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## SCHOOL OF PHARMACY AND HEALTH SCIENCES

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COURSE: BCM 3110 A: MICROBIAL BIOCHEMISTRY - **WRITING**  
CREDIT UNIT: 4.5

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**Prerequisites:** Introduction to Parasitology and Disease Vectors

### Course Description

This course provides a comprehensive exploration of different microbes which include bacteria, viruses, parasitic protozoa, helminths and fungi. Specific focus is on energy metabolic strategies of the microbes, replication and cell division mechanism. It also delves into microbial genetics, genetic information flow in bacteria, genotypic variation and mutations. It further explores genetic transfer in bacteria, mechanisms of drug resistance in bacteria, transposition and genetic engineering process and its application in microbial diagnosis. The mechanism of action of different bacterial toxins are elucidated with emphasis on control measures. Further, the module explores viruses' structure, life cycles and replication cycles of DNA and RNA viruses. A few examples of oncogenic DNA and RNA viruses are examined. Energy metabolism of parasitic protozoa and helminths are described as well as antiparasitic chemotherapy. The same approach is applied to fungal energy metabolism, metabolism of secondary metabolites and a look at examples of antifungal agents. Last, microbial genomics is introduced as applied in studying TB transmission dynamics and SARS-CoV-2 epidemiology.

The course integrates researched and published examples to reinforce theoretical concepts. Moreover, this course will be writing intensive and learners will be engaged in higher order thinking through literature search, analyzing and reporting clearly the published articles.

This course aligns to Sustainable Development Goal 3 (SDG 3) which seeks good health and wellbeing, SDG 4 which seeks to ensure equitable quality education which promotes lifelong learning and SDG 8 which prepares the students for full productive employment.

### Link to University Mission and Program Learning Outcomes:

1. **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.
2. **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.
3. **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.

4. **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.
5. **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.
6. **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.

**Course Purpose:** To equip the students with knowledge on microbial biochemistry and the chemical processes that takes place in microorganisms

**Course Learning Outcomes:**

**Upon completion of this course student should be able to:**

1. Explain microbial metabolic processes, genetics, replication pathogenesis and role in evolution
2. Elucidate the mechanisms through which microorganisms develop resistance against antimicrobials
3. Differentiate viruses structure, life cycles, replication and viral infections
4. Describe metabolism of secondary metabolites in parasitic protozoa and helminths
5. Discuss energy metabolism in fungi, metabolism of secondary metabolites and antifungal agents
6. Apply writing intensive skills in collecting, analyzing, evaluating and reviewing publications

**COURSE CONTENT**

Week	Topic	Activity and learning outcome	Reading
Week 1	<b>Microbial Metabolism:</b> Metabolism and catabolism Photosynthesis in bacteria Anoxygenic photosynthesis Metabolic diversity – Classification based on energy source and carbon source Photosynthetic bacteria, Chemoautotrophs, Chemoheterotrophs	<b>(outcomes 1,2,6)</b> Lecture  Reading assignment – Shapes, structure and cell membrane of bacteria, Difference between gram positive and negative bacteria and examples	Microbial Biochemistry 3rd Edition Chapter 1,6,7,8
Week 2	<b>Microbial Bioenergetics:</b> Aerobic respiration, Anaerobic respiration, Fermentation Types of Fermentation	<b>(outcomes 1,2,6)</b> Lecture and class discussion <b>Writing Intensive</b>	Microbial Biochemistry 3rd Edition Chapter 6,7,8

