Master Course Syllabus
Kennedy King College
One of the City Colleges of Chicago
Biotechnology
Semester/Academic Year (20__ - 20__)

Course Prefix and Number: Biotech 201

Course Title: Survey of Biotechnology

Length of Course: 16 weeks

PCS Code: 1.2

IAI Code:

Semester Credit Hours: 2.0

Contact Hours (minutes): 2 (1600 minutes)

Lecture Hours (minutes): 2 (1600 minutes)

Lab Hours (minutes): 0.0

Method of Delivery (mark all that apply): Face to Face _X_ Online _X_ Hybrid _X___

Course Catalog Description: This course will serve to introduce students to modern biotechnology which is based on recent developments in molecular biology, especially those in genetic engineering and bioengineering. Students will explore the diversity of the field focusing on such areas as medicine, biohazard, bioremediation, biocatalysis, biosafety, agriculture, forensics, quality control and assurance, testing, regulation, law and policy, intellectual property, proteomics, pharmacogenomics, nutrition, and product development. This course will incorporate speakers that are representative of specific areas in biotechnology. Writing assignments, as appropriate to the discipline, are part of the course.

Prerequisites: Pursuit of an Associates of Applied Science Degree in Biotechnology (0215).

Course Objectives:
This course covers:

1. The definition of Biotechnology.
2. Bioremediation - what it is and how it works.
3. Tools and techniques like genetic manipulation, cloning, transformation etc.
4. The various scientific and ethical issues related to stem cell use and cloning
5. Medical diagnostics tools.
6. Genetic engineering and how genetically modified organisms are created.
7. Plant biotechnology and its applications.
8. Why bioethics is important to biotechnology
9. How to identify a variety of career paths and employment opportunities related to the biotechnology industry.

Upon successful completion of the course, students will be able to:

1. Define biotechnology and describe the biology disciplines that contribute to it.

2. Compare and contrast prokaryotic cells to eukaryotic cells.
3. Define recombinant DNA technology and explain how it is used to clone genes.
4. Articulate the process of protein production by using biotechnology techniques
5. Articulate the advantages of using bacteria in biotechnology applications.
6. Describe the impact of biotechnology on agriculture production.
7. Outline some of the medical advances that have been made using animal models.
8. Explain how DNA analysis can improve medical diagnostics.
9. Explain what bioremediation is and describe why it is important.
10. Discuss the important goals, benefits and practices of aquaculture and to describe its global impact.
11. Articulate the importance of model organisms in medical biotechnology.
12. Describe the Animal and Plant Health Inspection Service and the U. S. Department of Agricultures' permitting process.
13. Define bioethics and explain how it relates to biotechnology.

Suggested Topical Outline					
Class Units (# of units is dependent on course – adjust accordingly)	Topic (Required)	Content (Optional - provide details)	Lab Information	Desired Outcome(s)	Suggested Assessment Method(s)
Unit 1	The Biotechnology Century and Its Workforce			• Define biotechnology and understand the many scientific disciplines that contribute to biotechnology. • Provide examples of historic and current applications of biotechnology and its products. • List and describe different types of biotechnology and their applications. • Provide examples of potential advances in biotechnology. • Discuss how medical diagnosis will change as a result of biotechnology and provide examples of how data from the Human Genome Project will be used to diagnose and treat human medical disease conditions. • Understand that there are pros and cons to biotechnology and many controversial issues in this field. • Describe career categories in biotechnology. • Develop an understanding of some important skills and training required to be part of the biotechnology workforce.	Chapter Quiz (10 – 20 questions)

				• Discuss hiring trends in the biotechnology industry.	
Unit 2	An Introduction to Genes and Genomes			• Compare and contrast the structures of prokaryotic and eukaryotic cells. • Discuss important experiments that led scientists to determine that DNA is the inherited genetic material of living organisms. • Describe the structure of a nucleotide and explain how nucleotides join together to form a double-helical DNA molecule. • Describe the process of DNA replication and discuss the role of different enzymes in this process. • Understand what genomes are and appreciate why biologists are interested in studying genomes. • Describe the process of transcription and understand the importance of mRNA processing in creating a mature mRNA molecule. • Describe the process of translation including the roles of mRNA, tRNA, and rRNA. • Define gene expression and understand why gene expression	Chapter Quiz (10 – 20 questions)

				regulation is important. • Discuss the role of operons in regulating gene expression in bacteria. • Name different types of mutations and provide examples of potential consequences of mutations.	
Unit 3	Recombinant DNA Technology and Genomics			• Define recombinant DNA technology and explain how it is used to clone genes. • Compare and contrast different types of vectors and describe practical features of vectors and their applications in molecular biology. • Discuss how DNA libraries are created and screened to clone a gene of interest. • Describe how agarose gel electrophoresis, restriction enzyme mapping, and DNA sequencing can be used to study gene structure. • Explain common techniques used to study gene expression. • Be familiar with RNA interference (RNAi) as a powerful new technique for silencing gene expression. • Understand potential scientific and medical consequences of the Human Genome Project,	Chapter Quiz (10 – 20 questions)

