

City University of Hong Kong

Course code & title : EE4115 Audio-Visual Engineering

Session : Semester B 2008/09

Time allowed : Two hours

This paper has **THREE** pages (including this cover page).

Instructions to candidates:

1. This paper consists of **THREE** questions.
 2. Answer **ALL** questions.
 3. Show clearly all essential steps and state any assumptions made.
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Materials, aids & instruments permitted to be used during examination:

City University Approved Electronic Calculator

Special materials: Nil

Answer ALL questions

Question 1 (33 marks)

(1.1) A monochrome video signal has the following specification:

- Lines per frame - 525
- Fields per second - 60
- Bandwidth - 5.5MHz

Calculate the maximum horizontal resolution of the video signal. (12 marks)

(1.2) Describe the structure of the comb filter employed in a *PAL* standard television. With the use of Fourier Transform, derive and sketch the magnitude of the transfer functions that correspond to the sum and difference paths of the comb filter.

(21 marks)

Question 2 (33 marks)

(2.1) Illustrate with diagrams the Layer Structure in *MPEG* bit-stream from a video sequence to image blocks.

(15 marks)

(2.2) A video sequence is encoded with the *MPEG* standard with the following information:

- Pictures per second: 25
- Maximum target bit-rate: 1.2 *Mbps*
- Quality of encoded frames
 - *I* frame : Highest.
 - *B* frame: Medium.
 - *P* frame: Lowest.
- Number of bits for representing the *I*, *B* and *P* frames
 - *I* frame : 0.25*Mb*.
 - *B* frame: 0.03*Mb*.
 - *P* frame: 0.02*Mb*.

Where *Mb* and *Mbps* stand for “mega-bit” and “mega-bit per second”, respectively.

Given that there are 2 *P* frames, determine the number of *I* and *B* frames per second of video sequence so that the best quality on the encoded pictures is attained within the target bit-rate.

(18 marks)

Question 3 (34 marks)

(3.1) An input signal $x(n)$ is input into a noise shaping circuit to give an output $y(n)$ as shown in figure Q3. $e(n)$ represents the combination of dithering and quantization noise, $H(\omega)$ is the noise shaping filter.

The transfer function of $H(\omega)$ is $e^{-jM\omega}$ where M is a finite, positive, and non-zero integer and ω is the frequency in radians per second. Determine the total noise-power gain of the noise shaper.

(20 marks)

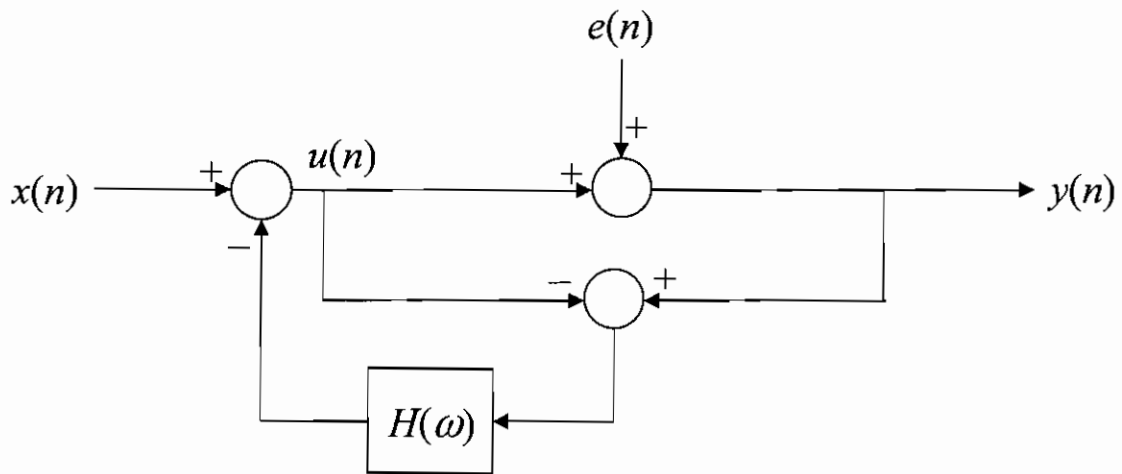


Figure Q3

(3.2) Explain the principles of the masking effect of the psychoacoustic model employed to conceal quantization noise. Also explain how the bandwidth of each band affects the effectiveness of masking.

(14 marks)

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