	Alternative energy generating patterns lipid metabolism protein metabolism,	<b>Activity One</b>	
Week 3	<b>Bacterial Growth and Multiplication:</b> - Bacterial cell division - Bacterial growth - Bacterial growth curve - Bacterial nutrition and nutrients - Factors affecting bacterial growth, Growth factors	<b>(outcomes 1,2,6)</b> Lecture and class discussion	Microbial Biochemistry 3rd Edition Chapter 1,3
Week 4	<b>Microbial Genetics:</b> Structure and function of genetic material, Central dogma, Transcription and Translation Genetic information flow in bacteria Phenotypic variation: Mutations	<b>(outcomes 1.2,6)</b> Lecture and class discussion	Microbial Biochemistry 3rd Edition Chapter 15,16,17
Week 5	<b>Bacteria Genetics:</b> Genetic transfer in bacteria: Transduction, Transformation, Conjugation - Resistance factor, Lysogenic conversion - Genetic mechanisms of drug resistance in bacteria - Transposition, Genetic engineering - PCR and application in microbial diagnosis Mechanisms of antibiotic resistance	<b>(outcomes 1.2,6)</b> Lecture and class discussion  <b>Quiz 1: Covering Wks. 1, 2, 3 and 4</b>  Reading assignment – Review of publications on PCR techniques applied in identification of bacterial, viral, fungal and parasitic diseases	Microbial Biochemistry 3rd Edition Chapter 15,16,17
Week 6	<b>Microbial Toxins:</b> - Cholera Toxin - Salmonella Toxin - Botulinum toxin - Aflatoxins	<b>(outcomes 1,2,6)</b> Lecture and class discussion <b>Submission of Writing Intensive Activity One Assignment</b>	Medical Microbiology 1 <sup>st</sup> Edition Chapter II
<b>Week 7</b>	<b>Mid Semester Exam</b>	<b>Mid Semester Exam</b>	<b>Mid Semester Exam</b>
Week 8	<b>Viruses:</b> - Structure, classification and characteristics of DNA and RNA viruses - Viral replication e.g. HIV - Target of various antiviral drugs	<b>(outcomes 3,6)</b> Lecture and class discussion <b>Writing Intensive Activity Two</b>	Medical Microbiology 1st Edition Chapter IV
Week 9	<b>Interferons and Viral</b>	<b>(outcomes 3,6)</b>	Medical Microbiology

	<b>Infections</b> - Interferons - Human Papillomaviruses, Herpes simplex virus (HSV-1 and HSV-2), Hepatitis Viruses (A, B, C, D and E), Human Immunodeficiency Virus (HIV), Corona viruses (SARS-COV-2)	Lecture and class discussion	1st Edition Chapter IV
Week 10	<b>Parasitic Protozoa and Helminths:</b> Energy metabolism - Antiparasitic chemotherapy	<b>(outcomes 4,6)</b> Lecture and class discussion	Medical Microbiology 1st Edition Chapter V
Week 11	<b>Fungal Metabolism:</b> Energy metabolism and biosynthesis - Metabolism of secondary metabolites - Antifungal agents	<b>(outcomes 5,6)</b> Lecture and class discussion  Quiz 2: Covering wk. 8, 9 and 10 work	Medical Microbiology 1st Edition Chapter III
Week 12	<b>Microbial Genomics:</b> Molecular Biology (MB) and Genomics (GS) for phylogenetics and cluster analysis for investigating TB transmission GS application in TB and SARS-CoV-2 epidemiology	<b>(outcomes 1,3,6)</b> Lecture and class discussion <b>Submission of Writing Intensive Activity Two Assignment</b>	
<b>Week 13</b>	<b>Presentations</b>	<b>Presentations</b>	
<b>Week 14</b>	<b>End Semester Exam</b>	<b>End Semester Exam</b>	<b>End Semester Exam</b>

## WRITING INTENSIVE ACTIVITIES

### Activity One – Pretest by Week 2

a). Microbial biochemistry plays a key role in the field of biotechnology, offering a diverse array of applications that have revolutionized various industries. The study of the biochemical processes within microorganisms has prepared for innovative solutions in medicine, agriculture, energy, and environmental management. Review application of microbial biotechnology under the following topics:

- i). Antibiotic production (ii). Industrial enzyme production (iii). Bioremediation (iv). Biofuel production (v). Vaccine development (vi). Agricultural biotechnology

Kindly note the following requirements:

1. The written report should **NOT EXCEED** 5 pages, including cited references
2. The word type should be Times New Roman, Font 12, Spacing 1.5
3. Use the APA referencing style
4. Reference material to be within the last 5 years

