Title: BIOC3262 Medical Biochemistry
Credits: 3
Level: Undergraduate - Year II
Semester: 2

Pre-requisite: BIOC2XXX Primary Metabolism

Offering Department: Department of Life Sciences, Faculty of Science and Technology, The University of the West Indies, St. Augustine.

Course Description:
Primary Metabolism is a theoretical course that introduces students to medical dysfunctions by studying tissues and how they are regulated. They are shown how pathologies which are indicated by physical or biochemical anomalies can be ascertained by the use of proper analytical methods to determine levels of chemicals or metabolites in the blood and or urine. The students have access to all materials used in delivering lectures as these materials are all accessible on myelearning. Students are assessed with the use of two mid-term exams a final and a major individual project that takes the form of a case study.

Instructor information

Dr. Valerie Bowrin
Rm 218 Old Wing Natural Science Bldg; phone ext 82079
Email: Valerie.Bowrin@sta.uwi.edu

Dr. Brian Cockburn
Rm 219 Old Wing Natural Science Bldg; phone ext 83541
Email: Brian.Cockburn@sta.uwi.edu

Purpose of the Course
To introduce the students to a macro level of biochemistry, as most of their courses to date focus on subcellular level activities. This course introduces students to organs and how they function biochemically and how they are regulated. The students are also taught about the consequences to the organism when regulatory systems are dysfunctional. The students also learn how hormones are involved in the biochemical functions of many systems and how pathologies can be diagnosed based on levels of hormones in blood or urine. The students are also introduced to the use of biochemical markers in diagnostic tests. This course also introduces students to clinical tests which are routinely used for laboratory findings.

COURSE CONTENT

TOPIC 1: Renal Function (4 lectures)
A brief outline of the structure and function of the kidney – the nephron. Renal blood flow, glomerular filtration rate (GFR), creatinine clearance, excretion of urea and uric acid. The role of

**TOPIC 2: Acid-base Balance (2 lectures)**


**TOPIC 3: Liver Function (4 lectures)**


**TOPIC 4: Clinical Analytical Methods (4 lectures)**

Collection and handling of specimens for analysis – types of samples, processing, stability, storage and laboratory criteria for acceptable and unacceptable samples. Analytical techniques and instrumentation in the clinical chemistry laboratory, including automation of procedures. Laboratory statistics – reference intervals (normal range), predictive value, confidence intervals, variance, random and systematic errors, precision, sensitivity, specificity, accuracy. Selection and evaluation of methods. Quality assurance and quality control. Laboratory safety and regulations – biological; and chemical hazards. Interpretation and use of laboratory results.

**TOPIC 5: Thyroid Biochemistry (3 lectures)**

Essential features of iodine metabolism, thyroid hormone biosynthesis and storage, secretion, transport and metabolism of thyroid hormones. Mechanism of thyroid hormone action and regulation of secretion. Disorders of the thyroid – Hyperthyroidism and hypothyroidism, causes, clinical and biochemical features, Laboratory investigation of thyroid function. The buffer systems in blood. The roles of the kidney and lung in regulating blood pH. Disturbances of acid-base

**TOPIC 7: Catecholamines (1 lecture)**


**TOPIC 8: Steroid Biochemistry (5 lectures)**

Sites of synthesis of steroid hormones – adrenal cortex, testis, and ovary. The different steroid hormones viz – glucocorticoids, mineralocorticoids, progestins, androgens, estrogens,. Pathways for the biosynthesis of steroid from cholesterol. Regulation of steroidogenesis. Mechanism of action of steroid hormones and their physiologic effects. Secretion, metabolism and excretion of steroids, regulation of menstrual cycle. Biochemical and clinical features of disorders of the adrenal cortex, testis, ovary e.g. Cushing’s syndrome, Addison’s disease, hyper-aldosteronism., congenital adrenal, hyperplasia, hypo and hypergonadism, polycystic ovarian disease, ovarian hyperfunction.

**TOPIC 9: Plasma Lipoproteins (3 lectures)**

Review of the biosynthesis of the main classes of lipids with emphasis on cholesterol biosynthesis and its regulation. Composition, physical properties and metabolism of the different classes of lipoproteins. Mechanisms involved in the transport of lipids in the plasma. Relationship of plasma lipids to the pathogenesis of arterial disease. Laboratory investigation of plasma lipid abnormalities.

**TOPIC 8: Clinical Enzymology (2 lectures)**

Mechanisms for the release of cellular enzymes into circulation. Criteria for selection of plasma enzyme tests. Examples of clinically important enzymes – alkaline phosphatase, creatine kinase, lactate dehydrogenase, α-amylase, aminotransferases, cholinesterase, gamma glutamyl transferase. Clinical information obtained from analysis of enzyme isoforms.

