LABETTE COMMUNITY COLLEGE BRIEF SYLLABUS

SPECIAL NOTE:
This brief syllabus is not intended to be a legal contract. A full syllabus will be distributed to students at the first class session.

TEXT AND SUPPLEMENTARY MATERIALS USED IN THE COURSE (if any):

Please check with the LCC bookstore http://www.labette.edu/bookstore for the required texts for this class.

COURSE NUMBER: RADI 218

COURSE TITLE: RADIATION PROTECTION II

CREDIT HOUR: 2

DEPARTMENT: Radiography

DIVISION: Health Science

PREREQUISITE: RADI 217 Radiation Protection I

REVISION DATE: 2/2012

COURSE DESCRIPTION:
The study of the biological effects of radiation and patient protection. Also included are radiation monitoring and occupational exposure and protection.

COURSE OUTCOMES & COMPETENCIES:
Students who successfully complete this course will without references and with 86% accuracy be able to:

1. Understand dose limits for exposure and ionizing radiation.

- List and describe the function of the four major organizations that share the responsibility for evaluating the relationship between radiation equivalent dose and induced biologic effects and five U.S. regulatory agencies responsible for enforcing established radiation effective dose limiting standards.
- Explain the function of the radiation safety committee (RSC) in a medical facility, and describe the role of the radiation safety officer (RSO) by listing the various responsibilities he or she must fulfill.
- Explain the purpose of the Radiation Control for Health and Safety Act of 1968 and the Consumer Patient Health and Safety Act of 1981.
- List the important provisions of the code of standards for diagnostic x-ray equipment that began on August 1, 1974.
- Explain the ALARA concept.

- Describe current radiation protection philosophy, and state the goal and objectives of radiation protection.
- Identify radiation-induced responses that warrant serious concern for radiation protection.
- Explain the concept of risk as it relates to the medical imaging industry.
- Describe effective dose limit and the effective dose-limiting system.
- Identify the risk from exposure to ionizing radiation at low absorbed doses.
- Discuss current National Council on Radiation Protection and Measurements recommendations.
- Given appropriate data, calculate the cumulative effective dose for the whole body for a radiation worker.
- Explain the function of collective effective dose, and list the unit used to express this quantity.
- Discuss the significance of action limits in health care facilities.
- Explain the concept of radiation hormesis.
- State the following in terms of International System (SI) units and traditional units:
    - Annual occupational effective dose limit and cumulative effective dose (CumEfD) limit for whole-body exposure excluding medical and natural background exposure, which are based on stochastic effects
    - Annual occupational equivalent dose limits for tissues and organs such as lens of the eye, skin, hands, and feet, which are based on deterministic effects
    - Annual effective dose limits for continuous (or frequent) exposure and for infrequent exposure of the general public from manmade sources other than medical and natural background, which are based on stochastic effects
    - Annual equivalent dose limits for tissues and organs such as lens of the eye, skin, hands, and feet of members of the general public, which are based on deterministic effects
    - Annual effective dose limit for an occupationally exposed student under the age of 18 years (excluding medical and natural background radiation exposure)
    - Occupational monthly equivalent dose limit to the embryo-fetus (excluding medical and natural background radiation) once the pregnancy is known

2. Understand equipment design for radiation protection.

- Explain the requirements for a diagnostic-type protective tube housing, x-ray control panel, radiographic examination table, and source-to-image distance indicator, and discuss their purpose.
- List the various x-ray beam limiting devices, and describe each.
- Explain the importance of luminance of the collimator light source, state the requirements for good coincidence between the radiographic beam and the localizing light beam when a variable rectangular collimator is used, and explain the function of the collimator's positive beam limitation (PBL) feature.
- Explain the function of x-ray beam filtration in diagnostic radiology, list two types of filtration used to adequately filter the beam, describe half-value layer (HVL), and give examples of HVLs required for selective peak kilovoltages.
- Explain the function of a compensating filter in radiography of a body part that varies in thickness, and list two types of such filters.
- Explain the significance of exposure reproducibility and exposure linearity.

