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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree (S,FE) Examination August 2021 (2015 Scheme)

Course Code: EC202

Course Name: SIGNALS & SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Check if the signals below are periodic. If so, find the fundamental period. (6)

(i) $x(t) = \sin\left(\sqrt{2}\,t\right) + \cos(t)$

(ii) $x[n] = \sin\left(\frac{2\pi n}{5}\right) + \cos\left(\frac{2\pi n}{3}\right)$

b) Sketch the signal below. (9)

$$x(t) = e^{-a|t|}, (a > 0)$$

(i) Represent the signal as a sum of a causal signal and an anti-causal signal.

(ii) Determine whether it is an energy signal, power signal or neither energy nor power.

2 a) Determine whether the following systems are linear. (10)

(i) $\frac{d^2}{dt^2} y(t) + 3ty(t) = \frac{t^2}{2} x(t)$

(ii) $y[n] = x^*[n]$, * indicating complex conjugate

b) A system is described by the input-output relation described below. Check whether the system is linear and time invariant. (5)

$y[n] = x[kn]$, k a real constant.

3 a) Find the output of the LTI system described by the impulse response (8)

$h[n] = [\underset{\uparrow}{2}, 3, 3, 2]$ to the input signal $h[n] = [1, 2, \underset{\uparrow}{2}, 1]$

b) Derive the stability condition of a continuous time LTI system having impulse response $h(t)$. (7)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Consider the periodic impulse train (8)

$$\delta_T(t) = \sum_{k=-\infty}^{\infty} \delta\left(t - kT\right)$$

. Determine its

(i) complex exponential Fourier series

(ii) Trigonometric Fourier Series

b) Given (7)

$$x(t) \xleftrightarrow{\text{Fourier Transform}} X(\Omega),$$

show that

$$\int_{-\infty}^{\infty} |x(t)|^2\, dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} |X(\Omega)|^2\, d\Omega$$

5 a) Compute the Laplace Transforms of the signals (9)

(i) $x(t) = e^{-2t}\left(u(t) - u(t-5)\right)$

(ii) $x(t) = \delta(3t + 5)$

(iii) $x(t) = e^{-2t}\cos\left(\Omega_0 t\right)u(t)$

b) The o/p $y(t)$ of a continuous time LTI system is $y(t) = 2e^{-3t}u(t)$, when the input $x(t)$ is a unit step. Find (6)

(i) $h(t)$, the impulse response

(ii) $y(t)$, when input $x(t) = e^{-t}u(t)$

6 a) State and prove the sampling theorem for Low pass signals. (10)

b) A signal $x(t) = 1 + \cos(5\pi t) + 0.5\cos(10\pi t)$ is ideally sampled. The interval between the samples is T_s seconds. Find (5)

(i) Maximum allowable value for T_s.

(ii) The minimum bandwidth of the Ideal reconstruction filter. Plot its frequency response.

PART C

Answer any two full questions, each carries20 marks.

7 a) A causal discrete-time LTI system is described by (10)

$y[n]-0.75y[n-1]+0.125y[n-2]=x[n]$

where $x[n]$ and $y[n]$ are the input and output of the system, respectively.

(a) Determine the system function $H(z)$.

(b) Find the impulse response $h[n]$ of the system.

(c) Find the step response $s[n]$ of the system.

b) Show that (10)

(i) $x_1[n]*x_2[n]\xleftrightarrow{z}X_1(z)X_2(z)$

(ii) $nx[n]\xleftrightarrow{z}-z\dfrac{d}{dz}X(z)$

8 a) Find the DFS of the following sequences (9)

(i) $x[n]=\cos\dfrac{\pi}{4}n$

(ii) $x[n]=\cos\dfrac{\pi}{4}n+\sin\dfrac{\pi}{3}n$

(iii) $x[n]=\cos^2\left(\dfrac{\pi}{8}n\right)$

b) Explain the relationship between z-Transform and DTFT (6)

c) State and Prove the Parseval's relationship for DTFT (5)

9 a) Find the DTFT of $x[n]=u[n]-u[n-N]$ (8)

b) (i) Find the impulse response of an Ideal Discrete Low Pass filter (LPF) with a cut off frequency ω_c (12)

(ii) Is an Ideal LPF realizable in the time domain? Give reasons.

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