CBCS SCHEME

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15EE54

Fifth Semester B.E. Degree Examination, July/August 2021
Signals and Systems

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions.*

1 a. Explain the signals and systems with the help of examples. **(05 Marks)**

b. Determine whether the following signals are periodic or not? If periodic determine fundamental period. i) $\text{Cos}t + \text{Sin}\sqrt{2}\,t$ ii) $\text{Cos}\frac{2\pi n}{5} + \text{Cos}\frac{2\pi n}{7}$. **(05 Marks)**

c. A signal x(t) = u(t), unit step function. Sketch and lable each of the following signals.
i) x(t – 2) ii) x(2t – 2) iii) x(t/2 – 2). **(06 Marks)**

2 a. Determine whether the system is linear, time invariant, stable and causal.
i) y(n) = log [x(n)] ii) y(t) = 10x(t) + 5. **(06 Marks)**

b. Determine the even and odd component of the following signal x(n) = 2, $0 \le n \le 3$. **(05 Marks)**

c. Determine whether the following signals are energy signals or power signals and calculate their energy or power

i) $x(n) = \left(\frac{1}{2}\right)^n u(n)$ ii) $x(t) = At \quad 0 \le t \le T$. **(05 Marks)**

3 a. The impulse response and the input to the system is given as
h(t) = u(t – 2) and x(t) = u(t + 1). Determine the output of the system. **(07 Marks)**

b. Find the total response of the system described by the system,

$y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$, given that

$x(n) = 2^n u(n) \cdot y(-1) = 2,\ y(-2) = -1$. **(09 Marks)**

4 a. Determine the convolution of two given sequences. $x(n) = \left[\underset{\uparrow}{1}, 2, 3, 4\right]$ and $h(n) = \left[\underset{\uparrow}{1}, 1, 3, 2\right]$. **(04 Marks)**

b. Determine the natural response of the system described by the differential equation

$10\frac{dy(t)}{dt} + 2y(t) = x(t)$ with y(0) = 2. **(06 Marks)**

c. A difference equation of a discrete time system is given below :

$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{2}x(n-1)$. Draw direct form – I and direct form – II structures. **(06 Marks)**

5 a. State and prove the following properties of continuous time Fourier transform.
i) Time shift property ii) Convolution in time. **(07 Marks)**

b. Obtain the Fourier transforms of following signals.
i) $x(t) = e^{at}u(-t)$ ii) $x(t) = e^{-a|t|}$ iii) $x(t) = \delta(t)$. **(09 Marks)**

6 a. The input and the output of a causal LTI system are related by differential equation $\frac{d^2y(t)}{dt^2}+6\frac{dy(t)}{dt}+8y(t)=2x(t)$. Find the impulse response of this system. **(07 Marks)**

b. A continuous, casual linear time invariant system is shown in Fig Q6(b). Determine the unit impulse of this system. Plot the response [step response].

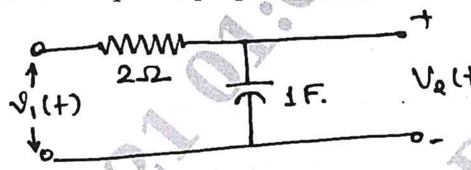

Fig Q6(b) **(09 Marks)**

7 a. Determine DT Fourier transform of
i) $x(n)=a^n u(n)$ for $-1<a<1$ ii) $x(n)=\delta(n)$ iii) $x(n)=-a^n u(-n-1)$ **(08 Marks)**

b. State and prove the following properties of DTFT, i) Frequency shift ii) Parseval's theorem. **(08 Marks)**

8 a. Determine the time domain signal
$$x(e^{j\Omega})=\frac{6}{e^{-j2\Omega}-5e^{-j\Omega}+6}$$ **(06 Marks)**

b. A discrete time system has a unit sample response h(n) given by $h(n)=\frac{1}{2}\delta(n)+\delta(n-1)+\frac{1}{2}\delta(n-2)$. Find the system frequency response $H(e^{j\Omega})$. Plot the magnitude and phase response. **(06 Marks)**

c. An LTI system is described by $H(f)=\frac{4}{2+j2\pi f}$. find its response y(t) if the input is $x(t)=u(t)$. **(04 Marks)**

9 a. List the properties of ROC. **(05 Marks)**

b. Determine the Z-transform of
i) $x(n)=a^n\cdot \text{Cos}[\Omega_0 n]\cdot u(n)$ ii) $x(n)=n\left(\frac{5}{8}\right)^n u(n)$. **(05 Marks)**

c. State and prove the initial value theorem and final value theorem. **(06 Marks)**

10 a. Find the inverse Z-transform of x(z) using partial fraction expansion approach.
$$x(z)=\frac{z+1}{3z^2-4z+1} \quad \text{ROC}: |z|>1.$$ **(07 Marks)**

b. Using unilateral Z-transform, solve the following difference equation. **(07 Marks)**
$y(n)+3y(n-1)=x(n)$ with $x(n)=u(n)$ and the initial condition $y(-1)=1$.

c. Explain the causality and stability interms of Z-transform. **(02 Marks)**

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