CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

NEW COURSE PROPOSAL

PROGRAM AREA _____ BIOLOGICAL AND PHYSICAL SCIENCES

1. **Catalog Description of the Course.** *[Include the course prefix, number, full title, and units. Provide a course narrative including prerequisites and corequisites. If any of the following apply, include in the description: Repeatability (May be repeated to a maximum of ___ units); time distribution (Lecture ___ hours, laboratory ___ hours); non-traditional grading system (Graded CR/NC, ABC/NC). Follow accepted catalog format.]*

   PHYS 464 MEDICAL INSTRUMENTATION (4)
   Three hours of lecture and two hours of lab activity per week, including two field trips per course.
   Prerequisite : BIOL/PHYS 434
   The detection, acquisition, processing and display of diagnostic clinical images. The course will concentrate on the fundamentals of the design of the instruments and the use of appropriate reconstruction algorithms in (computed) radiography, (digital) fluoroscopy, computed tomography, ultrasound, magnetic resonance imaging and radionuclide imaging. Activities will include image reconstruction examples, investigation of recent innovations, and two trips to local Radiology departments.
   Same as BIOL 464

   BIOL 464 Medical Instrumentation (4)
   Three hours of lecture and two hours of lab activity per week, including two field trips per course.
   Prerequisite : BIOL/PHYS 434
   The detection, acquisition, processing and display of diagnostic clinical images. The course will concentrate on the fundamentals of the design of the instruments and the use of appropriate reconstruction algorithms in (computed) radiography, (digital) fluoroscopy, computed tomography, ultrasound, magnetic resonance imaging and radionuclide imaging. Activities will include image reconstruction examples, investigation of recent innovations, and two trips to local Radiology departments.
   Same as PHYS 464

2. **Mode of Instruction.**

	Units	**Hours per Unit**	**Benchmark Enrollment**
Lecture	___3_____	____1____	__20_____
Seminar	_____	_____	_____
Laboratory	_____	_____	_____
Activity	___1_____	____2____	__20_____

3. **Justification and Learning Objectives for the Course.** (Indicate whether required or elective, and whether it meets University Writing, and/or Language requirements) *[Use as much space as necessary]*

   Computerization is the key to the acquisition of high-quality, diagnostically useful clinical images, and is central in the design of modern biomedical equipment. This course explains the fundamentals of the design of modern diagnostic equipment, and explains how clinical images are reconstructed from the signals obtained from a variety of modalities.
   The course would be part of a proposed Medical Imaging Emphasis within the Biology major, preparing students for graduate or professional studies in the medical sciences.

   Through this course, students will be able to
   - explain the principles and basic concepts of modern clinical imaging equipment
   - define the facets of image quality and identify the components contributing to them
   - compute transmission time of an image over a network
   - explain the factors determining image quality in digital fluoroscopy
   - outline the features of x-ray sources, detectors, collimators, and display systems used in x-ray CT
   - describe the different approaches to the reconstruction of CT images from projection measurements
   - characterize the properties of an ultrasound transducer, and its utility within an ultrasound imaging system
   - describe the three modes of ultrasound imaging
   - explain the phenomenon of nuclear magnetic resonance
   - explain the pulsing and signal acquisition scheme used in <u>three</u> common pulse sequences

- list the components of an MRI system, state their principle of operation and describe their contribution to the system
- explain the physiological basis of functional MRI
- describe the principles and application of rate measurements with radioactive isotopes
- explain the origin of and the correction for the resolving time of a scintillation camera
- critically evaluate scientific and medical literature
- organize and express ideas clearly and convincingly in oral and written forms.

This course is not designed to satisfy the University Writing or Language requirements, although it will include substantial components of writing and oral presentation.

4. Is this a General Education Course YES <u>NO</u>
If Yes, indicate GE category:

A (English Language, Communication, Critical Thinking)	
B (Mathematics & Sciences)	
C (Fine Arts, Literature, Languages & Cultures)	
D (Social Perspectives)	
E (Human Psychological and Physiological Perspectives)	

5. Course Content in Outline Form. *[Be as brief as possible, but use as much space as necessary]*

Radiography: X-ray film, intensifying screens, grids. Spatial and contrast resolution, signal-to-noise ratio. Influences on image quality. Description of image quality: point spread function (PSF) and modulation transfer function (MTF). Visual perception.
Computed radiography: instrumentation, imaging plates, computer hardware, networking and picture archiving and communication systems (PACS).
Fluoroscopy and image intensifier tubes, digital fluoroscopy.
Computed tomography (CT): principles, sources and detectors, scan motions, CT numbers, reconstruction algorithms.
Ultrasonics: characteristics of ultrasound, transducer design, presentation modes, signal processing and image reconstruction.
Magnetic resonance imaging (MRI): fundamentals, relaxation times, pulse sequences, image reconstruction, tissue contrast, advantages.
Radionuclide imaging: the gamma camera, collimation, energy discrimination, single-photon emission tomography (SPECT) and positron emission tomography (PET).

There will be project, in which students in small teams will investigate different aspects of clinical instrumentation. (Typical projects would be (i) an investigation of the factors determining the contrast of the images in CT <u>or</u> MRI (ii) motion suppression in MRI and (iii) image artifacts in ultrasound, CT <u>or</u> MRI. Reports on the projects will be typed and include figures, graphs, images and references.

Field trips (2) to Radiology Departments will illustrate the clinical utility of the various instruments.

The course will include two presentations by invited specialists.

6. References. *[Provide 3 - 5 references on which this course is based and/or support it.]*

W.R.Hendee & E.R.Ritenour. Medical Imaging Physics. John Wiley, 4th edition, 2002. (ISBN 0-471-38226-4).
R.R.Carlton & A.M.Adler. Principles of Radiographic Imaging; an Art and a Science. Delmar, 2001. (ISBN 0-7668-1300-2)
S.C.Bushong. Magnetic Resonance Imaging: Physical and Biological Principle. Mosby, 1996. (ISBN 0-8151-1342-0).
P.P.Dendy & B.Heaton. Physics for Diagnostic Radiology. IOP, 1999. (ISBN 0-7503-0591-6)
B.H.Brown et al. Medical Physics and Biomedical Engineering. IOP, 1999. (ISBN 0-7503-0368-9).

7. List Faculty Qualified to Teach This Course.

Dr. Geoff Dougherty

8. Frequency.

a. Projected semesters to be offered: Fall __X___ Spring _____ Summer _____

9. New Resources Required.

a. Computer (data processing), audio visual, broadcasting needs, other equipment

Use of a PC lab for 2 hours/week

b. Library needs

Books listed in para.6.

c. Facility/space needs

Transport for two field trips to Radiology Departments.

10. Consultation.

Attach consultation sheet from all program areas, Library, and others (if necessary)

11. If this new course will alter any degree, credential, certificate, or minor in your program, attach a program modification.

__Geoff Dougherty_____12/11/02_____

Proposer of Course Date