### Activity Two – Post test by Week 8

a). SARS-CoV-2 produced numerous variants which have been identified by the WHO as variants of concern (VOC) and include Alpha, Beta, Gamma, Delta, Omicron and Epsilon. Discuss the variants under the following topics:

- i. The distinguishing features/characteristics of each variant
- ii. Approaches to developing a vaccine against each variant

Kindly note the following requirements:

1. The written report should **NOT EXCEED** 5 pages, including cited references
2. The word type should be Times New Roman, Font 12, Spacing 1.5
3. Use the APA referencing style
4. Reference material to be within the last 5 years

**RUBRIC FOR EVALUATION OF THE WRITING INTENSIVE ACTIVITIES**

<b>Criteria</b>	<b>Exceeds Expectation</b> <b>9-10</b>	<b>Meets Expectation</b> <b>6-8</b>	<b>Approaching Expectation</b> <b>3-5</b>	<b>Below Expectation</b> <b>1-2</b>	<b>Score</b>
<b>Purpose/Audience</b>	The writing engages the reader with an original approach to the subject. It may encompass conflicting ideas and inspires the reader to contemplate the relationship of complex ideas.	The writing clearly goes beyond the minimum requirements of the assignment. It attempts to engage the reader through originality and presentation of complex ideas.	The writing meets the minimum requirements of the assignment. It offers insight into the subject through basic logic and the presentation of ideas based on some evidence.	The writing fails to meet the minimum requirements of the assignment. It offers little insight into the subject and has serious flaws in logic and omissions in evidence.	
<b>Content and Support</b>	The writing has a clearly articulated originality of content and subordinate ideas supported by reliable and relevant evidence based on the information gathered.	The writing has a clearly articulated the relevant content and its supported by appropriate evidence and sound logic. Minor gaps in logic and argument may appear.	The writing has a clear content and related subordinate ideas supported by clear thinking and appropriate evidence. Logical arguments may be one-sided or incomplete.	The writing may need a more clearly articulated the content and/or appropriate related subordinate ideas. Logic is unclear and adequate supporting evidence is lacking.	
<b>Organization</b>	The writing flows smoothly and logically from a well-defined thesis. It contains an appropriate introduction, conclusion, and smooth transitions between paragraphs.	The writing is organized logically and flows well. An introduction and conclusion are evident, but transitions between body paragraphs may be smoother.	The writing demonstrates rudimentary organization and logical structure, but ideas need to be more fully developed and supported by more appropriate evidence.	The writing is noticeably lacking in organization. There is no clear introduction nor conclusion and ideas are neither carefully nor fully developed. Supporting evidence is clearly lacking.	
<b>Style</b>	The writing engages the reader through an original prose style appropriate to the subject. Language is precise. Sentences are varied but not noticeably so. Active voice is apparent.	The writing keeps the reader's attention through a carefully crafted prose style. Language chosen is appropriate to the subject, but may call attention to itself in minor ways.	The writing is clear but could be expressed in a style more appropriate to the subject. It is jargon-free but may require a more complete explanation of some terms used.	The writing lacks clarity and is sometimes confusing. The language chosen is not appropriate to the subject nor the assignment.	
<b>Syntax/Grammar</b>	The writing contains sentences that are always complete and grammatically correct, and free of confusion and ambiguity.	The writing contains sentences that are complete or which imply unstated connections and/or conclusions. The writing may exhibit a few minor errors in grammar or style, but do not impair the flow of the reading.	The writing contains some grammatical errors easily corrected by adherence to a uniform style throughout. Additional proofreading would help eliminate errors.	The writing is confusing and ambiguous owing to substantial errors of grammar and syntax. There is no evidence of proofreading, editing, or rewriting.	

## TEACHING APPROACHES

**Lectures, power point presentations and class discussions:** The instructor will give lectures in class to explain to the students' various topics on biochemistry of microorganisms. 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

**Video shows** on selected topics will be presented in class to assist in comprehending concepts taught

**Assignment criteria:** Students will be given quizzes and/or research assignment(s) 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.

