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Question Paper Code : 51058

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Seventh Semester

Electronics and Instrumentation Engineering

OEC 753 – SIGNALS AND SYSTEMS

(Common to: Computer Science and Engineering/Electrical and Electronics Engineering/Instrumentation and Control Engineering/Information Technology)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the mathematical and graphical representation of a continuous time unit step function.

2. Determine whether the signal $x(n)=\sin\frac{5\pi}{2}n$ is a periodic signal or not.

3. What are the Fourier series coefficients of the signal $x(t)=2\sin\frac{5\pi}{2}t$?

4. State the time shifting property of the continuous time Fourier transform.

5. Two systems with impulse responses $h_1(t)=u(t)$ and $h_2(t)=\delta(t-1)$ are connected in series. What is the overall impulse response $h(t)$ of the system?

6. What is the formula used for convolving two continuous time signals $x(t)$ and $h(t)$?

7. State the need for sampling a continuous time signal.

8. If the $z-$transform of a sequence $x(n)$ is $x(z)=1+z^{-1}+2z^{-2}$. What is the $z-$ transform of $x[n-1]$?

9. Distinguish between recursive and non recursive systems.

10. Convolve the sequences

$x(n)=\{1,2,0,4\}$ and $h(n)=\{1,2,3\}$.

PART B — (5 × 13 = 65 marks)

11. (a) Give the input-output relationship of a discrete time system $y(n)=2x(n-1)+5$. Determine whether the system is linear, time invariant, causal and stable.

Or

(b) Prove that the signals $x(t)=t\,u(t)$ and $x(n)=n\,u[n]$ are neither energy signals nor power signals.

12. (a) Prove that the Fourier transform of the rectangular pulse represented by

$$x(t)=\begin{cases}1, & |t|<2\\ 0 & |t|>2\end{cases}$$

is an aperiodic sinc function as a function of frequency.

Or

(b) Find the Laplace transform of $x(t)=e^{-t}u(t)-e^{t}u(-t)$. Also specify its region of convergence.

13. (a) Convolve the following signals

$x(t)=e^{-2t}\,u(t)$

$h(t)=u(t)$

Or

(b) Given the system function

$H(s)=\dfrac{2}{s^2+3s+2}, ROC:\mathrm{Re}\{s\}>-1$. Find the differential equation representation of the system and the impulse response $h(t)$ of the system.

14. (a) Discuss quantitatively the sampling theorem with necessary illustrations.

Or

(b) State and prove the time shifting property and time scaling property of DTFT.

15. (a) Convolve the following sequences

$x(n)=(0.5)^n u(n)$

$h(n)=(0.3)^n u(n-1)$

Or

(b) Given $H\left(e^{jw}\right)=\frac{2}{\left(1-0.2e^{-jw}\right)\left(1-0.5e^{-jw}\right)}$. Find the difference equation representation of the system and the impulse response $h(n)$ of the system.

PART C — (1 × 15 = 15 marks)

16. (a) Given the differential equation representation of a system $\frac{d^2}{dt^2}y(t)+\frac{d}{dt}y(t)-2y(t)=x(t)+\frac{d}{dt}x(t)$. Find the impulse response $h(t)$ and the step response $s(t)$ of the system.

Or

(b) A DT LTI system is represented by the following difference equation $y(n)-0.5\,y(n-1)=\frac{1}{3}x(n)$. Find the impulse response $h(n)$ and the step response $s(n)$ of the system.

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