**City University of Hong Kong**

**Information on a Course
offered by Department of Electronic Engineering
with effect from Semester A 2012/13**

**Part I**

| | |
|---|---|
| Course Title: | Video and Speech Compression |
| Course Code: | EE6805 |
| Course Duration: | One semester (13 weeks) |
| No. of credits: | 3 |
| Level: | P6 |
| Medium of Instruction: | English |
| Prerequisites *:* | EE5410 Signal Processing or<br>EE3202 Digital Signal Processing or<br>EE3210 Signals & Systems or<br>equivalent |
| Precursors : | Nil |
| Equivalent Course *:* | Nil |
| Exclusive Courses: | Nil |

**Part II**

**Course Aims:**

The aim of this course is to provide students with theoretical and technical knowledge in video and speech compression technologies and to simulate students' interest in learning the internal functioning of modern-day speech and video compression systems.

**Course Intended Learning Outcomes (CILOs)**
*Upon successful completion of this course, students should be able to:*

| No. | CILOs |
|---|---|
| 1. | Describe the general characteristics and modelling of speech and video signals, and devise modelling techniques for the analysis of these signals |

| 2. | Apply lossless entropy coding algorithms and analyse the relationship between compressibility and source probability distribution |
|----|---|
| 3. | Apply the skills for compression of speech signals and analyse the trade off in speech quality, compression ratio and coding complexity |
| 4. | Apply the skills for compression of images and videos and analyse the trade off in quality, compression ratio and coding complexity |
| 5 | Apply ITU/MPEG standard compression algorithms for coding of speech and video signals and evaluate the performance of these standard coding algorithms |

**Teaching and Learning Activities (TLAs)**

*(Indicative of likely activities and tasks designed to facilitate students' achievement of the CILOs. Final details will be provided to students in their first week of attendance in this course)*

| CILO 1 | Lecture, case study |
|--------|---|
| CILO 2, 4 | Lecture, tutorial, case study |
| CILO 3 | Lectures, tutorial, assignment (mini project) for implementing a simple speech or image encoder/decoder |
| CILO 5 | Lecture, coder evaluation assignment including group discussion |

*Mini-projects are designed to encourage students to discover the inter-relationship between various coding strategies in time/frequency domains and to evaluate the practicality of applying compression under real-world situations*

Timetabling Information

| **Pattern** | **Hours** |
|-------------|-----------|
| Lecture: | 26 |
| Tutorials: | 13* |
| Laboratory: | |
| Other activities: | 0 |

*\*Some of the tutorials will be conducted in the laboratory.*

**Assessment Tasks/Activities**

*(Indicative of likely activities and tasks designed to assess how well the students achieve the CILOs. Final details will be provided to students in their first week of attendance in this course)*

| | *Type of assessment tasks* | *Weighting (if applicable)* |
|---|---|---|
| Continuous Assessment | Tests, Assignments, (mini project), Tutorial Quizzes and case study | 40% |
| Examination | Written exam | 60%    2 hours |

Remarks:  To pass the course, students are required to achieve at least 35% in course work and 35% in the examination.

**Grading of Student Achievement:**

| **Letter Grade** | **Grade Point** | **Grade Definitions** |
|------------------|-----------------|------------------------|
| A+<br>A<br>A- | 4.3<br>4.0<br>3.7 | Excellent |
| B+<br>B<br>B- | 3.3<br>3.0<br>2.7 | Good |

| | | |
|---|---|---|
| C+ | 2.3 | Adequate |
| C | 2.0 | |
| C- | 1.7 | |
| D | 1.0 | Marginal |
| F | 0.0 | Failure |

**Constructive Alignment with Programme Outcomes**

| PILO | How the course contribute to the specific PILO(s) |
|---|---|
| 1, 2, 3 | The course provides students with amble opportunities in acquiring knowledge of and evaluation of new coding technologies, and also the applications of mathematics and engineering problem solving skills which are central to the aims of this program. |
| 4, 5 | Students are required to complete an assignment designed to gain practical experience in implementing a workable speech coding/decoding system. The analytical and research skills developed are central to the aims of this program. |

**Part III**

**Keyword Syllabus:**

Principles of Source Compression
Digital representation, source entropy, compression ratio, lossy and lossless compression, Huffman, arithmetic coding

Fundamental concepts in speech
Basic speech representation: speech production, source-filter model for speech generation, human auditory perception. Digitization: sampling and quantization, SNQR and speech quality.

Speech Compression
Linear prediction, LPC parameter representation; PARCOR and LSP, vector quantization, code excited linear predictive (CELP) coding. Issues of rate-distortion, coding complexity and latency, error concealment. Speech compression standards: G.723/G.729, GSM-AMR, MPEG-4.

Fundamental concepts in video
Video signal representation: PAL/NTSC, digitization, colour models; YUV, YIQ, YCbCr.

Video Compression
Basic video compression techniques: chroma subsampling, transform coding; DCT, wavelet, scaled quantization, forward/backward prediction, motion compensation, entropy coding, rate-distortion issues, scalable coding.
Video compression standards: H.261, H.263, MPEG-1,2,4.

**Recommended Reading:**

Essential Reading
Murat A Tekalp : Digital Video Processing, (Prentice Hall, 1996, ISBN 0-13-190075-7).

John R Deller, JR John G Proakis and John H L Hansen : Discrete-Time Processing of Speech Signals, (MacMillan, 1993, ISBN 0-02-328301-7)

Supplementary Reading
Jerry D. Gibson, et al, " Digital Compression for Multimedia : Principles and Standards," Morgan Kaufmann Publishers, January 1998

Ze-Nian Li and Mark S. Drew : Fundamentals of Multimedia, Prentice Hall, 2004.

K. R. Rao and J. J. Hwang : Techniques & Standards For Image, Video & Audio Coding, Prentice Hall, 1996.

B. Furht, S. W. Smoliar, and H. J. Zhang: <u>Video and Image Processing in Multimedia Systems</u>, Kluwer Academic Publishers, 1995.

Jorg Wilberg, " <u>Codesign for Real-Time Video Applications</u>," Kluwer, November 1997

Ralf Steinmetz and Klara Nahrstedt : <u>Multimedia Fundamentals: Media Coding and Content Processing</u>, Prentice Hall, 2002.

Bishnu S Atal, Vladimir Cuperman, Allen Gersho : <u>Advances in Speech Coding</u>,  (Kluwer Academic Publishers, 1991, ISBN 0-7923-9091-1)

W B Kleijn : <u>Speech Coding and Synthesis</u>, (Kluwer Academic Publishers, 1995)

Thomas Barnwell, Kambiz Nayebi and Craig Richardson, "<u>Speech Coding: A Computer Laboratory Textbook</u>", John Wiley & Sons Inc., 1996. ISBN 0-471-51692-9

<u>ITU Standards</u>, G.723, G.728 speech coders

<u>ISO MPEG Audiovisual coding standards</u>.

**Online Resources (if any)**
Nil