



SCHOOL OF PHARMACY AND HEALTH SCIENCES

COURSE: BOT 3353: General Plant Biochemistry and Toxicology.

LECTURER : Dr. Jonathan Mwangi
CLASS DAYS/TIME: THU 13.30am- 16.50pm
CLASS VENUE: SC5
CREDIT UNIT: 3.0

1. DESCRIPTION (AS IN THE CATALOGUE)

1.1 Prerequisite: BCM 1341; BOT 3352

1.2 The course provides the students with knowledge on the basic metabolism in plants and introduces secondary metabolism to prepare students for pharmacognosy courses.

2. LINK TO UNIVERSITY MISSION OUTCOMES & TO PROGRAM LEARNING OUTCOMES

- **High order thinking:** The ability to collect, analyze and evaluate information and formulate conclusions. Students develop and demonstrate the ability to think critically, analytically and creatively.
- **Literacy:** Competence in oral, written, quantitative, and technological skills. Students develop and demonstrate competency in oral and written communication as well as demonstrate scientific, quantitative and technological literacy.
- **Global understanding and multicultural perspective:** Awareness, knowledge and appreciation of both the diversity and commodity of cultures. Students acquire these perspectives through formal study of languages, history, literature and the arts and through

working, studying and living cooperatively in a radically, ethnically, and culturally diverse environment. Further, students acquire an understanding of economic, historical, political, geographic and environmental relationships on a global basis.

- **Preparedness for career:** Mastery of a field of knowledge and its multi-cultural and multinational application. Such mastery is accomplished through both formal study and various experienced forms of learning such as internships and field experiences.
- **Community service and development:** A sense of being part of a community and a desire to be of service to it. Students are given opportunities to participate in community service, citizenship, or social action projects or activities.
- **Leadership and ethics:** As part of their growth and development, students formulate and articulate the ethical standards which will guide their professional and personal lives.

Program Learning Outcomes

By the end of their training the graduates should be able to:

1. Plan, organize and control the manufacturing, compounding, packaging and quality of pharmaceutical products
2. Plan, organize and manage the procurement, storage and distribution of pharmaceutical materials and products.
3. Interpret and uphold the laws, regulations and ethics that govern the practice of pharmacy.
4. Provide pharmacist-initiated care to patients and ensure the rational use of medicines.
5. Provide information, advice and education on disease, health, community health and medicines-related issues.
6. Participate in pharmaceutical and medical research and evaluate critically new therapies and current advances in formulation and modes of drug action to ensure the optimal selection and use of medicines.

3. EXPECTED COURSE LEARNING OUTCOMES

At the end of the course, the student should be able to:

1. Describe the basic Carbon flow metabolism of plants (CLO 1).
2. Describe the biosynthesis of the most common plant primary metabolites (CLO 2).
3. Explain the assimilation of sulphur and nitrogen in plant metabolism (CLO 3).
4. Discuss the types and role of plant growth regulators (CLO 4)
5. Elucidate the biosynthesis of common plant secondary metabolites (CLO 5)
6. State the principles of plant biopharming (CLO 6)

4. CONTENT & CLASS SCHEDULE:

Week	Weekly Learning Outcomes (WLOs)	Assessment and Rubrics	Activities: Learner Interaction & Engagement	Reading
Wk 1 Describe the basic Carbon flow metabolism of plants (CLO 1)	After completing this week's content, you should be able to; 1. Describe the photosynthesis process and its regulation (WLO 1) 2. Discuss the synthesis of sucrose and its regulation (WLO 2) 3. Describe the synthesis of starch and its regulation (WLO 3)	Participate in the discussion forum based on the week 1 video clips (5 Points) - (WLO 1, 2 & 3) Individual Assignment: See the last slide of week 1 powerpoint presentation (To be submitted in week 4) - 20 points (WLO 2)	- Review Module Reading Resources assigned in Lesson 1 (WLO 1&2) - Watch https://www.youtube.com/watch?v=CIG4-W0FIXE Video clip on sucrose synthesis – 9:12 minutes (WLO 1) - Watch the video on starch synthesis https://www.youtube.com/watch?v=W9SViazIH00 – 6:52 minutes (WLO 3)	Lesson Notes (WLO 1, 2 & 3) Watch Videos (WLO 1, 2 & 3)
Wk 2 Describe the biosynthesis of the most common plant primary	After completing this week's content, you should be able to; 1. Discuss the composition of the unique sugars of plants-stachyose, raffinose, fructans and	1. Attend and participate in class lecture 2. Participate in the discussion forum based on the week 1 video clips (5	Participate in Class Exercise: what unique sugars do you know of?	Lesson Notes (WLO 1, 2 & 3) Watch Videos (WLO 1, 2 & 3)

