COURSE CONTENT

Course

Course Code: MCB415
Course Title: Microbial Genetics and Molecular Biology (3 Units)
Course status: Compulsory

Course Contact Hours and Duration

Three hours per week for 15 weeks (45hours)

Venue and Time

BIOLAB Tuesdays 11:00am-12:00noon
A03 Thursdays 11:00am-1:00pm

Course lecturers: Okolie (2.0) and Ndako (1.0)

Lecturer Data

Name of lecturer: OKOLIE Charles
Highest qualifications obtained: PhD
Department: Biological Sciences
College: College of Science and Engineering
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Office Location: A311, First College Building, Landmark University Omu-Aran

Name of lecturer: NDAKO James
Highest qualifications obtained:
Department: Biological Sciences
College: College of Science and Engineering
E-mail:
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Office Location:

Course Content

The genetic code. Replication and mutation. Specific peculiarities of bacterial and fungal genomes. Methods in microbial genetics. Genetic engineering. Introduction to bioinformatics. Biotechnology Business.

Okolie

- Talking through the course (Course overview)
- Specific peculiarities of fungal genomes
- Specific peculiarities of bacterial genomes
- Methods in microbial genetics
- Genetic engineering
- Introduction to bioinformatics
- Biotechnology Business

Ndako

- The genetic code
- Introduction to Viral Genomics
- Replication and mutation

- ❖ Biotechnology Business

Course Description

The course MCB415 represents important fundamentals in microbial genetics and molecular biology. Some genetic puzzles which easily come to mind include the difference between the genome of the eukaryote (e.g: fungi) and the prokaryote (e.g: bacteria), why some bacteria are referred to as Gram positive while others are Gram negative, some fungi are able to produce the antibiotic penicillin which kills some bacteria, some bacteria fix nitrogen to plant roots while others are not capable, some bacteria are urease positive (coded by gene *ure*) while others are not, etc. Students offering this course are required to attempt and submit any given assignment promptly. Students' knowledge will be examined via continuous assessment and the mid-semester examination which add up to a maximum mark of 30 and the semester examination which carries a maximum mark of 70, making a total of 100 marks.

Course Justification

i. The course is designed to provide an introductory background to microbial genetics and molecular biology.
ii. Understanding of MCB415 will help the student create a picture of the genes which make of microbial genomes and how the proteins encoded by the genes determine the microbial phenotypes.
iii. Understanding of MCB415 will provide the student with the connection between the various possible uses of microbes in agriculture and industry.
iv. Understanding of MCB415 will provide the student with the understanding of the connection between microbial genomes and their association with the processes and issues in life including helpful and harmful roles of microbes in agriculture, health and the environment.
v. The students will also be taught the entrepreneurial possibilities open in microbial biotechnology and possible ways of accessing them including the intellectual property and patent issues.

Course objectives

At the end of this course, students would be able to:

i. Show knowledge of microbial genomes.
ii. Show understanding of the operation of microbial genomes for protein functionality.
iii. Explain the various differences between the eukaryotic genome and the prokaryotic genome.
iv. Apply genomic techniques to agriculture, health and the environment.

Course Requirement

The student should have knowledge of molecular structure of biomolecules. BCH211 is

prerequisite to MCB415.

Method of Grading- An illustration below

S/N	Grading	Score (%)
1.	Test	10
2.	Assignment	5
3.	Practical (laboratory work)	15
4.	Examination	70
	Total	**100**

Course Delivery Strategies

i. Teaching

ii. Tutorials

iii. Practical sessions

Method of Lecture Delivery/Teaching Aids

Classroom teaching including the use of magnetic boards, visual aids such as powerpoint slide projectors. Real-life examples will be used to link the classroom training with the students' everyday life.

DETAILS OF LECTURE CONTENT

- **Week of 5th October, 2015: Okolie**
- **Topic:** Talking through the subject of MCB415 – Microbial Genetics and Molecular Biology.
- **Objectives**

At the end of the talk, the students should be able to have a basal understanding of what MCB415 seeks to teach and their relevance in agriculture and the life sciences. The commercial values of Microbial Genetics and Molecular Biology will be discussed.

- **Study Question**

  What do you understand from the talk on Microbial Genetics and Molecular Biology and how would the lesson learnt benefit your daily life?

- **Recommended Further Reading**

  (1) Microbial genetics. Second Edition by Stanley R. Maloy, John E. Cronan, and David Freifelder (2013). Published by Jones & Bartlett Learning.

  (2) Modern Microbial Genetics. By UN Streips and RE Yasbinv (2013). Second Edition. John Wiley & Sons.

