EC36

USN

NEW SCHEME

Third Semester B.E. Degree Examination, Dec.06 / Jan.07
Electronic and Communication Engineering
Signals and Systems

Time: 3 hrs.] [Max. Marks:100

Note: ***1. Answer any FIVE full questions.***
2. Justify any assumptions made.

1 a. Determine and sketch the even and odd parts of the signal shown in figure Q1 (a). **(05 Marks)**

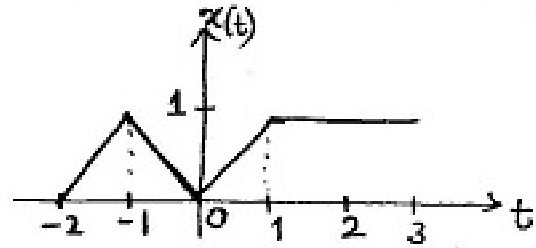

Fig. Q1 (a)

b. Determine whether the discrete-time signal $x(n) = \cos\left(\frac{\pi n}{5}\right)\sin\left(\frac{\pi n}{3}\right)$ is periodic. If periodic, find the fundamental period. **(05 Marks)**

c. Determine whether the following signals are power signals or energy signals or neither:

i) $e^{-at}; t \ge 0$

ii) $2e^{j3t}$ **(06 Marks)**

d. Determine if each of the following signals is invertible. If it is, construct the inverse system. If it is not, find the two input signals that have the same output.

i) $y(t) = \int_{-\infty}^{t} x(\tau)d\tau; y(-\infty) = 0$

ii) $y(n) = nx(n)$ **(04 Marks)**

2 a. Determine whether the system given by the following relation is,

i) Linear
ii) Time-invariant and
iii) Stable.

$$y(n) = x(n)\sum_{k=-\infty}^{\infty}\delta(n-2k)$$ **(06 Marks)**

b. Figure Q2 (b)-1 shows a staircase-like signal $x(t)$ that may be viewed as a superposition of four rectangular pulses. Starting with the rectangular pulse shown in figure Q2(b)-2, construct this waveform and express $x(t)$ in terms of $g(t)$. **(06 Marks)**

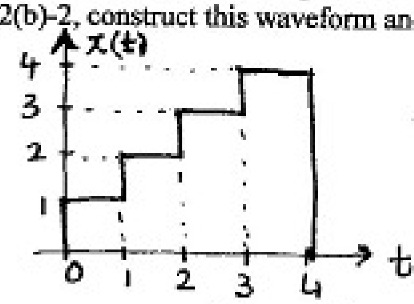

Fig Q 2(b)(i)

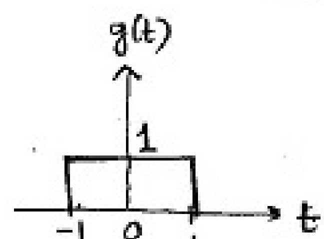

Fig Q 2(b)(ii)

Contd....2

2 c. Find the convolution of two finite duration sequences,

$h(n) = a^n u(n)$ for all n

$x(n) = b^n u(n)$ for all n

i) When $a \neq b$ ii) When $a = b$ **(08 Marks)**

3 a. Find the step response of a system whose impulse response is given by, $h(t) = u(t+1) - u(t-1)$ **(05 Marks)**

b. Determine the output of the system described by the difference equation,

$$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = 2x(n).$$

with input $x(n) = 2u(n)$ and initial conditions $y(-1) = 1$, $y(-2) = -1$ **(08 Marks)**

c. Draw the direct form I and direct form II implementations of the system represented by the differential equation,

$$\frac{d^3y(t)}{dt^3} + 2\frac{dy(t)}{dt} + 3y(t) = x(t) + 3\frac{dx(t)}{dt}$$ **(07 Marks)**

4 a. Determine the complex fourier coefficients for the signal shown in figure Q4 (a). **(08 Marks)**

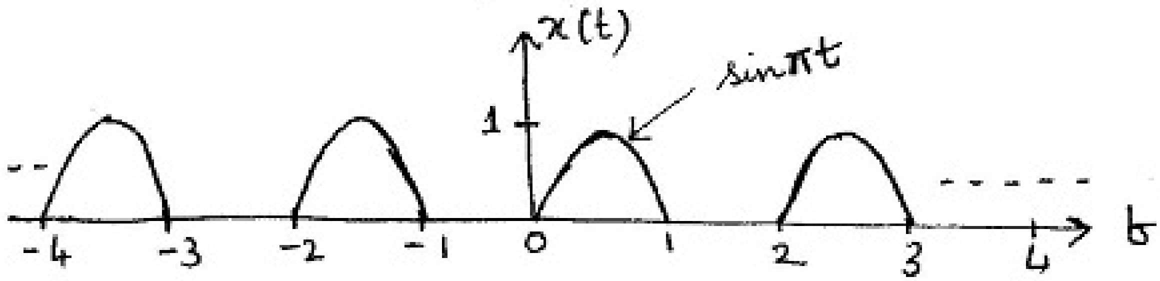

Fig. Q4 (a)

b. State and prove Parseval's theorem as applied to Fourier series. **(06 Marks)**

c. Evaluate the DTFT of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n-4)$. **(06 Marks)**

5 a. Determine the time domain signal corresponding to $X(e^{j\Omega}) = |\sin(\Omega)|$. **(06 Marks)**

b. Use appropriate properties to determine the inverse FT of

$$x(j\omega) = \frac{j\omega}{(2+j\omega)^2}.$$ **(07 Marks)**

c. Use the duality property of Fourier representation to evaluate the following :

i) $x(t) \xleftrightarrow{FT} e^{-2\omega}u(j\omega)$

ii) $\frac{1}{1+t^2} \xleftrightarrow{FT} X(j\omega)$ **(07 Marks)**

6 a. Determine the frequency response and impulse response for the system described by the differential equation,

$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}.$$ **(06 Marks)**

b. Determine the difference equation description for the system with the following impulse response:

$$h(n) = \delta(n) + 2\left(\tfrac{1}{2}\right)^n u(n) + \left(-\tfrac{1}{2}\right)^n u(n).$$ **(06 Marks)**

6 c. Specify the Nyquist rate and Nyquist intervals for the following signals :

i) $g_1(t) = \operatorname{sinc}(200t)$

ii) $g_2(t) = \operatorname{sinc}^2(200t)$

iii) $g_3(t) = \operatorname{sinc}(200t) + \operatorname{sinc}^2(200t)$ (08 Marks)

7 a. Specify the important properties of ROC of Z-transform. (06 Marks)

b. Find the Z-transform of the signal,

$x(n) = n\sin\left(\frac{\pi}{2}n\right)u(-n)$. (06 Marks)

c. Find the time domain signals corresponding to the following Z-transforms.

i) $X(Z) = \frac{1}{1-Z^{-2}}; |Z| > 1$

ii) $X(Z) = \cos(2Z); |Z| < \infty$ (08 Marks)

8 a. The output of a discrete-time LTI system is $y(n) = 2\left(\frac{1}{3}\right)^n$ when the input $x(n)$ is $u(n)$.

i) Determine the impulse response $h(n)$ of the system.

ii) Determine the output when the input is $\left(\frac{1}{2}\right)^n u(n)$. (13 Marks)

b. Use unilateral Z-transform to determine the forced response, the natural response and the complete response of the system described by the difference equation,

$y(n) - \frac{1}{2}y(n-1) = 2x(n)$

with the input $x(n) = 2\left(-\frac{1}{2}\right)^n u(n)$ and initial condition $y(-1) = 3$. (07 Marks)

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