**Course Topics**

**EEE 508: Digital Image and Video Processing and Compression**

**Prerequisites:** EEE 404 Real-Time Digital Signal Processing OR EEE 407 Digital Sig-

nal Processing or equivalent & EEE 350 Random Signal Analysis or equivalent & a Programming course.

**Course Description:** Fundamentals of digital image/video perception, representation, processing, and compression.

**Course Topics:**

Vision and Perception

* + Overview of the Human Visual System
	+ Modeling the Human Visual System
	+ Luminance and Brightness
	+ Luminance and Contrast Masking
	+ Color Models
	+ Temporal Properties of Vision
	+ Image Fidelity Criteria

Two-Dimensional Digital Signal Processing Basics

* + Representation of 2-D Signals, Special 2-D Signals
	+ Two-D Linear Shift-Invariant Systems
	+ Two-D Sampling

Transforms

* + General Form
	+ Matrix Representation of Images and Transforms
	+ Vector Representation versus Matrix Representation
	+ Separable and Unitary Transforms
	+ Special Important Transforms: DFT, DCT, DST, Hadamard, Karhunen-Loeve
	+ Image Decomposition using Filter Banks
	+ Wavelets

Segmentation

* + Edge Detection
	+ Thresholding
	+ Pixel-based Segmentation
	+ Region-based Segmentation

Enhancement

* + Contrast and Dynamic Range Modification
	+ Histogram Modification and Equalization
	+ Highpass Filtering
	+ Homomorphic Processing
	+ Noise Smoothing: Linear and Non-linear filtering
	+ Edge Detection and Enhancement
	+ Basic Morphological Operators

Restoration

* + Blur and Additive Noise Removal
	+ Inverse Filtering
	+ Wiener Filtering
	+ Constrained Least-Squares Approach
	+ Image Extrapolation

Quantization and Quantizer Design

* + Some Results from Information Theory
	+ Entropy Coding
	+ Rate-Distortion Theory
	+ Optimal Quantizer Designs
	+ Scalar Quantization: Uniform and Nonuniform
	+ Optimal Lloyd-Max Quantizer
	+ Vector Quantization (VQ)
	+ VQ Design
	+ Generalized Lloyd (LBG) Algorithm
	+ VQs with Structural Constraints: Tree-Structured VQ, Multistage Residual VQ, Gain-Shape VQ
	+ VQs with Memory: Finite-State VQ, Trellis VQ

Image and Video Compression

* + General Coder Structure
	+ Predictive Coding: DPCM. ADPCM
	+ Transform Coding: block-based coding, quantization, and bit allocation
	+ Subband Coding: Filter Banks, Multi-resolution Subband Decomposition, Wavelets
	+ Highlights of Multi-Rate Signal Processing
	+ Entropy Coding: Huffman and Arithmetic Coding
	+ Run-Length Coding
	+ JPEG Image Compression Standards
	+ Video Compression: Motion Estimation and Compensation
	+ MPEG and H.26x Video Compression Standards