Common Course Number: BSC-4420-L

Course Title: Biotechnology Laboratory

Catalog Course Description:

This course provides students with practical, hands-on laboratory experiences to supplement the BSC-4330 course. This laboratory course addresses the proper use of laboratory techniques including but not limited to: appropriate record keeping and experimental design, the use of quantitative and analytical techniques such as chromatography, spectrophotometry, and electrophoresis; the proper use of laboratory equipment such as centrifuges, balances, and microscopes; preparation and measurement of laboratory solutions and reagents; protein/nucleic acid isolation and characterization procedures; and tissue culture techniques. Special emphasis will be placed on relevant laboratory safety techniques and the proper use and disposal of laboratory reagents, materials and biological specimens. (2 credits, 4 hr laboratory)

Credit Hours Breakdown: 2 credit

Prerequisite: BSC-2010, BSC-2010-L; BSC-2011, BSC-2011-L, MCB-2013, MCB-2013-L, CHM-1045, CHM-1045-L, CHM-1046, CHM-1046-L, PCB - 3060, with a minimum grade of C, are required before taking this course.

Co requisite: BCH-3023, BSC-4420

Course Competencies:

Competency 1: The student will demonstrate knowledge of the safety regulations that must be implemented at the biotechnology laboratory by:

A. Explaining the relevance of working in a safe laboratory environment, understanding the different physical hazards and risk assessments involved in working in the biotechnology laboratory.

B. Outlining general personal protection regulations, identifying safety laboratory dressing, the locations and purpose of full body shower stations, eye wash stations, fire extinguishers, chemical storage rooms, flammable and corrosive chemical cabinets, glassware cabinets and other laboratory instruments used in the biotechnology laboratory.

C. Explaining use of autoclaves, electrical equipment and gel electrophoresis devices

D. Explaining proper procedure of broken glassware and sharp instruments disposal.

E. Identifying the chemical hazards involved in working in the biotechnology laboratory.

F. Working safely with different chemical by understanding the hazards and toxicity imposed by contacting with each chemical in the laboratory.

G. Identifying the routes for toxicity exposure and implementing strategies for minimizing exposure.

H. Integrating knowledge of safety procedures in radionuclides disposal.

I. Manipulating biological molecules using non-radioisotopic techniques.

J. Safely handling of microorganism cultures and tissue cultures.

K. Describing the proper safety measures when working with recombinant DNA products

L. Recognizing proper storage and disposal of hazardous materials and biological specimens.

M. Identifying federal, state, and International Science Engineering Fair guidelines for humane and ethical treatment and handling of biological specimens and experimental subjects.

Competency 2: The student will demonstrate knowledge of standard operating and record-keeping procedures in a biotechnology laboratory by:

A. Identifying and maintaining appropriate procedural forms, protocols, reports, and logbooks.

B. Recording/obtaining data from instruments appropriately.

C. Maintaining appropriate electronic documentation (database) of experimental procedures and results.

D. Accurately using analytical laboratory documents

E. Implementing appropriate labeling procedures

F. Implementing appropriate "chain of custody" documentation.

Competency 3: The student will be able to demonstrate knowledge of basic mathematical calculations by:

A. Resolving complex mathematical equations/calculations and measurements such as: percent calculation, volumetric density, concentration and dilutions, application of logarithms, and units' conversion.

B. Resolving equations with different units.

C. Resolving equations with different ratios and proportions

D. Resolving exponential relationships

E. Representing data graphically

Competency 4: The student will demonstrate knowledge of appropriate experimental design/protocols by:

A. Recognizing samples' representation and randomness.

B. Calculating the variance and standard deviation.

C. Recognizing patterns of normal distribution and standard deviation

D. Setting appropriate experimental controls.

E. Implementing and explaining the use of false positive and false negative experimental controls.

Competency 5: The student will demonstrate knowledge of the appropriate use and handling procedures of laboratory equipment/instruments by:

A. Performing appropriate handling and quantitative procedures using mechanical and electric balances.

B. Performing appropriate handling and quantitative procedures using pipettes, micropipetting devices and volumetric glassware.