				and discuss its ethical, legal, and social issues. • Define bioinformatics and explain why this new field is important.	
Unit 4	Proteins as Products			• Describe in general terms the molecular structure of proteins. • Provide three examples of the medical applications of proteins. • Explain the uses of some biotechnologically produced enzymes in industry. • List common household products that may include manufactured proteins as ingredients. • Explain why E. coli is frequently used for protein production. • Explain why protein glycosylation may determine the choice of an expression system. • Outline a general scheme for protein purification of hemoglobin. • Explain how the target protein is separated from other cell proteins given a specific purification sequence. • Explain proteomics and how it will affect future protein studies.	Chapter Quiz (10 – 20 questions)
Unit 5	Biotech Speaker/Field trip				Reflection Paper

Unit 6	Microbial Biotechnology			• Provide examples of how prokaryotic cell structure differs from eukaryotic cell structure and describe shapes of many common bacteria. • Describe the practical features of bacteria that make them useful as model organisms and tools for many applications in biotechnology. • Provide examples of how yeast can serve valuable roles in biotechnology. • Define fermentation and discuss the difference between alcohol and lactic acid fermentation. Provide examples of common foods and beverages produced by each fermentation process. • List examples of medically important proteins that are produced in bacteria using recombinant DNA technology. • Describe how microorganisms play an important role in the development and production of many vaccines and provide examples of the importance of vaccines. • Discuss why studying microbial genomes can be valuable to scientists. • Define environmental genomics.	Chapter Quiz (10 – 20 questions)

				• Define bioterrorism, identify microorganisms that may pose a threat as bioweapons, and discuss biotechnology strategies that may be used to detect, and identify and combat bioweapons.	
Unit 7	Plant Biotechnology			• Describe the impact of biotechnology on the agricultural industry. • Discuss the limitations of conventional crossbreeding techniques as a means of developing new plant products. • Explain why plants are especially suitable for genetic engineering. • List and describe several methods used in plant transgenesis, including protoplast fusion, the leaf fragment technique and gene guns. • Describe the use of Agrobacterium and the Ti plasmid as a gene vector. • Define antisense technology and give an example of its use in plant biotechnology. • List crops improved by genetic engineering. • Outline the environmental impacts, both pros and cons, of crops enhanced by biotechnology.	Chapter Quiz (10 – 20 questions)

				• Analyze the health concerns raised by opponents of plant biotechnology. • Outline several ways in which biotechnology might reduce hunger and malnutrition around the world.	
Unit 8	Animal Biotechnology			• List some of the medical advances made using animal research models. • Explain what makes a good animal model for genetic studies. • Describe two alternatives to the use of animal models, including their limitations. • Discuss some of the ethical concerns about using animals in research. • Outline the process used to create Dolly the sheep. • Discuss some of the limitations to the cloning processes. • List some of the products that can be produced using transgenic animals as bioreactors. • Explain how knockouts animals can be used to provide information about genetic disorders and other diseases. • Describe the process used to create monoclonal antibodies.	Chapter Quiz (10 – 20 questions)
Unit 9	DNA Fingerprinting			• Define DNA fingerprinting.	Chapter Quiz (10 – 20 questions)

	and Forensic Analysis			• Outline the process of collecting and preparing a DNA sample to be used as evidence. • List some factors that can degrade DNA evidence and some of the precautions required to maintain the reliability of DNA evidence. • Describe the steps in RFLP analysis. • Describe the PCR method. • Explain how DNA fingerprints are compared and evaluated. • Compare two or more DNA fingerprints and determine if they are matches. • Describe the use of DNA fingerprinting techniques in establishing familial relationships. • List some of the uses of DNA profiling in biological research. • Discuss some of the ethical issues surrounding DNA fingerprinting.	
Unit 10	Biotech Speaker/Field trip				Reflection paper
Unit 11	Bioremediation			• Define bioremediation and describe why it is important. • Describe advantages of bioremediation strategies over other types of cleanup approaches. • Name some of the common chemical	Chapter Quiz (10 – 20 questions)

