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) $\cos t + \sin\sqrt{2}\,t$ ii) $\cos\frac{2\pi n}{5} + \cos\frac{2\pi n}{7}$. **(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. $x(n) = \left[\begin{matrix}1, & 2, & 3, & 4\\ & \uparrow & & \end{matrix}\right]$ and $h(n) = \left[\begin{matrix}1, & 1, & 3, & 2\\ \uparrow & & & \end{matrix}\right]$. **(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].

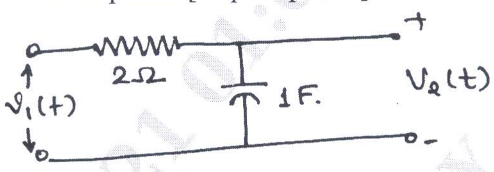

Fig Q6(b) **(09 Marks)**

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) $x(n)= n\left(5/8\right)^n u(n)$. **(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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