

**City University of Hong Kong**  
**Course Syllabus**

**offered by College/School/Department of Electrical Engineering**  
**with effect from Semester B in 2019/2020**

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**Part I Course Overview**

**Course Title:** Digital Audio Technology

**Course Code:** EE4209

**Course Duration:** One Semester (13 weeks)

**Credit Units:** 3

**Level:** B4

**Proposed Area:**  Arts and Humanities  
*(for GE courses only)*  Study of Societies, Social and Business Organisations  
Science and Technology

**Medium of Instruction:** English

**Medium of Assessment:** English  
EE3210 Signals and Systems

**Prerequisites:**  
*(Course Code and Title)* \_\_\_\_\_

**Precursors:**  
*(Course Code and Title)* Nil

**Equivalent Courses:**  
*(Course Code and Title)* EE4207 Digital Speech And Audio Processing

**Exclusive Courses:**  
*(Course Code and Title)* Nil

## Part II Course Details

### 1. Abstract

The aim of this course is to provide students with a solid foundation in digital audio technology.

### 2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs <sup>#</sup>	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	A2	A3
1.	Describe the characteristics of audio signals and explain the principles of over-sampling analogue to digital conversion		✓	✓	
2.	Develop basic skills for coding audio signals digitally in time and frequency domains		✓	✓	
3.	Describe the concept and internal functioning of modern audio coding standards		✓	✓	
4.	Develop basic skills on the processing and synthesis of music signals		✓	✓	
5.	Describe the design parameters for multi-channel home audio systems		✓	✓	
		100%			

\* If weighting is assigned to CILOs, they should add up to 100%.

<sup>#</sup> Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

### 3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lectures	Key concepts are described and illustrated	✓	✓	✓	✓	✓	2 hrs/week
Tutorials	Key concepts are worked out based on problems	✓	✓	✓	✓	✓	1 hr/week

### 4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.					Weighting*	Remarks
	1	2	3	4	5		
<u>Continuous Assessment: 50%</u>							
Tests (2)	✓	✓	✓	✓	✓	30%	
Assignments (3) #	✓	✓	✓	✓	✓	20%	
<u>Examination: 50% (duration: 2hrs )</u>							
Examination	✓	✓	✓	✓	✓	50%	
						100%	

\* The weightings should add up to 100%.

#### Remark:

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination. # may include homework, tutorial exercise, project/mini-project, presentation, lab report

**5. Assessment Rubrics**

*(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)*

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal levels

**6. Constructive Alignment with Major Outcomes**

*(Please state how the course contribute to the specific MILO(s))*

<b>MILO</b>	<b>How the course contribute to the specific MILO(s)</b>
1, 2, 5	The course provides students with ample opportunities in the applications of mathematics, and engineering problem solving skills which are central to the aims of this program
3	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 Other Information** (more details can be provided separately in the teaching plan)

### **1. 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; 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. Waveform coding: PCM, ADPCM, Dolby DTS, Linear prediction.

Psychoacoustic coding: Transform coding, QMF and MDCT, MPEG I, II, IV Audio, Advanced audio coding and MP3.

Lossless coding: Meridian Lossless Packing coding for DVD-Audio, Direct Stream Digital for Sony/Philips Super Audio CD, MPEG-IV ALS Predictive Lossless Coding.

#### 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.

#### Room Acoustics and 3D Sound

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

#### Multimedia applications

Internet and digital audio broadcast; music jukebox.

## 2. Reading List

### 2.1 Compulsory Readings

*(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)*

1.	Ken C. Pohlmann, Ken C. Pohlman: <u>Principles of Digital Audio</u> , McGraw Hill Text; 3rd edition (September 1995), ASIN: 0070504695
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### 2.2 Additional Readings

*(Additional references for students to learn to expand their knowledge about the subject.)*

1.	Dai Tracy Yang, Chris Kyriakakis, and C.-C. Jay Kuo: <u>High-Fidelity Multichannel Audio Coding</u> , EURASIP Book Series on Signal Processing and Communications, Hindawi Publishing Corporation, 2004. ISBN 977-5945-13-5
2.	Udo Zolzer: <u>Digital Audio Signal Processing 2nd Edition</u> , Wiley (August 2008), ISBN 978-0-470-99785-7
3.	Marina Bosi, Richard E. Goldberg, Leonardo Chiariglione: <u>Introduction to Digital Audio Coding and Standards</u> , Kluwer Academic Publishers; (December 2002), ISBN: 1402073577.
4.	John Watkinson: <u>Introduction to Digital Audio</u> , Focal Press; 2nd edition (November 13, 2002), ISBN: 0240516435.
5.	F. Alton Everest: <u>Master Handbook of Acoustics</u> , McGraw-Hill/TAB Electronics; 4th edition (September 22, 2000), ISBN: 0071360972.
6.	John Watkinson: <u>Art of Digital Audio</u> , Third Edition, Focal Press; 3rd edition (December 2000), ISBN: 0240515870.
7.	Jerry Whitaker and Blair Benson: <u>Standard Handbook of Audio and Radio Engineering</u> , McGraw-Hill Professional, ISBN: 0070067171.
8.	John Watkinson: <u>MPEG Handbook</u> , Focal Press; 1st edition (September 2001), ISBN: 0240516567.
9.	Eberhard Zwicker, H. Fastl, and H. Frater: <u>Psychoacoustics: Facts and Models</u> , Springer Verlag; 2nd edition (April 1999), ISBN: 3540650636.
10.	David Howard and James Angus: <u>Acoustics and Psychoacoustics (Music Technology)</u> , Focal Press; 2nd edition (January 3, 2001), ISBN: 0240516095.