITY AND AMMONIUM EXCRETION
        IV. ANALYSIS OF ACID BASE DISTURBANCES

9. POTASSIUM BALANCE
    A. DISTRIBUTION OF POTASSSIUM IN BODY FLUID COMPARTMENTS
    B. INTERNAL VS EXTERNAL BALANCE
    C. NEPHRON HANDLING OF POTASSIUM LOW VS NORMAL OR HIGH POTASSIUM DIET
    D. SEGMENTAL ANALYSIS OF POTASSIUM HANDLING
    E. THE DISTAL NEPHRON: PRINCIPAL CELLS AND INTERCALATED CELLS
    F. REGULATION OF POTASSIUM HANDLING: ALDOSTERONE
    G. FACTORS AFFECTING POTASSIUM SECRETION

10. THE COMPOSITION OF THE URINE AND THE BALANCE CONCEPT

TEACHING STRATEGIES:

METHODS:

Lectures
Clinical cases
Paper presentations by students
Independent study

AUDIOVISUAL RESOURCES:

Power Point
Blackboard

ESSENTIAL REQUIREMENTS:

Attendance
Class Participation

EVALUATION STRATEGIES:

An exam will be offered to evaluate the accomplishment of objectives. The exam will weight 60% of the final grade. The remaining 40% will be obtained from a paper report and presentation (20%) and 4 discussion questions (20%).

EVALUATION SYSTEM:

A 90-100 %
B 80-89 %
C 70-79 %
D 60-69 %
F 50-59 %

BIBLIOGRAFY:

1) **Vander's Renal Physiology, Sixth Edition. DC Eaton and JP Pooler Editors, McGraw Hill, 2004.**
2) **Renal Physiology, Third Edition, BM Koeppen and BA Stanton Editors. The Mosby Physiology Monograph Series. Mosby, 2001**
3) **Renal Physiology Notes, N. Escobales, 2011**

REASANOBLE ACCOMODATION STATEMENT:

Students with a health condition or situation that, according to the law, makes them eligible for reasonable accommodation have the right to submit a written application to the professor and the dean of their Faculty, according to the procedures established in the document Submittal Process for reasonable Accommodation of the Medical Sciences Campus. A free copy of this document may be obtained at the Office of the Dean for Student Affairs, second floor of the School of Pharmacy building; phone 787-758-2525 ext. 5203. A copy may also be obtained at the Office of the faculty Deans as well as in the MSC web page. The application does not exempt the student from complying with the academic requirements pertaining to the programs of the Medical Sciences Campus.

ACADEMIC INTEGRITY

The University of Puerto Rico promotes the highest standards of academic and scientific integrity. Article 6.2 of the UPR Student Bylaws (Certification JS 13 2009–2010) states that "academic dishonesty includes but is not limited to: fraudulent actions, obtaining grades or academic degrees using false or fraudulent simulations, copying totally or partially academic work from another person, plagiarizing totally or partially the work of another person, copying totally or partially responses from another person to

examination questions, making another person to take any test, oral or written examination on his/hers behalf, as well as assisting or facilitating any person to incur in the aforementioned conduct". Fraudulent conduct refers to "behavior with the intent to defraud, including but not limited to, malicious alteration or falsification of grades, records, identification cards or other official documents of the UPR or any other institution." Any of these actions shall be subject to disciplinary sanctions in accordance with the disciplinary procedure, as stated in the existing UPR Student Bylaws.

DISCLAIMER: The above statement is an English translation, prepared at the Deanship of Academic Affairs of the Medical Sciences Campus, of certain parts of Article 6.2 of the UPR Student Bylaws "Reglamento General de Estudiantes de la Universidad de Puerto Rico", (Certificación JS 13 2009-2010). It is in no way intended to be a legal substitute for the original document, written in Spanish.