				pollutants in the environment that need to be cleaned up and provide examples of ways in which chemicals enter different zones of the environment. • Distinguish between aerobic and anaerobic biodegradation and provide examples of microbes that can contribute to bioremediation. • Explain why studying genomes of organisms involved in bioremediation is an active area of research. • Define phytoremediation and explain how it can be used to clean up the environment. • Discuss how in situ and ex situ approaches can be used to bioremediate soil and groundwater. • Discuss the roles of bioremediation at a wastewater (sewage) treatment plant. • Provide examples of how genetically modified organisms can be used in bioremediation.	
Unit 12	Aquatic Biotechnology			• Discuss important goals and benefits of aquaculture and recognize and appreciate the worldwide impact of fish farming. • Discuss the controversies surrounding aquaculture and	Chapter Quiz (10 – 20 questions)

				describe its limitations. • Describe examples of commonly used fish farming practices. • Understand how the identification of novel genes from aquatic species may be beneficial to the biotechnology industry. • Provide examples of transgenic finfish and their uses. • Discuss how triploid species can be created. • Provide examples of medical applications of aquatic biotechnology. • Describe nonmedical products of aquatic biotechnology and their applications. • Define biofilming and explain how scientists are looking to marine organisms as a natural way to minimize biofilming. • Describe how marine organisms may be used for biodetection and remediation of environmental pollutants.	
Unit 13	Medical Biotechnology			• Provide examples of model organisms and explain why they are important. • Describe different karyotyping techniques that can detect chromosome abnormalities and molecular	Chapter Quiz (10 – 20 questions)

				techniques for genetic testing. • Provide examples of why pharmacogenomics can change how many genetic disease conditions may be treated in the future. • Discuss how monoclonal antibodies may be used for treating disease. • Understand the purpose of gene therapy and compare and contrast different gene therapy strategies and recognize limitation of gene therapy. • Define regenerative medicine and provide examples of how cell and tissue transplantation and organ engineering can be used. • Understand what stem cells are and describe how they can be isolated. Provide examples of possible therapies that may be developed from stem cells in the future. • Compare and contrast therapeutic cloning and reproductive cloning. • Briefly explain how molecular biology techniques and the Human Genome Project are being used to create human disease gene maps.	

Unit 14	Biotechnology Regulations			• Describe the APHIS (USDA) permitting process, including the precautions that must be taken to prevent the accidental release of bioengineered plants into the environment. • List the six criteria that must be met before a plant is eligible for "notification" under APHIS guidelines. • Describe the role of the EPA in regulating biotechnology products. • Describe the FDA's role in regulating food and food additives produced using biotechnology. • Describe the FDA's role in regulating pharmaceutical products including phase testing. • Cite examples of the regulatory agencies' ability to respond to emerging situations. • Describe the functions of patents and explain how patents encourage discovery. • Explain why DNA sequences are considered patentable.	Chapter Quiz (10 – 20 questions)
Unit 15	Biotech Speaker/Field trip				Reflection paper
Unit 16	Ethics and Biotechnology			• Define bioethics and explain how it relates to biotechnology.	Chapter Quiz (10 – 20 questions)

				• Identify different approaches to ethical thought. • Identify potential ethical problems associated with biotechnological research. • Pose questions and approaches that address the ethical problems identified in this chapter. • Identify the outcomes and pitfalls associated with different ethical approaches. • Describe the ethical considerations for research with humans. • Discuss interactions among science, economics, communication, and public policy. • Understand and explain controversies and ethical issues surrounding genetic testing, stem cells, and cloning. • Describe possible pathways to careers in the bioethics field.	Final comprehensive Exam

Students Course Is Expected to Serve: Students may take this course to meet concentration requirements for an Associates of Applied Science Degree in Biotechnology.

Suggested Texts, Materials, and Resources:

Text: Introduction to Biotechnology by W. J. Thieman and M. A. Palladino 4th ed. Pearson 2019
Materials:
Resources:
Supplies:

Suggested Methods of Instruction: Instruction methods include lectures and class discussions. Using Internet resources to supplement topics being studied.

Suggested Methods of Assessment and Evaluation:
Students will be evaluated with Exams, Quizzes, papers and Discussions.

Suggested Grading Scale:

Assignments:	Grade Distribution: 90 % to 100 % = A 80 % to 89% = B 70 % to 79 % = C 60 % to 69 % = D Below 60% = F

Suggested Exit Assessment/Competencies (as applicable):

Processing Validation (To be completed by College)

Add – Effective Term/Year: _____ Reactivate – Effective Term/Year: _____
Inactivate – End Term/Year: _____ Withdraw – End Term/Year: _____

Approved College(s):

DA: ___ HW: ___ KK:_X_ MX:___ OH:___ TR:___ WR:___

Syllabus Preparer/Advocate: _____Clifford Wilson, III_____

Title of Advocate: _____Assistant Professor_____

College of Advocate: _____Kennedy King College_____

ICCB Submission Date: (/ /)
ICCB Approval Date: (/ /)
IAI Submission Date: (/ /) IAI Panel: _____
IAI Approval Date: (if applicable) (/ /) IAI Code: _____