## COURSE EVALUATION

Class attendance	5%
Individual presentation	5%
Individual assignment	10%
Continuous practical assessment	10%
Quizzes	10%
Mid semester exam	25%
End semester exam	25%
Practical exam	10%
<b>Total</b>	<b>100%</b>

## KEY INSTITUTIONAL ACADEMIC POLICIES

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

- **Academic dishonesty**
  - a. Any intentional giving or use of external assistance during an examination without the express permission of the faculty member giving the examination.
  - b. Fabrication: any falsification or invention of data, citation or other authority in an academic exercise;
  - c. Plagiarism: any passing off of another's ideas, words, or work as one's own;
  - d. Previously Submitted Work: presenting work prepared for and submitted to another course;
- **Attendance** “The university expects regular class attendance by all students. Each student is responsible for all academic work missed during absences” (Page 45, University Catalogue).
- **Seven absences** from class will result in an automatic grade F
- **Acts of misconduct** “The code of conduct prohibits certain acts of misconduct by students enrolled at the university. The following acts are examples of violations:
  - ✓ Fabrication – any falsification or invention of data, citation, or other authority in an academic exercise.
  - ✓ Plagiarism – any passing of another’s ideas, words, or work as one’s own
  - ✓ Unauthorized collaboration – collaboration in any academic exercise unless the faculty member has stated that such collaboration is permitted.

- All references used to do assignments should be cited correctly (APA format)
- All online quizzes and Examinations will be administered under **Respondus Lock down and Zoom**
- Assignments should be done and submitted on the due dates. Late submission of assignments and practical's will be penalized. **Five marks** will be deducted for each day.
- Late submission due to reasons allowed in the institution Policy will be graded **but it is the responsibility of the learner to inform the faculty before the set due date to allow setting of a new date for submission for the affected learner.**
- **No make ups** are given for **mid semester** or **end semester examinations**. A student who fails to take mid or end semester examinations due to reasons allowed in the institution policy will be awarded an **Incomplete (I) grade** if the reason and **evidence for missing is provided and approved before the exam grading.**
- Special examination for missed mid semester examination will be offered **in week 10** of the same semester while special exam for missed end semester examination will be offered **on Friday of week 3, in the subsequent semester. Deans approval is required to be allowed to sit for special end semester examination.**
- **Mid** and **End** Semester examinations will comprise of three sections **Section A:** Multiple Choice Questions (40 Marks) and **Section B:** Short Answer Questions (30 Marks).

### REFERENCE BOOKS

1. Cohen, G. (2014). Microbial Biochemistry 3rd Edition. Springer. ISBN-13: 978-9401789073
2. F. Kayser, K. Bienz, J. Eckert, R. Zinkernagel (2005). Medical Microbiology 1st Edition. ISBN-10 : 1588902455; ISBN-13 : 978-1588902450

### OTHER REFERENCE TEXTS

1. Cooper, E. (2019). Recent Advances in Microbial Biotechnology. Callisto Reference. ISBN-13: 978-1641161169
2. Kundu, R., Narula, R. (2019). Advances in Plant & Microbial Biotechnology 1st ed. Springer. ISBN-13: 978-9811363207
3. Gurusamy, R., Natarajan, S. (2016). Microbial Biochemistry. Magnum Publishing LLC. ISBN-13: 978-1682501528

### GRADING

<b>SCORE</b>	90-100	87-89	84-86	80 -83	77-79	74-76	70-73	67-69	64-66	62-63	60-61	0-59
<b>GRADE</b>	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

### ACCESSIBILITY AND INCLUSION ACCESSIBILITY

The instructor is committed to creating a course that is inclusive in its design, but may have missed something. If you encounter barriers, please let me know immediately so that I can determine if there is a design adjustment that can be made or if an accommodation might be needed to overcome the limitations of the design. I will always be happy to consider creative solutions if they do not compromise the intent of the assessment or learning activity.