metabolites (CLO 2)	<p>glycans (WLO 1)</p> <p>2. Discuss the synthesis of the structural polysaccharides of plants- cellulose, alginates and gums (WLO 2)</p> <p>3. Relate the composition and importance of plant cell walls (WLO 3)</p>	Points) - (WLO 1 & 2)		
<p>Wk 3</p> <p>Describe the biosynthesis of the most common plant primary metabolites (CLO 2)</p>	<p>After completing this week's content, you should be able to;</p> <p>1. Describe the structure and diversity of plant fatty acids (WLO 1)</p> <p>2. Discuss the biosynthesis of common FAs in plants (WLO 2)</p> <p>3. relate the composition of FAs like cutin and waxes (WLO 3)</p>	<p>1. attend and Participate in the class lecture (1 point)</p> <p>2. Prepare and submit individual assignment given in week 1 (20 points)</p>	<p>- Review Module Reading Resources assigned in Lesson 2 (WLO 1, 2 &3)</p> <p>- Watch https://www.youtube.com/watch?v=CIG4-W0FIXE Video clip on unique FAs biosynthesis in plants – 9:12 minutes (WLO 1)</p> <p>- participate and contribute in the class exercise on FAs of plants</p>	<p>Lesson Notes (WLO 1, 2 & 3)</p> <p>Watch Videos (WLO 1, 2 & 3)</p>
<p>Wk 4</p> <p>Explain the assimilation of sulphur and nitrogen in plant metabolism (CLO 3)</p>	<p>After completing this week's content, you should be able to;</p> <p>1. explain the assimilation of sulphur and its importance in plant metabolism (WLO 1)</p> <p>2. describe the uptake and reduction of nitrate (WLO 2)</p> <p>3. discuss the assimilation</p>	<p>1. Attend and participate in class lecture (1 point)</p> <p>2. attend and contribute to group work on N2 assimilation (10 points)</p> <p>3. Quiz 1 (30 points)</p>	<p>- Review Module Reading Resources assigned in Lesson 3 (WLO 1&2)</p> <p>- Watch the video on sulphur assimilation https://www.youtube.com/watch?v=W9SViazIH00 – 4:25 minutes (WLO 1)</p> <p>Watch the video on Nitrogen assimilation https://www.youtube.com/watch?v=W9SViazIH00 – 6:52 minutes (WLO 2 & 3)</p> <p>Watch the video on glyphosate MOA https://www.youtube.com/watch?v=W9SViazIH00 –</p>	<p>Lesson Notes (WLO 1, 2 & 3)</p> <p>Watch Videos (WLO 1, 2 & 3)</p>

	of ammonia (WLO 3) 4. relate the shikimic acid pathway and its importance in plant metabolism (WLO 4)		6:12 minutes (WLO 4)	
Wk 5 Describe the biosynthesis of the most common plant primary metabolites (CLO 2)	After completing this week's content, you should be able to; 1. discuss the storage proteins in various plant species (WLO 1) 2. describe the economic importance of various plant toxic proteins- glutens, anti-nutrient compounds, protease inhibitors (WLO 2)	1. Attend and participate in class lecture 2. Participate in discussion forum based on wk 5 content (5 points)	- Review Module Reading Resources assigned in Lesson 4 (WLO 1&2) - Watch the video on plant storage proteins https://www.youtube.com/watch?v=W9SViazIH00 – 6:09 minutes (WLO 1 & 2) - Watch the video on plant anti-nutrients https://www.youtube.com/watch?v=W9SViazIH00 – 7:22 minutes (WLO 2)	Lesson Notes (WLO 1 & 2) Watch Videos (WLO 1 & 2)
Wk 6 Describe the biosynthesis of the most common plant primary metabolites (CLO 2)	After completing this week's content, you should be able to; 1. discuss economically important enzymes and proteins of plants- Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin) (WLO 1).	1. Attend and participate in class lecture 2. Present group work from wk 4 (10 points)	- Review Module Reading Resources assigned in Lesson 5 (WLO 1&2) - Watch the video on plant enzymes https://www.youtube.com/watch?v=W9SViazIH00 – 8:29 minutes (WLO 1 & 2)	Lesson Notes (WLO 1) Watch Videos (WLO 1)
Wk 7		MID SEMESTER EXAMINATION (70 points)		Lesson Notes (CLOs 1 - 3)