  (3) Websites mentioned in class.

- **Week of 12th October, 2015: Ndako**
- **Topic :** The genetic Code
- **Objectives**

At the end of the topic students should be able to understand that:

1. The genetic code is a set of rules defining how the four-letter code of DNA is translated into the 20-letter code of amino acids, which are the building blocks of proteins.

2. The genetic code is a set of three-letter combinations of nucleotides called codons, each of which corresponds to a specific amino acid or stop signal.

3. The concept of codons was first described by Francis Crick and his colleagues in 1961.

Study Question:

i) Discuss the role of DNA as the hereditary material responsible for all the characteristics of an organism.
ii) How does the DNA control the activities of a cell?
iii) Briefly describe the different types of amino acids commonly found in proteins

Recommended Further Reading.

Genetics and Molecular Biology, 1986 by Robert Schleif published by Addison-Wesley Publishing Company. 2nd edition Department of Biology, the Johns Hopkins University Baltimore, Maryland.USA

- **Week 19th October, 2015: Okolie**
- **Topic: Eukaryotic genomics – The Fungal genome**.
- **Objectives**

At the end of this week, the students should understand the features of the fungal genome as an example of eukaryotic genome. Special attention will be given to the genomes of *Saccharomyces cerevisiae* and *Candida spp.* as examples of helpful and harmful fungi in agriculture, industry and medicine. The student should also understand the commercial and health values of fungal genomes.

- **Study Question**

  Discuss the relevance of the genome of *Saccharomyces cerevisiae* to the baker and to the brewer.

- **Recommended Further Reading**

  i. Microbial genetics. Second Edition by Stanley R. Maloy, John E. Cronan, and David Freifelder (2013). Published by Jones & Bartlett Learning.
  ii. Modern Microbial Genetics. By UN Streips and RE Yasbinv (2013). Second Edition. John Wiley & Sons.
  iii. National Centre for Biotechnology Information (www.ncbi.nlm.nih.gov) and other websites mentioned in class.

- **Week of 26th October, 2015: Okolie**
- **Topic: Prokaryotic genomics – The Bacterial Genome**.
- **Objectives**

At the end of this week, the students should understand the features of the bacterial genome as the typical prokaryotic genome. Special mention will be made of the genomes of *Escherichia coli, Agrobacterium tumefaciens, Deinococcus radiodurans, Klebsiella spp., Staphylococcus aureus* and *Clostridium spp.* The student should also understand the helpful and harmful roles of bacteria as well as their agricultural, industrial, commercial and health values.

- **Study Question**

Discuss the association of horizontal gene transfer with gastroenteritis.

- **Recommended Further Reading**
  1. Microbial genetics. Second Edition by Stanley R. Maloy, John E. Cronan, and David Freifelder (2013). Published by Jones & Bartlett Learning.
  2. Modern Microbial Genetics. By UN Streips and RE Yasbinv (2013). Second Edition. John Wiley & Sons.
  3. National Centre for Biotechnology Information (www.ncbi.nlm.nih.gov) and other websites mentioned in class.

- **Week of 02 Novemebr, 2015: Ndako**
- **Topic: Viral Genomics**
- **Objectives**
- At the end of the topic students are expected to note the following facts:

  i) Viral diseases have an enormous impact on human health worldwide.
  ii) Genomic technologies are providing infectious disease researchers an unprecedented capability to study at a genetic level the viruses that cause disease and their interactions with infected hosts.
  iii) The goals of the Broad Viral Genomics Group as pioneer to the application of these technologies to address the crucial unanswered biological questions in viral disease and to foster a community of research leaders focused on using genomics to advance preventative and therapeutic strategies for viral diseases.

- **Study Question**
- What are the similarities and differences in evolutionary patterns among all the genes in a viral genome.
- **Recommended Further Reading: As represented in other topics outlined.**

- **Week of 09 November, 2015: Ndako**
- **Topic: Replication and Mutation**.
- **Objectives**

  Students are to understand the following basics at the end of the lectures:

a) That the DNA is unzipped before the original strands are used to help make the new molecules.
b) That MUTATIONS are any changes in the sequence of bases of DNA.
c) That Sometimes during replication, the cell makes a mistake and adds the wrong base.
d) When the cell replicates its DNA again, the two strands that are produced are no longer exactly the same.

- **Study Question**

  Students ability to differentiate the various types of mutations.
- **Recommended Further Reading**

  As represented below.