**LEARNING OUTCOMES**

**Renal function**

**At the end of this topic students should be able to:**
1. Describe the function of the kidneys.
2. describe tests to measure kidney function.
3. explain what urea and tests to measure urea levels.
4. explain the significance and causes of urea levels.
5. explain what creatinine is and tests to measure its levels.
6. explain the significance of urea and uric acid levels and causes of abnormal levels of urea.
7. explain tests to measure tubular function.
8. describe the pathological conditions of the kidneys.
9. explain what Nephrotic syndrome is.

**Acid-base balance**

**At the end of this topic students should be able to:**

1. explain acid-base homeostasis.
2. discuss the regulation of acid balance.
3. explain what are blood buffer systems: Bicarbonate buffer system, phosphate buffer systems, protein buffer system.
4. explain respiratory regulation of acid-base balance.
5. explain renal regulation of pH.
6. discuss mechanisms by which kidneys regulate HCO balance.
7. describe acid-base disorders.

**Liver function test**

**At the end of this topic students should be able to:**

1. describe the functions of the liver.
2. describe the Liver function test.
3. describe the basic processes in liver disease.
4. explain the liver function and protein metabolism relationship.
5. describe tests related to conjugation and excretion.
6. describe tests related to pigment metabolism.
7. explain jaundice: types, tests, causes, disorders.
8. describe how you would estimate serum bilirubin: different tests.
9. describe bile acid synthesis and utilization and clinical significance.
10. explain the link between serum enzymes and liver disease.
11. discuss evidence of hepatocellular damage and of cholestasis.
12. explain GGT significance.
13. state what are the markers for viral hepatitis.

**Clinical Analytical Methods**
At the end of this topic students should be able to:

Centrifugation

1. explain the principle of centrifugation using illustrations.
2. describe the types of centrifuges.
3. discuss the applications of centrifugation.

QC

1. describe what quality control means.
2. explain why QC is needed.
3. discuss the advantages of QC in the testing laboratory.
4. explain at what levels QC must act upon.
5. state QC goals should be set for a testing laboratory.
6. explain how QC goals can be achieved with respect to internal and external programmes and giving appropriate exs.
7. state what criteria must be met in accepting or rejecting lab results.
8. describe the types of errors that can be generated in a testing lab.
9. describe what criteria must be met before changing a test.

Specimen collection

1. describe what types of samples are collected by the testing lab.
2. describe the routinely used anti-coagulants.
3. describe how urine samples are collected and preserved.
4. describe how cerebrospinal fluid (csf) is collected and handled.

Thyroid function

At the end of this topic students should be able to:

1. examine all the stages of thyroid hormone biosynthesis and their regulation.
2. analyze the regulation, stimulation and/or inhibition and the effectors of thyroid hormone activity.
3. state the influences on thyroid hormone concentration in the plasma and the difference between free and bound.
4. analyze the reasons for high and low concentrations of thyroid hormones in the plasma and the clinical consequences of this.
5. differentiate between primary and secondary causes of thyroid hormone dysfunction.
6. compare clinical tests and their applicability, usefulness and limits.
7. examine the types of thyroid hormone dysfunction, signs and symptoms, their treatment and the targets of these treatments.
8. justify sequences of investigative tests that can be used to eliminate possible causes and confirm diagnoses.
9. examine and analyze case studies.

**Catecholamines**

**At the end of this topic students should be able to:**

1. describe metabolism of catecholamines.
2. illustrate the embryological origin of adrenal medulla and how this affects the synthesis, storage and metabolism of catecholamines.
3. analyze the metabolic effects of catecholamines and give reasons for the sometimes contradictory effects.
4. examine the types of dysfunctions, their causes and treatment.
5. analyze and explain case studies based on regulation and function of catecholamines.

**Steroid hormones**

**At the end of this topic students should be able to:**

1. illustrate the biosynthetic pathway for the steroid hormones from cholesterol and know the major sites of synthesis for the different families of steroid hormones.
2. examine the mechanisms of action of steroid hormone activity and their regulation.
3. detail both endogenous and exogenous effects of steroid hormones on the body.
4. analyze the types, causes and treatment of steroid hormone dysfunctions using case studies.
5. design schemes for tests to enable critical diagnoses to be made.