				Watch Videos (Wks 1 - 6)
Wk 8 Discuss the types and role of plant growth regulators (CLO 4)	After completing this week's content, you should be able to; 1. discuss the role of auxins (WLO 1) 2. discuss the role of gibberellins (WLO 2) 3. discuss the role of cytokinins (WLO 3) 4. discuss the role of growth inhibitors (WLO 4) 5. discuss the role of ethylene (WLO 5)	1. Attend and participate in class lecture 2. Participate in discussion forum based on week 8 content (5 points)	- Review Module Reading Resources assigned in Lesson 6 (WLO 1, 2, 3, 4 & 5) - Watch the video on plant tissue culture https://www.youtube.com/watch?v=W9SViazIH00 – 8:29 minutes (WLO 1 & 2)	Lesson Notes (WLO 1, 2, 3, 4 & 5) Watch Videos (WLO 1, 2, 3, 4 & 5)
Wk 9 Elucidate the biosynthesis of common plant secondary metabolites (CLO 5)	After completing this week's content, you should be able to; 1. define plant secondary metabolites (WLO 1) 2. discuss the different classes of secondary metabolites (WLO 2) 3. relate the economic importance of some plant secondary metabolites (WLO 3)	1. Attend and participate in class lecture 2. PBL on plant secondary metabolites (20 points)	- Review Module Reading Resources assigned in Lesson 8 (WLO 1, 2 & 3) - Watch the video on plant secondary metabolism https://www.youtube.com/watch?v=W9SViazIH00 – 14:04 minutes (WLO 1, 2 & 3)	Lesson Notes (WLO 1, 2 & 3) Watch Videos (WLO 1, 2 & 3)
Wk 10 Elucidate the biosynthesis of common plant secondary metabolites (CLO 4)	After completing this week's content, you should be able to; 1. discuss the synthesis and role of isoprenoid compounds (WLO 1) 2. relate the role and synthesis of stress compounds in plants (WLO 2)	1. Attend and participate in class lecture 2. Quiz 2 (30 points)	- Review Module Reading Resources assigned in Lesson 9 (WLO 1&2) - Watch the video on isoprenoids https://www.youtube.com/watch?v=W9SViazIH00 – 8:09 minutes (WLO 1 & 2)	Lesson Notes (WLO 1 & 2) Watch Videos (WLO 1 & 2)

<p>11</p> <p>Elucidate the biosynthesis of common plant secondary metabolites (CLO 4)</p>	<p>After completing this week's content, you should be able to;</p> <ol style="list-style-type: none"> 1. explain the synthesis of glucosides and cyanogenic glycosides (WLO 1) 2. explain the synthesis of glucosinolates (WLO 2) 3. relate the toxicity of cyanogenic glycosides and glucosinolates (WLO 3) 	<ol style="list-style-type: none"> 1. Attend and participate in class lecture 2. Participate in discussion forum on week 11 content (5 points) 	<ul style="list-style-type: none"> - Review Module Reading Resources assigned in Lesson 10 (WLO 1, 2 & 3) - Watch the video on plant cyanogenic glycosides and glucosinolates <p>https://www.youtube.com/watch?v=W9SViazIH00 – 11:11 minutes (WLO 1, 2 & 3)</p>	<p>Lesson Notes (WLO 1, 2 & 3)</p> <p>Watch Videos (WLO 1, 2 & 3)</p>
<p>12</p> <p>State the principles of plant biopharming (CLO 5)</p>	<p>After completing this week's content, you should be able to;</p> <ol style="list-style-type: none"> 1. relate the knowledge of plant metabolism to plant biopharming (WLO 1) 2. describe tracer techniques for investigating plant metabolites (WLO 2) 3. discuss isotopic tracer methods and administration of labelled substances to living organisms or cells (WLO 3) 	<ol style="list-style-type: none"> 1. Attend and participate in class lecture 	<ul style="list-style-type: none"> - Review Module Reading Resources assigned in Lesson 10 (WLO 1, 2 & 3) - Watch the video on plant biopharming and plantibodies <p>https://www.youtube.com/watch?v=W9SViazIH00 – 9:29 minutes (WLO 1, 2 & 3)</p>	<p>Lesson Notes (WLO 1, 2 & 3)</p> <p>Watch Videos (WLO 1, 2 & 3)</p>
<p>Wk 13</p> <p>Biogenic investigations of plant metabolites</p>	<p>After completing this week's content, you should be able to;</p> <ol style="list-style-type: none"> 1. relate the knowledge of plant metabolism to plant biopharming (WLO 1) 2. describe tracer 	<ol style="list-style-type: none"> 1. Attend and participate in class lecture 2. Group work presentations on PBL from week 10 (10 points) 	<ul style="list-style-type: none"> - Review Module Reading Resources assigned in Lesson 11 (WLO 1, 2 & 3) - Watch the video on radiotracer techniques in plants <p>https://www.youtube.com/watch?v=W9SViazIH00 – 10:03 minutes (WLO 1, 2 & 3)</p>	<p>Lesson Notes (WLO 1, 2 & 3)</p> <p>Watch Videos (WLO 1, 2 & 3)</p>

