

2009 Paper 9 Question 12

Digital Signal Processing

(a) Make the following statements correct by changing one word or number. (Negating the sentence is not sufficient.)

(i) In the stopband, a filter design approximates a gain of -1 . [1 mark]

(ii) For infinite sequences the z -transform always converges across the entire complex plane. [1 mark]

(iii) The Barlett window is the product of a rectangular window and a raised cosine function. [1 mark]

(iv) Multiplying two complex variables can be implemented with two real-valued multiplications and five real-valued additions. [1 mark]

(v) As a continuous signal is sampled, its Fourier spectrum becomes non-linear. [1 mark]

(b) Briefly explain

(i) the zigzag ordering of DCT coefficients in JPEG; [3 marks]

(ii) the difference between I-frames, P-frames and B-frames in MPEG; [3 marks]

(iii) the relationship between YCrCb and RGB colour coordinates. [4 marks]

(c) A 300 Hz sine wave is sampled at 1000 Hz. This discrete sequence is then multiplied, sample by sample, with the discrete sequence

$$\dots, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1, 0, -1, \dots$$

Which frequencies appear in the Fourier transform of the result?

[5 marks]