DEPARTMENT OF BIOLOGY
MEDGAR EVERS COLLEGE of the CITY UNIVERSITY OF NEW YORK

SYLLABUS
BIO 472 *** MOLECULAR BIOTECHNOLOGY - PRINCIPLES AND APPLICATIONS

I. TEXT BOOKS:

1. Glick, B. R. and J. J. Pasternak. 2003 (Third Edition). Molecular Biotechnology- principles and applications of recombinant DNA. ASM press. For Lecture.

2. D.A. Micklos ,G.A. Freyer and D. A. Crotty 2003. DNA Science (2nd Ed). Cold Spring Harbor Laboratory Press. For lab.

3. Selected articles from scientific journals.

II. COURSE DESCRIPTION:

This course would cover all aspects of Biotechnology including theoretical basis of gene manipulation, products and processes involved in this fastest growing discipline. The usefulness and implications of biotech products would be discussed. The biotech concepts learned in the lectures would be reinforced by hands-on laboratory projects. The lab component of the course would include several techniques such as, genomic and plasmid DNA isolation and purification, from a variety of samples, cloning gene of interest, separation technology, blotting technology, gene library construction and screening, RT-PCR technology, DNA fingerprinting technology (RAPD, AFLP, Microsatellite, RFLP) and DNA sequencing and analysis that are routinely used in most molecular biotechnology laboratories. On successful completion of this course students should be able to directly apply these techniques if they decide a career in biotechnology.
Credit: Four (3 class and 3 lab hours).

III. THE PURPOSE:

a. give students a basic understanding and awareness of DNA science and related emerging technologies.
b. prepare students' background for advanced studies in biotechnology discipline beyond the baccalaureate degree.
c. provide students with initial training for professional career in biotechnology sector.

IV. COURSE OBJECTIVES:

Students will:
a. Acquire an understanding of the historical development of molecular biotechnology revolution.
b. Gain advance knowledge on manipulation of nucleic acid molecules.
c. Learn about different genetic systems, their organization and expression mechanisms.
d. Obtain knowledge of the biology of different vectors that are being used in the recombinant DNA technology.
e. Develop competency in molecular cloning and genetic engineering technology.

f. Learn about the applications of recombinant DNA technology and moral and ethical considerations.
g. Acquire basic skills to participate in an emerging technology.
h. Gain learning experience that would integrate the theory, practice and application of molecular biotechnology.
i. Learn how recombinant DNA technology can be used to create various useful products.
j. Gain knowledge about bioinformatics.
k. Learn to place orders for lab supplies and equipment.
l. Develop skills to maintain lab record and managing data.

V. SYLLABUS/COURSE OUTLINE:

A. ***LECTURE TOPICS***

1. **Development of Modern Biotechnology:**
   (a). Emergence of molecular biotechnology and its commercialization, concerns and consequences.
   (b). Molecular biotechnology biological systems,
   ©. DNA Science-an overview. Ch. 1&2.

2. **Recombinant DNA technologies:** Ch. 4 and handouts.

   (a). Restriction Endonucleases;
   (b). Cloning vectors: plasmids, λ-based vectors, BAC, YAC, plant cloning vectors, mammalian cell vectors;
   ©. Genetic transformation of Prokaryotes;
   (d). construction and screening gene libraries;
   (e). Nucleic acid hybridization technologies

3. **Chemical Synthesis, Sequencing, and Amplification of DNA:** . Ch. 5
   (a). Chemical synthesis of DNA,
   (b). PCR and PCR-related technology,
   ©. DNA sequencing technology.

4. **Manipulation of gene expression:**
   (a). gene organization, expression and control mechanisms in prokaryotes and eukaryotes.
   (b). Gene expression from strong and regulatable promoters,
   ©. Protein stability- fusion proteins, DNA integration into the host chromosome, increasing secretion, metabolic load. Ch. 6.

5. **Recombinant protein production in eukaryotic cells:** Yeast expression system, cultured insect cell expression system, and mammalian expression system. Ch. 7.

6. **Directed Mutagenesis and Protein Engineering:** Directed mutagenesis procedure, protein engineering. Ch. 8.

7. **Molecular Diagnostics:** Monoclonal antibodies, DNA diagnostic systems, molecular diagnosis of genetic disease, prospects. Ch. 9.

8. **Microbial Biotechnology:** Microbial production of therapeutic agents, vaccines, restriction enzymes, small biological molecules, antibiotics and biopolymers. commercial production of genetically engineered microorganisms for bioconversions, microorganisms and agriculture-nitrogen-fixing bacteria, microbial insecticides, bioremediation, biomining, microorganism and future. Ch 10-16.
9. **Plant Biotechnology:** plant tissue culture and applications, plant genetic engineering and its application in agriculture, developing transgenic plant strains by genetic engineering and public concern, future prospect. Ch. 17 &18.