- Explain how the use of high-speed screen-film combinations reduces radiographic exposure for the patient when film is the image receptor of choice.
- Explain how radiographic grids increase patient dose.
- Identify the minimal source-skin distance (SSD) that must be used for mobile radiography to ensure patient safety, and state the reason for this minimal SSD requirement.
- Explain the process of digital radiography and computed radiography, and discuss why it is imperative that patients undergoing digital imaging procedures not be overexposed initially.
- Explain how patient exposure may be reduced during routine fluoroscopic procedures, C-arm fluoroscopic procedures, high-dose (high-level-control [HLC]) fluoroscopy interventional procedures, cineradiographic procedures, and digital fluoroscopic procedures.
- Discuss the use of fluoroscopic equipment by nonradiologist physicians who perform interventional procedures or other potentially lengthy tasks, and identify the responsibilities of the radiographer during such procedures.

3. Explain the management of patient radiation dose during diagnostic x-ay procedures.

- Explain the meaning of a holistic approach to patient care, and recognize the need for effective communication between imaging department personnel and the patient.
- Explain how voluntary motion can be eliminated or at least minimized and how involuntary motion can be compensated for during a diagnostic radiographic procedure.
- Explain the need for protective shielding during diagnostic imaging procedures, state the reason for using gonadal shielding or other specific area shielding, and compare the various types of shields available for use.
- Discuss the need to use appropriate radiographic technical exposure factors for all radiologic procedures, and explain how these factors may be adjusted to reduce patient dose.
- Explain how a radiographer can achieve a balance in technical radiographic exposure factors to ensure the presence of adequate information in the recorded image and also minimize patient dose.
- Explain how adequate immobilization and correct image processing techniques reduce radiographic exposure for the patient.
- Compare the use of an air gap technique for certain examinations such as a cross-table lateral projection of the cervical spine with the use of a midratio grid (8:1).
- State the reason for reducing the number of repeat images, and describe the benefits of repeat analysis programs.
- List six nonessential radiologic examinations, and explain the reason why each is considered unnecessary.
- List four ways to indicate the amount of radiation received by a patient from diagnostic imaging procedures, and explain each.
- Explain the concept of genetically significant dose (GSD).
- Discuss the protocol to be followed when irradiation of an unknown pregnancy occurs, and explain how the absorbed dose to the patient's embryo-fetus is determined.

- Discuss the value of mammography for the detection of breast cancer, state the maximum dose to the glandular tissue of a 4.5-cm compressed breast using a screen-film system, identify the value of digital mammography for imaging of patients with dense breasts, and describe how to achieve dose reduction.
- Compare the patient dose received from a succession of adjacent computed tomography (CT) scans with the patient dose received from a conventional series of diagnostic images of the adult cranium.
- State the goal of computed tomography (CT) imaging from a radiation protection point of view.
- Discuss the Alliance for Radiation Safety in Pediatric Radiology and the Image Gently Campaign.
- Explain the reason children require special radiation protection when undergoing conventional diagnostic imaging procedures.
- Describe special precautions employed in radiography to protect the pregnant or potentially pregnant patient during an x-ray examination.

4. Explain the management of imaging personnel radiation dose during diagnostic x-ray procedures.

- State the annual occupational effective dose limit for whole-body exposure of diagnostic imaging personnel during routine operations, and explain the significance of the ALARA (as low as reasonably achievable) concept for these individuals.
- Explain the reason that occupational exposure of diagnostic imaging personnel must be limited, and state the most important reason for allowing a larger equivalent dose for radiation workers than for the population as a whole.
- Identify the type of x-radiation that poses the greatest occupational hazard in diagnostic radiology, and explain the various ways this hazard can be reduced or eliminated.
- Explain how the various methods and techniques that reduce patient exposure during a diagnostic examination also reduce exposure for the radiographer and other diagnostic personnel.
- Discuss the responsibilities of the employer for protecting declared pregnant diagnostic imaging personnel from radiation exposure.
- List and explain the three basic principles of radiation protection that can be used for personnel exposure reduction.
- State and explain the inverse square law by solving mathematical problems applying its concept.
- Explain the purpose of diagnostic-type protective tube housing, differentiate between a primary and a secondary protective barrier, and list examples of each.
- Describe the construction of protective structural shielding, and list the factors that govern the selection of appropriate construction materials.
- List and describe the protective garments that may be worn to reduce whole- or partial-body exposure, and discuss the circumstances in which such garments are worn.
- Explain the various methods and devices that may be used to reduce exposure for personnel during routine fluoroscopic examinations and during interventional procedures that use high-level-control fluoroscopy.

