(Knowledge for development)

KIBABII UNIVERSITY

(KIBU)

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

END OF SEMESTER EXAMINATIONS
YEAR FOUR SEMESTER TWO EXAMINATIONS

FOR THE DEGREE OF
BACHELOR OF SCIENCE
(COMPUTER SCIENCE)

COURSE CODE : CSC 455E

COURSE TITLE : DIGITAL AUDIO TECHNOLOGIES

DATE: 29/08/2022 **TIME:** 09.00 A.M – 11.00 A.M

INSTRUCTIONS TO CANDIDATES

ANSWER **QUESTIONS ONE** AND **ANY OTHER TWO.**

QUESTION ONE [COMPULSORY] [30 MARKS]

(a) Define the following terms applicable in digital audio processing

(i) Surround Sound **[2 marks]**

(ii) Bit depth **[2 marks]**

(b) One of the important characteristics of digital audio signal is that it can be compressed due to generally large audio files.

(i) Give two reasons motivating data compression in digital audio signals **[2 marks]**

(ii) State and briefly explain two forms of data compression **[3 marks]**

(c) Briefly explain the concept of Nyquist theorem in relation to Nyquist rate and frequency applicable in digital audio signal processing **[4 marks]**

(d) Consider a sound moving in an audio broadcast room with the dimensions 4m length, 4m width and 4m height. The speed of sound is 343m/s in the dry air room at the temperature of 20°c and assuming the average absorption coefficient of room surfaces is 1. Applying the Sabine reverberation equation, determine the following;

(i) Total sound absorption rate (RT_{60}) **[5 marks]**

(ii)Estimate the Critical Distance (dc) based on (i) above **[3 marks]**

(e) In Dolby DTS, Direct Stream Transfer is a complex coding method that uses three stages. List the three stages adopted by Dolby DTS **[3 marks]**

(f) (i) State three problems associated with uniform quantization in Pulse Code Modulation systems **[3 marks]**

(ii) On a compact disc, the audio signal is sampled at 44.1 kHz and each sample is coded on 16 bits. What will be the bit rate of the resulting PCM code? **[3 marks]**

QUESTION TWO [20 MARKS]

(a) Define the following key terms applicable in describing audio signals and state their related metrics

(i) Intensity **[2 marks]**
(ii) Frequency **[2 marks]**
(iii) Critical band **[2 marks]**

(b) Briefly explain the roles of the following common audio processors in digital audio systems

(i) Echo cancellation **[1 mark]**

(ii) Limiters **[1 mark]**

(iii) Gates **[1 mark]**

(iv) Automatic Gain Control **[1 mark]**

(c) Illustrate using diagrams the following two main steps involved in digitization of audio signals

(i) Sampling **[3 marks]**

(ii) Quantization **[3 marks]**

(d) Distinguish between the following two forms of sound synthesis applicable in digital audio systems

(i) FM Synthesis **[2 marks]**
(ii) Wavetable Synthesis **[2 marks]**

QUESTION THREE [20 MARKS]

(a) (i) What is the role of the audio sequencer in digital audio production **[2 marks]**

(ii) Music sequencers can be categorized by their handling data types. State and briefly explain four categories of handling data types **[6 marks]**

(b) (i) Define the meaning of auditory human perception in digital audio production **[2 marks]**

(ii) Briefly describe the frequency range of human hearing in relation to auditory human perception **[2 marks]**

(c) (i)List four characteristics of analog audio systems that contribute to their weaknesses compared to digital audio systems **[4 marks]**

(ii)State four reasons why analog audio signals are converted to digital systems in digital audio processing **[4 marks]**

QUESTION FOUR [20 MARKS]

(a) State the meaning of the following terms applicable in digital audio technologies

(i) Noise **[1 mark]**

(ii) Distortion **[1 mark]**

(iii)Digital Audio Broadcast **[1 mark]**

(b) (i) Briefly explain the role of psychoacoustic model in digital audio compression **[2 marks]**

(ii) Psychoacoustics is based heavily on human anatomy, especially the ear's limitations in perceiving sound. List four common limitations **[4 marks]**

(c) State three forms of digital audio coding formats and briefly describe the roles of each **[6 marks]**

(d) (i)Microphones and loudspeakers main examples of transducers in digital audio processing. Briefly explain the differences between the two types of transducers **[2 marks]**

(ii) State and briefly describe three common characteristics of microphones and loudspeakers **[3 marks]**

QUESTION FIVE [20 MARKS]

(a) Define the following terms applicable in audio production

i. Room Acoustics **[1 mark]**

ii. Acoustic Absorption **[1 mark]**

iii. Reverberation **[1 mark]**

iv. Depth perception **[1 mark]**

(b) Briefly discuss the concept of Internet Radio Broadcast and its applications **[4 marks]**

(c) In reference to data compression for digital audio signals, briefly describe and differentiate the following coding methods

i. Run Length Coding for Binary Files **[3 marks]**

ii. Huffman coding **[3 marks]**

iii. Arithmetic Coding **[3 marks]**

(d) MPEG audio coding is comprised of three independent layers. Each layer is a self-contained SBC coder with its own time frequency mapping, psychoacoustic model, and quantizer. List the three layers and state the coding format applicable in each layer. **[3 marks]**