MiraCosta College

BTEC 110 - BASIC TECHNIQUES IN BIOTECHNOLOGY

Units Lecture	2.00	**Units Lab**	2.00	**Units Total**	4.00
Total Hrs Lecture	33.00	**Total Hrs Lab**	99.00	**Total Course Hrs**	132.00

COURSE DESCRIPTION

This course focuses on the basic laboratory skills needed for employment in the bioscience/biotechnology industry. Students learn laboratory safety and documentation while acquiring skills in the maintenance and calibration of basic lab equipment, calculation and preparation of lab solutions and media, and routine handling of both bacterial and mammalian cell cultures (tissue culture). Students also develop fundamental skills in spectroscopy, centrifugation, performance of assays, gel electrophoresis, and the purification and handling of biological molecules, such as proteins and DNA.

ENROLLMENT RESTRICTIONS

PREREQUISITES
None

COREQUISITES
None

ADVISORIES
Eligibility for ENGL 100.
MATH 101 or MATH 101B or qualification through the Math Competency Exam.
CHEM 108
BIO 101 or BIO 100 or BIO 105

OUTLINE OF COURSE CONTENT

The course will address the following topics:

LECTURE
I. Solution preparation
A. Documentation and maintenance of laboratory notebooks
B. Chemical awareness and laboratory safety (chemical, physical, and biological hazards)
C. Applied mathematics
D. Solution calculations
E. Introduction to pH and buffered solutions.
II. Aseptic technique and cell growth
A. Principles of bacterial cell growth (focus on E. coli)
B. Bacteriophage life cycles
C. Growth of eukaryotic cells in culture
D. Practical aspects of cell culture in the laboratory, including physical and nutritional requirements of cells.
III. Assays
A. Underlying principles of quantitative methods to include assay parameters such as design, range, limitations, linearity, interference, and reproducibility
B. Principles of spectroscopy
C. Computational analysis of assay results.
IV. Chromatography
A. Properties of biomolecules (function, size, charge, cellular localization)
B. Principles of chromatography to include size, ion exchange, and affinity
C. Calculation of yield, purity, specific activity, fold-purification.
V. Separation by electrophoresis
A. Principles of separation by electrophoresis
B. Practical applications of electrophoresis.
VI. Foreign Gene Expression
A. Central dogma (DNA—RNA—protein)
B. Recombinant DNA technology techniques (isolation of DNA, assessment of DNA yield and integrity, and introduction of foreign DNA)
C. Production of foreign proteins in cells
D. Assessment of product (antibody-mediated detection and quantification with ELISA/Western).

LABORATORY

I. Solution preparation
A. Skill development in weighing and volumetric techniques
B. Calibration of lab equipment (pipettors, balances, pH meters, autoclave)
C. Measurement of pH
D. Understanding, compliance, and development of standard lab procedures (SOPs).
II. Aseptic technique and cell growth
A. Skill development in the routine handling of equipment, solutions, and cultures in a sterile manner
B. Media preparation
C. Introduction to microscopy, centrifugation, and spectroscopy; containment as related to cell culture
D. Isolation of bacterial colonies and phage
E. Maintenance, manipulation, and storage of bacterial and eukaryotic cultures
F. Quantification techniques of cell/bacteriophage growth (generation time, confluency)
G. Bacteriophage quantification (titering).
III. Assays
A. Applied spectrophotometry
B. Assay performance (end-point and kinetic)
C. Assay development
D. Analysis and interpretation of results.
IV. Chromatography
A. Fractionation of cells using centrifugation
B. Size exclusion chromatography of a biomolecule
C. Ion exchange chromatography of a biomolecule
D. Computation of outcomes (yield, purity, and specific activity).
V. Separation by electrophoresis
A. Polyacrylamide gel preparation
B. Polyacylamide gel electrophoresis performance for the separation of proteins
C. Analysis and interpretation of results.
VI. Directed project
A. Introduction of recombinant DNA into host cells
B. Identification of recombinant cells
C. Evaluation of foreign protein production.

PERFORMANCE OBJECTIVES

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

1). Demonstrate the ability to follow instructions for laboratory procedures as described in Standard Operating Procedures (SOPs) and other written documents, including safety and awareness
2). Document lab procedures, calculations, measurements, observations, and analyses in a lab notebook
3). Prepare chemical solutions safely, efficiently, and effectively; perform necessary calculations to prepare solutions described by molarity, weight per volume, and percentage
4). Calibrate and use various basic laboratory equipment, including pipettors, balances, pH meters, and autoclaves
5). Relate aseptic technique principles to the manipulation and maintenance of bacterial and eukaryotic cell cultures
6). Recognize, manipulate, and quantify bacterial cultures of E. coli, various common bacteriophage, and eukaryotic (mammalian) cell cultures, using terms such as titer, generation time, and confluency
7). Explain how assays are used to determine unknown quantities; relate this process to underlying principles of visible and UV spectroscopy
8). Perform both endpoint and kinetic rate assays, utilizing the principles of range, limitations, linearity, interference, and reproducibility in data collection and analysis
9). Relate the principles of electrophoresis to the separation of various biomolecules by their physical properties; demonstrate the ability to prepare a variety of gels and use them effectively to separate these molecules
10). Apply basic knowledge of a biomolecule’s properties, such as cellular localization, size, charge, and function, to purify the molecule from complex mixtures using column chromatography; calculate yield, specific activity, and fold-purification
11). Isolate DNA from biological sources, assess the yield and integrity of the product, introduce the foreign DNA into cultured cells, and perform protocols (ELISA/Western) using antibody reagents to detect the presence and quantity of specific proteins produced as the result of the inserted DNA.