- Explain the various methods and devices that may be used to reduce the radiographer's exposure during a mobile radiographic examination.
- Explain the variation in dose rate caused by scatter radiation near the entrance and exit surfaces of the patient during C-arm fluoroscopy, and discuss methods of dose reduction for C-arm operators.
- Describe methods used to provide patient restraint during a diagnostic x-ray procedure, and identify individuals who might use them.
- List the three categories of radiation sources that may be generated in an x-ray room; list the considerations on which the design of radiation-absorbent barriers should be based; and explain the importance of each.
- Differentiate between a controlled area and an uncontrolled area.
- Discuss new approaches to shielding design.
- Discuss the requirements for posting caution signs for radioactive materials and radiation areas.

5. Demonstrate a basic understanding of cell biology.

- State the purpose for acquiring a basic knowledge of cell structure, composition, and function as a foundation for radiation biology.
- Identify and describe some important functions of the major classes of organic and inorganic compounds that exist in the cell.
- List the essential functions of water in the human body.
- Name and describe a landmark event pertaining to the human genome that occurred in 2001.
- Describe the molecular structure of deoxyribonucleic acid, and explain the way it functions in the cell.
- List the various cellular components, and identify their physical characteristics and functions.
- Distinguish between the two types of cell division, mitosis and meiosis, and describe each process.

6. Understand molecular and cellular radiation biology.

- List the three radiation energy transfer determinants, and explain their individual concepts.
- Differentiate among the three levels of biologic damage that may occur in living systems as a result of exposure to ionizing radiation, and describe how the process of direct and indirect action of ionizing radiation on the molecular structure of living systems occurs.
- Draw a diagram to illustrate the various effects of ionizing radiation on a DNA macromolecule, and describe the effects of ionizing radiation on chromosomes, various types of cells, and ultimately the entire human body.
- Describe target theory.
- Explain the purpose and function of survival curves for mammalian cells.
- List the factors that affect cell radiosensitivity.
- State and describe the law of Bergonié and Tribondeau.

7. Discuss radioisotopes and radiation protection.

- Explain what causes cancerous growths or tumors to be eliminated or controlled by irradiation.
- Describe how therapeutic isotopes may be characterized.
- Describe the process of electron capture.
- Identify the two best radiation safety practices to follow for patients having therapeutic prostate seed implants.
- Explain the process of beta decay.
- Discuss the radiation hazards that may be encountered by personnel caring for a patient who is receiving iodine-131 therapy treatment for thyroid cancer.
- Explain how radioisotopes that are used as radioactive tracers in nuclear medicine work.
- Identify the most common radioisotope used in nuclear medicine diagnostic studies.
- Identify and describe the type of radiation events that are used in positron emission tomography (PET).
- Identify the most common isotope used for PET scanning.
- Explain the benefit of the combined imaging device called a PET/CT scanner.
- Describe radiation safety concerns associated with the design of a PET/CT imaging suite and explain how radiation protection has been provided.
- Discuss the reasons for concern over the use of radiation as a terrorist weapon, and identify what action most hospitals have taken for handling emergency situations involving radioactive contamination.
- Explain what a radioactive dispersal device, or "dirty bomb," is, and discuss the possible consequences of the detonation of such a device.
- Describe the procedure for external decontamination from radioactive materials.
- State the dose limit per event for individuals engaged in both non-lifesaving and lifesaving activities during a radiation emergency.
- Explain the reason why the Environmental Protection Agency (EPA) sets limits for radioactive contamination.
- Discuss the medical management of persons experiencing radiation bio-effects.
- Describe various strategies used to treat internal radiation contamination.