City University of Hong Kong

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

Part I

Course Title:	Digital Audio Processing and Applications
Course Code:	EE5809
Course Duration:	One semester (13 weeks)
No. of credits:	3
Level:	P5
Medium of Instruction:	English
Prerequisites:	Nil
Precursors:	EE3210 Signals and Systems or EE3118 Linear Systems and Signal Analysis
Equivalent Course:	Nil
Exclusive Courses:	Nil

Part II

Course Aims:

The aim of this course is to provide students with a solid foundation in digital audio processing and applications, and to stimulate student's interest in developing the necessary skills for audio engineering profession.

Course Intended Learning Outcomes (CILOs)

No.	CILOs
1.	describe the characteristics of audio signals and explain the principles of over-sampling analogue to digital conversion and analyse the relationship between quantization noise and signal precision
2.	develop basic skills for coding audio signals digitally in time and frequency domains and evaluate their performance thereof
3.	describe the concept and internal functioning of modern audio coding standards and evaluate the suitability of these standards for real-world applications
4.	develop basic skills on the processing and synthesis of music signals
5	describe the design parameters for multi-channel home audio systems and evaluate their performance thereof

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, 3, 4, 5	Lecture, tutorial, case study
CILO 2	Lecture, tutorial, assignment (mini project), and case study

Case study and mini-projects are designed to encourage students to apply the knowledge learn from the course to build a real-world application.

Timetabling Information

Pattern	**Hours**
Lecture:	26
Tutorials:	13
Laboratory:	
Other activities:	

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	Assignments (mini projects),, Test, Tutorial quiz, case study, Presentation	30%
Examination	Written exam	70% 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+ A A-	4.3 4.0 3.7	Excellent
B+ B B-	3.3 3.0 2.7	Good
C+ C C-	2.3 2.0 1.7	Adequate
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 digital audio technologies, and also the applications of mathematics and engineering problem solving skills which are central to the aims of this program.
4, 5, 6	Students are required to complete an assignment designed to gain practical experience in implementing a workable digital audio coding/decoding system. They need to write a report and present their work accordingly. These practical training and presentation skills are central to the aims of this program

Part III

Keyword Syllabus:

Introduction

Characteristics of audio and music signals; digitization of audio signal; bandwidth; precision, and signal-to-quantization noise ratio ; over-sampling A/D conversion; sigma-delta A/D, digital processing of audio signals; digital filtering; microphone and loudspeaker characteristics; sound propagation in different environments; human auditory perception; loudness and frequency masking; critical band.

Audio coding

Fundamental of data compression: lossy and lossless compression, Huffman and arithmetic coding, model-based predictive coding, time- and frequency-domain approaches.

Audio coding formats: WAV coding formats for CD; Digital Audio Broadcast (DAB).

Waveform coding: PCM, Delta Modulation, ADPCM, Dolby DTS.

Pyschoacoustic coding: Transform coding, QMF and MDCT, MPEG I, II, IV Audio, Advanced audio coding and MP3. Perceptual audio quality measurement; PEAQ

Lossless coding: Meridean Lossless Packing coding for DVD-Audio, Direct Stream Digital for Sony/Philips Super Audio CD, Blu-Ray audio.

Music synthesis

Musical acoustic; Time- and frequency-domain representation of sound; sinusoidal and harmonic signal; additive synthesis and non-linear synthesis; FM synthesis and Chebyshev techniques; physical modelling; wavetable synthesis; MIDI format; instrument and sequencing.

Sound effects and audio production

Concert hall, studio and home listening room acoustics; absorption, reverberation time and Sabin calculations; room design for good acoustics; Sound effects: reverberation, depth perception, Sound localization/spatialization, 3D sound synthesis; HRTF modelling, Surround sound; Compression and expansion; Digital mixing; filtering; Dolby ProLogic; THX; Dynamic EQ; Common DSP techniques for audio processing.

Multimedia applications

Internet audio broadcast; music jukebox.

Recommended Reading:

Text Book:

Ken C. Pohlmann, Ken C. Pohlman: Principles of Digital Audio, McGraw Hill Text; 3rd edition (September 1995), ASIN: 0070504695.

Reference Book:

Marina Bosi, Richard E. Goldberg, Leonardo Chiariglione: Introduction to Digital Audio Coding and Standards, Kluwer Academic Publishers; (December 2002), ISBN: 1402073577.

John Watkinson: Introduction to Digital Audio, Focal Press; 2nd edition (November 13, 2002), ISBN: 0240516435.

F. Alton Everest: Master Handbook of Acoustics, McGraw-Hill/TAB Electronics; 4th edition (September 22, 2000), ISBN: 0071360972.

John Watkinson: Art of Digital Audio, Third Edition, Focal Press; 3rd edition (December 2000), ISBN: 0240515870.

Jerry Whitaker and Blair Benson: Standard Handbook of Audio and Radio Engineering, McGraw-Hill Professional, ISBN: 0070067171.

John Watkinson: MPEG Handbook, Focal Press; 1st edition (September 2001), ISBN: 0240516567.

Eberhard Zwicker, H. Fastl, and H. Frater: Psychoacoustics: Facts and Models, Springer Verlag; 2nd edition (April 1999), ISBN: 3540650636.

David Howard and James Angus: Acoustics and Psychoacoustics (Music Technology), Focal Press; 2nd edition (January 3, 2001), ISBN: 0240516095.

Online Resources (if any)
Nil