**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