C. Performing appropriate handling and quantitative procedures using thermometers

D. Performing appropriate handling and quantitative procedures using pH-meters

E. Performing appropriate handling and quantitative procedures using spectrophotometers.

F. Performing appropriate handling procedures using centrifuges.

G. Performing appropriate handling and maintenance of incubators.

H. Performing appropriate handling procedures using laminar flow cabinets.

I. Performing appropriate handling and quantitative procedures using varied chromatography devices/techniques.

J. Performing appropriate handling and quantitative procedures using electrophoresis equipment and accessories.

K. Performing appropriate handling procedures using gel-viewing devices.

L. Performing appropriate handling procedures using gel-drying devices and water baths.

M. Performing appropriate handling and quantitative procedures using microscopes.

Competency 6: The student will demonstrate knowledge of protein isolation and purification techniques by:

A. Using spectrophotometry as a quantitative method for protein concentration determination, and explaining the chemical reaction mechanism responsible for the Bradford Assay.

B. Implementing chromatography and electrophoresis for qualitative protein analysis.

C. Performing protein purification by sodium dodecyl sulfate polyacrylamide-gel electrophoresis (SDS-PAGE) and comasie blue staining of proteins separated by this method.

D. Explaining the principles of *in situ* hybridization (Western Blotting)

Competency 7: The student will demonstrate knowledge of nucleic acid structure, function and properties by:

A. Performing and explaining DNA endonuclease restriction procedure.

B. Performing and explaining DNA fragments separation by means of agarose gel and polyacrilamide gel electrophoresis.

C. Discussing the resolving power of agarose gel and polyacrilamide gel electrophoresis for the isolation of DNA fragments.

D. Constructing a standard curve that will relate the distance migrated by marker DNA fragments on agarose gel and extrapolating the size of a given DNA fragment profiled by agarose gel electrophoresis from such standard curve.

E. Constructing a restriction map for a given sample of DNA using restriction enzyme data manipulation.

F. Quantifying isolated DNA by spectrophotometric methods or directly from agarose gel electrophoresis by comparing the isolated sample with standard DNA fragments of known concentrations.

G. Performing a bacterial transformation and manipulate culture media to select for transformants.

H. Explaining the technique of cloning a desired piece of DNA into a plasmid vector.

I. Utilizing DNA ligase to generate a phosphodiester bond between the cloned piece of DNA and the plasmid DNA vector.

J. Explaining the technique of transforming a suitable bacterial host with the recombinant DNA molecule just generated and selecting clones containing the desired piece of DNA.

K. Explaining the use of PCR to amplify a desired DNA sample.

L. Performing a non-radioisotope DNA sequencing protocol to obtain the sequence of a specific DNA fragment.

Competency 8: The student will demonstrate knowledge of the procedures used to analyze spontaneous and induced mutagenesis by:

A. Performing *in vitro* induced mutagenesis by subjecting cell cultures to UV radiation.

B. Analyzing frequency of chromosome aberrations in intact and irradiated cells.

C. Utilizing paper chromatography to define the lack of enzyme xanthine dehydrogenase in mutant *Drosophila melanogaster*.

D. Analyzing protein chromatography results from wild type and mutant *Drosophila* specimen.

E. Performing the procedure for determination of spontaneous mutation rate in *E. coli* subjected to antibiotics.

F. Evaluating the *E. coli* survival rate as an indication of a presence of cells processing genes for resistance to antibiotics.

Competency 9: the student will demonstrate practical knowledge of cell and tissue culture techniques by:

A. Developing primary cell cultures, and explaining the procedures used in cell and tissue culture.

B. Explaining contamination problems common to tissue culture, and implementing the use of proper aseptic procedures during tissue culture procedures.

C. Maintaining and propagating bacterial culture (s).