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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATIONS-2022

B.Tech - IV Semester (ECE)

COURSE CODE: 10B11EC301 MAX. MARKS: 25

COURSE NAME: 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) The step response of the system of an LTIC system is $s(t) = e^{-2t}u(t)$. Determine the unit impulse response of the system. [2] [CO2]

b) Solve the differential equation [3]

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

if the input $x(t) = e^{-2t}u(t)$ and the initial conditions are $y(0) = \dot{y}(0) = 0$.

Q2. a) Find correlation between $f(t)$ and $g(t)$ where $f(t) = e^{-2t}u(t)$ and $g(t) = \delta(t-1) + \delta(t+1)$. [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. $h[n] = u[n-1]$

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

iii. $h(t) = e^{-6t}\cos(20\pi t)\,u(t)$

iv. $h(t) = (t+1)e^{-t}u(t)$

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

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

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

[3]

b) Calculate the coefficients for the continuous-time periodic signal

$$x[n] = \begin{cases} 1 & 0 \leq n < 10 \\ -1 & 10 \leq n < 20 \end{cases}$$

with fundamental frequency $f_0 = 1$.

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

$$\cos\left(\frac{5n}{2}\right)$$

Sketch and label the magnitude of Fourier transform.

b) Determine the inverse Fourier transforms of: [3]

$$X(\Omega) = 2\pi\delta(\Omega - \pi) + 5\pi\delta(\Omega + \pi)$$

Q5. a) Given that $x(t)/x[n]$ has the Fourier transform $X(w)/X(\Omega)$, 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. $y(t) = \int x(t-1)dt$

ii. $z[n] = x[2n] - x[n-1]$

b) Derive convolution property of Fourier series. [3]