SUBJECT DESCRIPTION FORM

Subject Title: Video, Image, and Audio Processing
Subject Code: EIE425 (for 42070 and 42077)
Number of Credits: 3
Hours Assigned: Lecture/tutorial 39 hours
Laboratory 3 hours
(Equivalent to 9 laboratory hours)

Pre-requisite: For 42070
Linear Systems (EIE312)
For 42077
Linear Systems (EIE312) or
Signal Processing Fundamentals (EIE327)
Exclusion: Speech and Image Processing (EIE421)

Co-requisite: nil

Objectives:
To provide a broad treatment of the fundamentals of speech, image, audio and video processing.

Student Learning Outcomes:
On successful completion of this subject, the students will be able to:

Category A: Professional/academic knowledge and skills
1. Understand the fundamentals of speech, image, audio and video signal processing and associated techniques.
2. Solve practical problems with some basic speech, image, audio and video signal processing techniques.
3. Design simple systems for realizing some multimedia applications with some basic speech, image, audio and video signal processing techniques.

Category B: Attributes for all-roundedness
4. Present ideas and findings effectively.
5. Think critically.
7. Work in a team and collaborate effectively with others.

Syllabus:
1. Speech processing
   1.1 Physiology of speech generation: characteristic of speech sounds; glottal excitation; speech production models: discrete-time speech production model; discrete-time filter model for speech production; source excitation model.
   1.2 Linear prediction analysis: All-pole models; least-squares estimation; spectral matching; spectral envelopes; applications of LP analysis.
   1.3 Speech coding: Coder’s attributes; waveform coding; vocoders; analysis-by-synthesis coding; code-excited linear predictive vocoder; regular pulse-excited LPC.

2. Image processing
   2.1 Fundamentals of digital image: Digital image representation and visual perception, image sampling and quantization.
   2.2 Image enhancement: Histogram processing; Median filtering; Low-pass filtering; High-pass filtering; Spatial filtering; Linear interpolation, zooming.
   2.3 Image coding and compression techniques: Scalar and vector quantizations; Codeword assignment; Entropy coding; Transform image coding; Wavelet coding; Codec examples.
   2.4 Image analysis and segmentation: Feature extraction; Histogram; Edge detection; Thresholding.
   2.5 Image representation and description: Boundary descriptor; Chaincode; Fourier descriptor; Skeletonizing; Texture descriptor; Moments.
3. **Audio processing**
   3.1 Fundamentals of digital audio: Sampling; Dithering; Quantization; psychoacoustic model.
   3.2 Basic digital audio processing techniques: Anti-aliasing filtering; Oversampling; Analog-to-digital
       conversion; Dithering; Noise shaping; Digital-to-analog Conversion; Equalisation.
   3.3 Digital Audio compression: Critical bands; threshold of hearing; Amplitude masking; Temporal
       masking; Waveform coding; Perceptual coding; Coding techniques: Subband coding and
       Transform coding; Codec examples.

4. **Video processing**
   4.2 Basic digital video processing techniques: Motion estimation; Interframe filtering; Motion-
       compensated filtering; Error concealment.
   4.3 Video coding techniques: Temporal redundancy; Spatial redundancy; Block-based motion
       estimation and compensation; Coding techniques: Model-based coding, Motion-compensated
       waveform coding; Codec examples.

**Laboratory Experiments:**
1. Audio compression
2. Speech signal analysis
3. Psychoacoustic behavior
4. Motion estimation and its application in video coding
5. Image processing techniques
6. Image compression

**Method of Assessment:**
Continuous Assessment: 40%   Examination: 60%

The continuous assessment will consist of a number of assignments, laboratory reports, and two tests.

**Textbooks:**

**Reference Books:**
1. Yao Wang, Joern Ostermann, and Ya-Qin Zhang, *Video Processing and Communications*,
   Wiley & Sons, Inc., 1996.