10. **Transgenic animals:** methods of gene transfer in animal cells, animal propagation, transgenic animals and their use, regulation and patenting of transgenic animals.

11. **Human Molecular Genetics:** understanding human genome, DNA markers and mapping genome, cloning human disease genes, human genome project. Ethical, legal and social implications, bioinformatics. Ch. 20.

12. **Medical Biotechnology:** Human gene therapy, gene delivery methods, gene therapy models, tissue engineering, cell adhesion-based therapy, stem cell biotechnology Ch. 21.

13. **Forensics and DNA Profiling:** Satellite DNA, single and multi-locus VNTRs, DNA typing and DNA fingerprinting technology.

14. **Regulation, Patents and Society:** Regulation of biotechnology, genetically engineered organism and environment, patent and biotechnology, NIH guidelines, social and ethical considerations. Ch. 22 & 23.

B. LABORATORY PROJECTS

Lab Requirements: For your own safety and protection, lab coat, gloves and safety eyeglasses must be worn in the lab during experiments. Students must sign a departmental form acknowledging that they have received lab safety instructions. Each lab session has an assigned reading in the lab manual. Lab reports are due at the beginning of the next session. Attendance is required. **No make-up labs are available**

Laboratory 1: Lab. Safety, Measurements and calculation, and Sterile Techniques, Preparation of media and reagents , Problem solving, Assignment 1

Laboratory 2: Micropipetting. Bacterial culture techniques and quantification, Preparing DNA extraction buffer.

Laboratory 3: DNA extraction strategies, DNA extraction from plant and animal samples purification and quantification methods, restriction and electrophoresis**.**

Laboratory 4a: Restriction analysis of lambda DNA
4b : Effect of DNA methylation on restriction.

Laboratory 5: Restriction mapping of the plasmid/Lambda DNA.

Laboratory 6a: PCR amplification of human mitochondrial DNA.
6b: DNA fingerprinting: Human VNTR polymorphism.

Laboratory 7: Rapid colony transformation of *E. coli* with plasmid DNA.

Laboratory 8: .Assay for an Antibiotic resistance Enzyme

Laboratory 9: .Purification and identification of Recombinant GFP

Laboratory 10: Isolation, purification and restriction of plasmid DNA (pAMP).

Laboratory 11: Recombination of antibiotic resistance genes for pAMP and pKAN.

Laboratory 12: Preparing competent E. coli cells and Transformation of E. coli with recombinant DNA
Laboratory 13: Purification and identification of recombinant DNA

Laboratory 14: Southern hybridization of lambda DNA.

Laboratory 15: Bioinformatics: Use of DNA analysis software, DNA sequence analysis, Blast searching, Phylogenetic analysis.

VI. METHOD OF INSTRUCTION:

Instruction would include, lecture, use of multimedia resources, class discussion, student presentation of selected topics, analysis of recent research articles.

VII. REFERENCE MATERIALS:

LECTURE

1. Lewin, B. 2004. Genes VIII. Pearson Education Inc. Pearson Prentice Hall
2. Barnum, S.R. 2005. Biotechnology- an introduction. Brooks/Cole, Thomson Learning, Inc.
3. Palladino, M.A. and Thieman, W.J. 2004. Introduction to Biotechnology. Pearson Education, Inc.
4. Kresina, T. F. 2001. Molecular Medicine and Gene Therapy. Wiley-Liss

LABORATORY

1. Sambrook, J., E.F. Fritsch and T. Maniatis. 1989. Molecular Cloning – A Laboratory Manual (2nd ed.). Cold Spring harbor Laboratory Press.
3. Seidman, L.A. and C. J. Moore. 2000. Basic Laboratory Methods for Biotechnology. Prentice-Hall Inc.

VIII. COURSE REQUIREMENTS:

Considering the dynamic nature of this discipline, students would be given reading materials from recent journals in addition to the designated textbook and reference books. Being a concept-oriented course, students will be involved in problem solving and quite a bit of analytical skills will be needed to obtain good score. Students must be willing to work in the lab outside scheduled lab hours to complete their experiments. There will be no makeup labs. Any student missing two labs will be considered to be withdrawn from the course. No violation of the lab. rules and ethics will be taken lightly.

IX. EVALUATION METHOD:

a. Students will be evaluated through a series of tests, assignments, presentations, term paper and on lab performance. The lecture and the lab will have 60% and 40% of total points respectively.

b. Grading system will be as follows:
Grading Scale: 97-100 = A+; 93-96.9 = A; 90-92.9 = A-; 87.1-89.9 = B+; 83-87 = B; 80-82.9 = B-; 77.1-79.9 = C+; 73-77 = C; 70-72.9 = C-; 67.1-69.9 = D+; 63-67 = D; 60-62.9 = D-; 00-59.0 = F.
A grade of "D" is not acceptable toward a degree at Medgar Evers College.