**Clinical Enzymology**

**At the end of this topic students should be able to:**

1. describe the different classes of clinical enzymes with named exs.
2. discuss the following enzymes with respect to function and clinical significance:
   Aldolase, aspartate and alanine transaminase, lactate dehydrogenase, creatine kinase,
3. Alkaline phosphatase, acid phosphatase, gamma glutamyl transferase, amylase, lipase, cholinesterase, glucose-6-phosphatase.

**TEACHING METHODOLOGY**
The predominant instructional mode will be lectures (3 per week) with tutorials scheduled every other week.

**ASSESSMENT**

In-course test(s)/Assignment(s) 50%
Final Theory Examination (3 hrs) 50%

**ASSESSMENT MATRIX**
State % weighting of each category / item
Objective-type assessment e.g. MCQ, T/F, fill in blanks, etc. Subjective-type assessment e.g. essays, paragraphs, notes, etc.

<table>
<thead>
<tr>
<th>Assessment tool</th>
<th>BIOL3XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theory: In-course</strong></td>
<td></td>
</tr>
<tr>
<td>Objective-type assessment:</td>
<td>2 @ 15%</td>
</tr>
<tr>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>Tutorial/Participation</td>
<td>2 @ 2.5%</td>
</tr>
<tr>
<td>Project report</td>
<td></td>
</tr>
<tr>
<td>Reading project</td>
<td></td>
</tr>
<tr>
<td>Library report</td>
<td></td>
</tr>
<tr>
<td>Other: Case studies: oral presentations</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Theory: Final</strong></td>
<td></td>
</tr>
<tr>
<td>Objective-type assessment:</td>
<td></td>
</tr>
<tr>
<td>Paragraphs, notes</td>
<td></td>
</tr>
<tr>
<td>Essay</td>
<td>100%</td>
</tr>
<tr>
<td>Case Studies</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

**DELIVERY MATRIX**

<table>
<thead>
<tr>
<th>Delivery strategy</th>
<th>BIOL3XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td></td>
</tr>
<tr>
<td>‘Chalk &amp; talk’</td>
<td></td>
</tr>
<tr>
<td>PowerPoint</td>
<td></td>
</tr>
<tr>
<td>Overheads</td>
<td></td>
</tr>
<tr>
<td>Table Title</td>
<td>Mixture of above</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

| **Tutorials** | | |
|---------------|-----------------|
| Group discussion | X |
| Problem sheets | X |
| Other:         | |

<table>
<thead>
<tr>
<th><strong>myeLearning tools</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources</td>
</tr>
<tr>
<td>Forums</td>
</tr>
<tr>
<td>Quizzes</td>
</tr>
<tr>
<td>Workshops</td>
</tr>
<tr>
<td>Assignments</td>
</tr>
<tr>
<td>Journals</td>
</tr>
<tr>
<td>Glossaries</td>
</tr>
<tr>
<td>Lessons</td>
</tr>
<tr>
<td>Wiki</td>
</tr>
<tr>
<td>Surveys/Choices</td>
</tr>
<tr>
<td>Chats</td>
</tr>
<tr>
<td>Dialogues</td>
</tr>
</tbody>
</table>


REQUIRED READING

**Essential Texts**

**Additional Readings**
Harper’s Biochemistry, 25th Ed, by Murray, Granner, Mayes and Rodwell
Clinical Biochemistry for Medical Students, by Laker.
Essential Endocrinology, 3rd Ed, by Laycock and Wise.
Endocrinology Science and Medicine: A review of fundamental principles by Adlin.

**Course Calendar**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1    | Introduction/Course Overview  
Renal Function | 3 |
| 2    | Tutorial  
Renal Function  
Acid-Base Balance | 1  
1  
1 |
| 3    | Acid-Base Balance  
Liver Function | 1  
2 |
| 4    | Tutorial  
Liver Function | 1  
2 |
| 5    | Clin Anal  
Methods | 2 |
| 6    | Clin Anal Methods  
Tutorial  
*Make-up exam (if necessary) | 2  
1 |
| 7    | Thyroid  
Case Studies Assigned | 3 |
| 8    | Exam #1 Review  
Catecholamines  
Steroids | VB  
1  
1  
1 |
| 9    | Steroids | 3 |
| 10   | **Incourse #2 (wks 1-10)**  
Tutorial  
Steroids | 1  
1  
1 |
<p>| 11   | Plasma Lipoproteins | 2 |</p>
<table>
<thead>
<tr>
<th></th>
<th>Clinical Enzymology</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Make-up exam (if necessary)</em></td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Clinical Enzymology</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Exam #2 Review</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Case Studies Presentations</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Missed Lectures / Tutorials</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Case Studies Presentations</td>
<td></td>
</tr>
</tbody>
</table>