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TEST -2 EXAMINATIONS-2022

B.Tech - IV Semester (ECE)

COURSE CODE: 18B11EC412 MAX. MARKS: 25

COURSE NAME: Fundamentals of Signals & Systems

COURSE CREDITS: 04 MAX. TIME: 1.5 Hour

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q1. **a)** For an LTIC system with the unit impulse response $h(t) = e^{-2t}u(t)$. Determine the step response of the system. [2] [CO2]

b) Solve the differential equation [3]

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

if the input $x(t) = t^2 + 5t + 3$ and the initial conditions are $y(0) = 2$ and $\dot{y}(0) = 3$.

Q2. **a)** Find correlation between $f[n]$ and $g[n]$ where $f[n] = u[n]$ and $g[n] = u[n-1] - u[n+1]$. [3] [CO2]

b) The following are the impulse responses of LTI systems. Determine whether each system is causal and/or stable. Justify your answers. [2]

i. $h[n] = \left(\frac{1}{5}\right)^n u[n]$

ii. $h[n] = (5)^n u[-n+3]$

iii. $h(t) = e^{-6t}u(4-t)$

iv. $h(t) = te^{-t}u(t)$

Q3. **a)** For the continuous-time periodic signal [2] [CO3]

$$x(t) = 2 + \cos\left(\frac{2\pi}{3}t\right) + 4\sin\left(\frac{5\pi}{3}t\right),$$

determine the fundamental frequency w_0 and the Fourier series coefficients D_n.

b) Calculate the coefficients for the continuous-time periodic signal [3]

$$x(t) = \begin{cases} 1.5 & 0 \le t < 1 \\ -1.5 & 1 \le t < 2 \end{cases}$$

with fundamental frequency $w_0 = \pi$.

Q4. a) Calculate the Fourier transforms of: [2] [CO3]

$$\delta[n+1] - \delta[n-1]$$

Sketch and label the magnitude of Fourier transform.

b) Determine the inverse Fourier transforms of:

$$X(w) = 2\pi\delta(w) + \pi\delta(w - 4\pi) + \pi\delta(w + 4\pi)$$ [3]

Q5. a) Given that $x(t)$/x[n] has the Fourier transform $X(w)$/X(Ω), express the Fourier transforms of the signals listed below in terms of $X(w)/X(\Omega)$. You may find useful the Fourier transform properties. [2] [CO3]

i. $y(t) = \frac{d^2}{dt^2}x(t-1)$

ii. $z[n] = x[1-n] + x[-1-n]$

b) Derive Parseval's relation of Fourier series. [3]