San Bernardino Valley College
Curriculum Approved: May 9, 2005

I. COURSE INFORMATION:

A. Division: Math & Science
Department: Biology Department
Course ID: BIOL 291
Course Title: Biotechnology II
Units: 5 units
Lecture: 3 hours
Laboratory: 6 hours
Prerequisite: BIOL 290

B. Catalog Description: This course will expand on the principles of cellular and molecular biology as applied in the biotechnology laboratory. Laboratory work will include DNA & RNA isolations, DNA amplification and sequencing, recombinant techniques, restriction analysis of DNA and protein purification and analysis.

C. Schedule Description: This course will expand on the principles of cellular and molecular biology as applied in the biotechnology laboratory.

II. NUMBER OF TIMES A COURSE MAY BE TAKEN FOR CREDIT: One

III. EXPECTED OUTCOMES:

Upon successful completion of this course, the student should be able to:

A. Apply practices of lab safety, safe handling, storage and disposal of hazardous wastes and reference Material Safety Data Sheets.
B. Illustrate and explain the workings of the biosafety and fume hoods to effectively protect personnel, environment and product.
C. Write, edit and follow a protocol.
D. Identify and prepare the proper buffers, stains, and other solutions utilized in a personally designed protocol.
E. Employ proper handling, inventory and temperature storage of biological samples at -79C, -20C, 0C and room temperature.
F. Perform routine tasks with DNA including extraction from multiple sources, restriction digest, quantitation, size determination, ligation, recombination, sequencing and amplification.
G. Identify and use appropriate gel documentation systems.
H. Apply the principles of electrophoresis and chromatography to the separation of biomolecules
I. Maintain a lab journal documenting procedures, calculations and results.

IV. CONTENT:

A. Lecture
1. Gene structure, expression, regulation
2. Bioseparation
   a) filtration – syringe, room, hood, water
   b) centrifugation – clinical, micro, ultra, G-force, rpm, density gradient, sedimentation coefficient
   c) chromatography – separation of RNA and DNA
   d) electrophoresis
3. Cloning
   a) libraries
   b) cDNA
   c) vector-host selection – statistical considerations
   d) selection, identification and characteristics of clones
4. Isolation and Purification of NA
5. Synthesis of DNA, sequencing
6. Northern, Southern, Western blots and analysis
7. Use, construction, labeling and detection of probes
8. PCR theory and protocols

9. Recombinant DNA technology and disease
10. Immunological assays
11. Industrial application
12. Risks and Benefits of Biotechnology

B. Laboratory exercises and preparatory lectures directed at the development of advanced skills in the following categories.
   1. Lab safety revisited
      a) fume hoods
      b) biosafety hoods
      c) clean rooms - air flow and room design
      d) handling of chemicals
   2. Solutions and materials revisited
      a) buffers
      b) gels
      c) stains
      d) columns
      e) enzymes
   3. Bacteriology revisited
      a) media selection and preparation
      b) antibiotic selection and use
      c) preparing competent cells for transformation
   4. Chromosomal DNA extraction
      a) examine and test protocols for different sources of DNA and levels of instrumentation, safety or facility
      b) gel electrophoresis, staining, documentation assess yield and size
   5. RNA isolation, gel electrophoresis and analysis
   6. Plasmid isolation, gene insertion, transformation, product identification and purification.
   7. Phage
      a) detection in host cells
      b) use and maintenance
      c) restriction digests, gel electrophoresis, and analysis
   8. DNA fingerprinting – PCR amplification
   9. DNA sequencing – sequence retrieval from internet sites
   10. Immunoassays
      a) Elisa
      b) Immunoblot
      c) Western blot
      d) Immunoelectrophoresis

V. METHODS OF INSTRUCTION:

A. Lecture format with and without various media support
B. Media support materials in the learning center
C. Open discussions
D. Problem solving groups
E. Presentations
F. Field trips & guest speakers – application ob biotechnology
G. Laboratory exercises on application of procedure and protocol development

VI. TYPICAL OUT-OF-CLASS ASSIGNMENTS:

A. Reading Assignment: Compare and write a written report on gel concentrations utilized in different types of biomolecule separations.
B. Writing Assignment:
   1. Write a protocol for determining the g-force of a clinical centrifuge.
   2. Use the internet site NCBI to retrieve the DNA sequence for _____. Write a paper on the history of DNA sequencing leading to the present use of the internet for this information.

C. Critical Thinking Assignment:
   1. Examine the protocol for plasmid DNA extraction and explain the solution requirements of each step.
   2. Prepare a standard curve for quantification of DNA.
   3. Division of the class into groups: Select either a pro or con position on the use of gene therapy for the treatment of disease. Research your position and prepare to debate with a group taking the opposing position.

VII. EVALUATION:

A. Methods of evaluation
   1. Objective and subjective examinations on lecture and laboratory materials presented in class. Examples:
      a) You must filter an organic solvent. Which type of membrane will you use:
         i. nitrocellulose
         ii. cellulose acetate
         iii. nylon
         iv. polysulfone
         v. polypropylene
      b) Solutions of proteins and of nucleic acids are colorless. Does this mean they do not absorb any light?
      c) A colleague tells you that a sample was centrifuged for a certain time at a speed of 15,000 RPM and the force of centrifugation 16,000 X g. Your centrifuge equipment has a radium of rotation of 9.2 cm. What speed will you use to achieve a force of 16,000 X g?
      d) Given a bacterial culture containing a plasmid, outline the procedure for isolating the genomic DNA. Explain the rational of each step and solution
   2. Laboratory practical exams. Example tasks:
      a) Prepare competent cells for transformation and properly store them for future use.
      b) Prepare a standard curve for protein concentration determination.
      c) Perform a restriction digest of lambda phage and Interpret the digest for size of fragments.
   3. Maintain a laboratory journal

B. Frequency of evaluation:
   1. Lecture examination every 3 to 4 weeks.
   2. Laboratory practical and written exams 2 to 3 times each semester

VIII. TYPICAL TEXT(S):

A. Kreuzer, Helen and Adrianne Massey, Recombinant DNA and Biotechnology; a guide for students, Second Edition, Washington, DC, ASM Press, 2001
B. Scheppler, Judith A., Patricia E. Cassin, and Rosa M. Gambier, Biotechnology Explorations, Applying the fundamentals, Washington, DC, ASM Press, 2000
C. Seidman, Lisa A., and Cynthia J. Moore, Basic Laboratory Methods for Biotechnology; Textbook and laboratory reference, New Jersey, Prentice Hall, 2000
D. Thieman, William J. and Michael A. Palladino, Introduction to Biotechnology, San Francisco, Pearson/Benjamin Cummings, 2004

IX. OTHER SUPPLIES REQUIRED OF STUDENTS:

A. Lab coat
B. Protective eye wear
C. Box of disposable gloves
D. NCR numbered page lab journal
E. Colored pencils and a black Sharpee