CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

NEW COURSE PROPOSAL

PROGRAM AREA ___ MATH AND COMPUTER SCIENCE, 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 345. DIGITAL IMAGE PROCESSING (3)
Three hours of lecture in the lab per week.
Prerequisite: Consent of instructor.
An introduction to the basic concepts and techniques for digital image restoration and enhancement, analysis, coding and compression. The emphasis is on processes which analyze primarily two-dimensional discrete images represented at the pixel level, including filtering, noise reduction and segmentation. Fourier analysis techniques will be explored.
Programming exercises will be used to implement the various processes, and their performance on synthetic and real images will be studied.
GenEd: B1, B4 and Interdisciplinary
Same as COMP 345, MATH 345

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2. **Mode of Instruction.**

	Units	**Hours per Unit**	**Benchmark Enrollment**
Lecture	3	1	20
Seminar			
Laboratory			
Activity			

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]*

Image processing has become a mature discipline. Thanks to algorithmic and implementation advances, it has become a vital cost-effective technology with a myriad of applications in medicine, robotics, consumer electronics, communications and geophysics. This course would become an elective for Computer Science and Math majors, and will be part of a proposed emphasis in Mathematics.

Through this course, students will be able to

- explain the principles and basic concept of sampling
- describe the fundamental properties of digital images and analyse the factors affecting the quality of a digital image
- apply appropriate techniques to restore and enhance images in both the spatial and (spatial) frequency domains
- explain the relationship between the sampled point spread function (PSF) and the modulation transfer function (MTF)
- use a variety of strategies to reduce the noise content of an image
- use a variety of strategies to segment an image
- distinguish between different image compression schemes
- program image-processing algorithms

Programming exercises will be used to implement the various processes, and their performance on synthetic and real images will be studied.
This course is not designed to satisfy the University Writing or Language requirements, although it will include substantial components of writing and oral presentation. A project report on particular processing strategies, consisting of both in-class writing and outside writing of revised prose on a topic, will be completed by each student and their report will be discussed in the class.

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

A (English Language, Communication, Critical Thinking)	
B (Mathematics & Sciences)	**X**
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]*

Sampling: spatial and intensity quantization. Nyquist sampling rate.
Image storage formats.
Image quality: spatial and contrast resolution, dynamic range, signal-to-noise ratio.
Basic image operations (inc. thresholding, histogram modification): look-up tables for contrast stretch, histogram equalization, density slicing and highlighting.
Spatial filtering: rank filters.
The point spread function and convolution: the Fourier transform and frequency domain filters: transfer functions.
Noise and Wiener filtering.
Morphological operations: interpolation: connectivity: gradients: edge detection: segmentation: active contours.
Information theory: image compression: lossless (Huffmann, LZW): JPEG and MPEG.

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

- W.K.Pratt. Digital Image Processing, 3rd ed. John Wiley, 2001 (ISBN 0-471-37407-5)
- Rafael C. Gonzalez and Paul Wintz, **Digital Image Processing,** Addison Wesley, 1992
- GA Baxes, **Digital Image Processing: Principles and Applications.** John Wiley, 1994
- JC Russ, **The Image Processing Handbook.** CRC Press, 1995.
- Anil K. Jain, **Fundamentals of Image Processing,** Prentice Hall, 1990.
- William K. Pratt, **Digital Image Processing,** Wiley-Interscience, 1978.
- Azriel Rosenfeld and Avinash C. Kak, **Digital Picture Processing,** Academic Press, 1982.

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

A multi-site licence for the Student Edition of MatLab with Image Processing Toolbox.
A lab containing 20+ PCs will be needed for a 3 h session per week.

b. Library needs

One copy each of the books listed in para.6.

c. Facility/space needs

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.

_____ Dr. Geoff Dougherty ______________________1/8/03______________________________
Proposer of Course Date