UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	DIGITAL SIGNAL PROCESSING
COURSE CODE	:	BEF 35603
PROGRAMME	:	BACHELOR OF ELECTRICAL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015 / JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) A periodic discrete signal is defined as

$$x[n] = \{ \ldots\ldots 0,\ 1,\ 2,\ 3, \underset{\Downarrow}{0},\ 1,\ 2, 3, \ldots\ldots \}$$

(i) Sketch the signal *x[n]*, for $-5 \leq n \leq 5$.

(2 marks)

(ii) Briefly explain whether the signal *x[n]* is even symmetric signal or not.

(2 marks)

(iii) Calculate the average signal power of *x[n]*.

(2 marks)

(iv) Sketch the signal $y[n] = x[-n] + x[n-5]$, for $0 \leq n \leq 8$.

(3 marks)

(v) Prove whether or not the system for *y[n]* is linear and time invariant.

(6 marks)

(b) State **five (5)** elements in the digital signal processing system.

(5 marks)

Q2 A continuous voltage signal has function:

$$v(t) = 10\sin(200\pi t + 90^{o}) + 5$$

If the voltage signal is sampled at 500 Hz and quantized by using rounding technique with quantitation interval of 1 V.

(a) Determine the digital frequency of the sampled signal and the number of samples signal in one period.

(2 marks)

(b) Determine the sampled signal, *v[n]* for one period.

(7 marks)

(c) Sketch the quantitation voltage signal, *v[n]* for one period.

(3 marks)

(d) State **three (3)** type of interpolation method in the reconstruction of the digital signal processing.

(3 marks)

(e) Estimate the value of the reconstructed signal $v(t)$ at 0.003 second using linear interpolation and using step interpolation.

(5 marks)

Q3 (a) A *Finite Impulse Response (FIR)* filter has an impulse response

$$h[n] = -3\delta[n+2] - 2\delta[n+1] - \delta[n] + \delta[n-2]; \quad \text{for } -2 \le n \le 2$$

Determine the output response of $y[n]$ using sum by column method for the input signal of

$$x[n] = \{\underset{\Downarrow}{1}, 2, 3\}$$

(5 marks)

(b) Function of the Finite Impulse Response (FIR) filter is given by

$$h[n] = \{\underset{\Downarrow}{4}, 3, 2\}$$

This function generate a cross-correlation

$$r_{hx}[n] = \{8, \underset{\Downarrow}{2}, -11, -11, -6\}$$

Calculate the input functions of the system.

(5 marks)

(c) A discrete signal has function

$$x[n] = 4\delta[n] + 3\delta[n-2] + \delta[n-4\}$$

(i) *Determine the Discrete Fourier Transform (DFT)* of $x[n]$.

(6 marks)

(ii) Calculate *Discrete Fourier Transform (DFT)* of $y[n]=x[n-2]$, by using the properties of the *DFT*.

(2 marks)

(iii) Calculate *Discrete Fourier Transform (DFT)* of $z[n]=x[-n]$, by using the properties of the *DFT*.

(2 marks)

Q4 (a) Determine the z-transform and specify its region of convergence of signal:

$$x[n] = n[2]^{n-2}u[n-1]$$

(5 marks)

(b) A system has z-transform function as

$$X(z) = \frac{z}{(z-0.5)(z+2)}$$

Calculate *x[n]* as an inverse of *X(z)* where *x[n]* represents a right-side signal.

(5 marks)

(c) A system is described by the following difference equation:

$$y(n) = y(n-1) + x(n) - x(n-2)$$

(i) Calculate the transfer function and the impulse response.

(5 marks)

(ii) Calculate *w(n)* as the response to the unit step of the input.

(5 marks)

Q5 (a) State **four (4)** practical mapping methods in IIR digital filter design

(4 marks)

(b) An analog filter has function:

$$H(s) = \frac{1}{s+2}$$

(i) Convert *H(s)* to a digital filter *H(z)*, using step invariant at sampling frequency of *S*=2 Hz.

(5 marks)

(ii) Convert *H(s)* to a digital filter *H(z)*, using mapping based on the forward difference at sampling rate *S*. Determine the sampling rate hence the filter always stable.

(5 marks)

(b) A lowpass filter

$$H(z)=\frac{z+1}{z^2-z+0.2}$$

has cutoff frequency f=0.5 kHz and operate at a sampling frequency S=10 kHz. Design a lowpass filter with a cutoff frequency of 2 kHz.

(6 marks)

- END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/SESSION : I/ 2015/ 2016 PROGRAMME : BEV
COURSE NAME : DIGITAL SIGNAL PROCESSING COURSE CODE : BEF 35603

FORMULAS

$e^{\pm jm\pi} = -1$ for m = 1,3,5....
$e^{\pm jn\pi} = 1$ for n = 2,4,6....

$e^{\pm jm\pi} = -1$ for m = 1,3,5....
$e^{\pm jn\pi} = 1$ for n = 2,4,6....

$e^{jm\pi/2} = j$ for m = 1,5,9....
$e^{jn\pi/2} = -J$ for n = 3,7,11....

$e^{-jm\pi/2} = -J$ for m = 1,5,9....
$e^{-jn\pi/2} = +j$ for n = 3,7,11....