	techniques for investigating plant metabolites (WLO 2) 3. discuss isotopic tracer methods and administration of labelled substances to living organisms or cells (WLO 3)			
14		END SEMESTER EXAMINATION (70 points)		

5. TEACHING METHODS

Lectures, power point presentations and class discussions: The instructor will give lectures in class to explain to the students various topics on plant biochemistry. The lectures will take a participatory approach where the instructor will involve students by frequently asking them questions that are meant to keep them alert in class and trigger class discussions. The instructor will also be free to answer questions from the students in the course of the lectures. Assignment criteria: Students will be given at least one research assignment on a relevant topic the instructor thinks is important and relevant to the course, but which will not be adequately covered in class due to limited time. Video demonstrations and/or CD-Roms on botanical techniques when available, after the relevant topic has been covered. Assignment criteria: Students will be given several individual or group research assignments on topics relevant to the course. These could include lectures, discovery learning, problem-based learning, experimental learning, group-based learning, independent studies and e-learning.

6. COURSE TEXT & OTHER READINGS

Biochemistry and Molecular Biology of Plants 2nd Edition. Bob B. Buchanan (Editor), Wilhelm Gruissem (Editor), Russell L. Jones (Editor). 2015. John Wiley and Sons

Toxicological Survey of African Medicinal Plants. 1st Edition. Victor Kuete. 2014. Elsevier Publishers.

Further Readings

Plant Toxicology, Fourth Edition (Books in Soils, Plants, and the Environment) 4th Edition. Bertold Hock (Editor), Erich F. Elstner (Editor). 2005.

Plant Biochemistry, Fourth Edition 4th Edition. Hans-Walter Heldt and Birgit Piechulla. 2011. Academic Press.

7. COURSE EVALUATION

Attendance and participation	10%
Continuous Assessment Tests /Quizzes (at least 2)	15%
Individual Assignments	7.5%
Group Assignments	7.5%
Midsem Exam	25%
Final Exam	35%
Total	<u>100%</u>

8. Key Institutional Academic Policies

Students should note the following are key policies as outlined in the University Catalogue and Students Handbook

1. Academic dishonesty

- Any intentional giving or use of external assistance during an examination without the express permission of the faculty member giving the examination.
- Fabrication:** any falsification or invention of data, citation or other authority in an academic exercise;
- Plagiarism:** any passing off of another's ideas, words, or work as one's own;
- Previously Submitted Work:** presenting work prepared for and submitted to another course;

2. Class Attendance

Students are expected to attend all classes. Upon being absent from **seven** classes in a 3 unit course, the instructor will give a student an “**F**” grade for that course.

9. USIU GRADING

- A 90 - 100
- A- 87 - 89
- B+ 84 - 86

B 80 - 83
B- 77 - 79
C+ 74 - 76
C 70 - 73
C- 67 - 69
D+ 64 - 66
D 62 - 63
D- 60 - 61
F 0 - 59