



You have max three (3) hours for answering the questions. You may leave after the first hour but not before. Allowed/required accessories: pens, calculator (no books, notes, laptops, phones, or conversation). Papers will be provided by the School of Electrical Engineering. Turn off your mobile phone. The results can be expected to appear within one month after the examination.

- Please answer in English.
- **Answer only five (5) questions.** If you answer more, only the worst five will be considered.
- Illustrate your answers by using graphics, formulas, or tables whenever possible.
- Answer clearly (both content wise and handwriting): According to Murphy's law, if an answer can be misinterpreted, it will be misinterpreted.
- Everyone must leave a paper, even if it contains only your name and student number!

Good luck with the exam!

1. Explain briefly but exactly the following concepts and their role in audio signal processing:

- (a) AAC
- (b) Allpass filter
- (c) Graphic equalizer
- (d) Minimum-phase filter
- (e) Schroeder's algorithm
- (f) Sinc function

2. Sound analysis.

- (a) Describe the main techniques used for analyzing sound signals.
- (b) Explain the principle of sinusoidal modeling.

3. Musical sound synthesis.

- (a) FM synthesis.
- (b) Subtractive synthesis. Explain the basic principles and challenges of its digital implementation.

4. Digital audio effects processing.

Explain the digital implementation of the following methods with text and diagrams:

- (a) Chorus
- (b) Flanging
- (c) Phasing

5. Sample rate conversion.

- (a) Describe the rational sampling rate conversion scheme and its polyphase implementation.
- (b) Describe the Smith–Gossett algorithm.

6. Audio coding.

- (a) Describe the existing and potential applications of audio coding techniques.
- (b) Explain the principles and draw the functional blocks of lossless audio coding.

Answer only five (5) questions out of six.