- **Week of 16 November, 2015: Okolie (Tuesday) and Ndako (Thursday)**
- **Topic: Tutorials and Continuous assessment**.
- **Objectives:** To test the extent of students' progress in understanding MCB415.

- **Week of 23 November, 2015: Okolie**
- **Topic: Genetic Engineering**
- **Objectives**

At the end of this week, the students should understand the basic techniques employed in engineering of microbial genomes for agricultural, industrial, health, and other uses.

- **Study Question**
  To be announced.
- **Recommended Further Reading**

1) Microbial genetics. Second Edition by Stanley R. Maloy, John E. Cronan, and David Freifelder (2013). Published by Jones & Bartlett Learning.
2) Modern Microbial Genetics. By UN Streips and RE Yasbinv (2013). Second Edition. John Wiley & Sons.
3) National Centre for Biotechnology Information (www.ncbi.nlm.nih.gov) and other websites mentioned in class.

- **Week of 30 November, 2015: Okolie**
- **Topic: Introduction to Bioinformatics**
- **Objectives**

This is hands-on bioinformatics. At the end of this week, the students should have familiarized themselves with databases at the National Centre for Biotechnology Information (NCBI: www.ncbi.nlm.nih.gov). The students should have attempted some hands-on bioinformatics exercises using some open access bioinformatics tools at NCBI.

- **Study Question**
- **Recommended Further Reading**

i. Introduction to Computational Molecular Biology (First Edition). By Setubal and Meidanis.
ii. Internet for the Molecular Biologist. By S.R. Swindell et al. (1996). Published by Horizon Scientific Press Ltd.
iii. National Centre for Biotechnology Information (www.ncbi.nlm.nih.gov) and other websites mentioned in class.

- **Week of 07 December, 2015: Okolie**
- **Topic: Methods in Microbial Genetics**
- **Objectives**

At the end of this week, the students should have learnt old and new methods of manipulation of microbial genomes. Genomic and post-genomic tools and techniques for handling microbial genomes will be discussed with deepened connection to modern practices in agriculture, medicine, pharmacy, bio-energy, industry and the environment.

- **Study Question**
  Discuss the polymerase chain reaction as a major gene manipulation tool.
- **Recommended Further Reading**

I. Microbial genetics. Second Edition by Stanley R. Maloy, John E. Cronan, and David Freifelder (2013). Published by Jones & Bartlett Learning.
II. Modern Microbial Genetics. By UN Streips and RE Yasbinv (2013). Second Edition. John Wiley & Sons.
III. PCR. McPherson MJ and Moller SG (2006) Oxford, UK, Taylor & Francis Group.

IV. National Centre for Biotechnology Information (www.ncbi.nlm.nih.gov) and other websites mentioned in class.

- **Week of 14 December, 2015: Okolie**
- **Topic: Microbial Associations with Animal and Plant Hosts**
- **Objectives**

At the end of this week, the students should have learnt the genomic factors underpinning the interesting associations between microbes and their hosts in the animal and plant kingdoms. These associations have implications for agriculture, medicine, pharmacy, bio-energy, industry and the environment.

- **Study Questions**

1.Using gene ontology, discuss microbial associations with animal and plant hosts
2.Describe the molecular mechanisms of inflammasome activation during microbial infections in humans

- **Recommended Further Reading**

1) Microbial genetics. Second Edition by Stanley R. Maloy, John E. Cronan, and David Freifelder (2013). Published by Jones & Bartlett Learning.
2) Modern Microbial Genetics. By UN Streips and RE Yasbinv (2013). Second Edition. John Wiley & Sons.
3) Unifying Themes in Microbial Associations with Animal and Plant Hosts Described Using the Gene Ontology by Torto-Alalibo et al. Microbiology And Molecular Biology Reviews, Dec. 2010, p. 479–503 (PDF in class)
4) Molecular Mechanisms of Inflammasome Activation during Microbial Infections by Broz and Monack. Immunol Rev. 2011 September ; 243(1): 174–190. doi:10.1111/j.1600-065X.2011.01041.x.

iv.**Week of 04 January, 2016: Okolie and Ndako**
v.**Topic: Biotechnology Business**
vi.**Objectives**

At the end of this week, the students should show basic understanding of the basic tenets of investing and doing business in biotechnology. There shall be a case study of a local biotechnology company. Issues in biotechnology business including founding a new business, funding, and intellectual property will be discussed in a business workshop style.

vii.**Study Question**

To be announced at the workshop.

- **Recommended Further Reading**

Websites to be announced in class.

Week 13: Tutorials and Practicals
Week 14: Revision
Week 15: Examination