ENTRI

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth Semester B.Tech Degree Examination July 2021 (2019 Scheme)

Course Code: ECT204

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 | Duration: 3 Hours (ECT204 SIG... p. 1)

PART A

(Answer all questions; each question carries 3 marks) **(ECT204 SIG... p. 1)**

1. **Determine energy of the signal** $x(t) = e^{-2t}u(t)$**. (ECT204 SIG... p. 1)**
2. **Plot the waveform of the following signal:** $x(t) = u(t+1) - 2u(t) + u(t-1)$**. (ECT204 SIG... p. 1)**
3. **Perform linear convolution of signals** $x_1[n] = [2, 2, 2, 2]$ **and** $x_2[n] = [1, 1, 1, 1]$**. (ECT204 SIG... p. 1)**
4. **Find Laplace Transform and sketch ROC for the signal** $x(t) = e^{2t}u(t) + e^{-3t}u(t)$**. (ECT204 SIG... p. 1)**
5. **State sampling theorem of a band limited Continuous time signal. (ECT204 SIG... p. 1)**
6. **Find the Nyquist rate and Nyquist interval of the following signal:** $x(t) = 3\sin 100\pi t + 2\cos 200\pi t$**. (ECT204 SIG... p. 1)**

7. Find DTFT of the signal $x[n] = [\frac{1}{2}(\frac{1}{2})^n + (\frac{1}{4})^n]u[n]$. (ECT204 SIG... p. 1)
8. State and prove differentiation property of DTFT. (ECT204 SIG... p. 1)
9. Derive the relation between DTFT and Z transform. (ECT204 SIG... p. 1)
10. Evaluate the transfer function H(z) of an LTI system described by $y[n] - \frac{1}{2}y[n-1] = 2x[n]$. (ECT204 SIG... p. 1)

PART B

(Answer one full question from each module, each question carries 14 marks) **(ECT204 SIG... p. 1)**

Module - 1

11. a) Test whether the following signals are periodic or not. If periodic, determine the fundamental period and frequency: (1) $x(t) = 3\cos(5t + \pi/6)$ **(2)** $x(t) = e^{(j\pi-2)t}$**. (6 marks) (ECT204 SIG... p. 1)**

b) Evaluate the discrete-time convolution sum with required plots for the signal y[n] = $3^n u[-n+3] * u[n-2]$**. (8 marks) (ECT204 SIG... p. 1)**

OR

12. a) Evaluate the autocorrelation of the signal $x(t) = e^{-t}u$**. (6 marks) (ECT204 SIG... p. 2)**

b) Evaluate the continuous time convolution integral for $y(t) = [u(t) - u(t-2)] * u(t)$ with proper plots. (8 marks) (ECT204 SIG... p. 2)

Module - 2

13. a) Find the trigonometric Fourier Series of the given continuous time square wave x(t). Plot the magnitude and phase spectra. (7 marks) (ECT204 SIG... p. 2)

b) Using standard transforms and properties, find Fourier Transforms of: (i) $x(t) = te^{-2t}u(t)$ (ii) $x(t) = \sin(2\pi t)e^{-t}u(t)$. (7 marks) (ECT204 SIG... p. 2)

OR

14. a) A periodic signal has the Fourier series representation $x(t) \leftrightarrow X(k) = -k2^{-|k|}$. Without determining x(t), find the Fourier series Y(k) and $\omega_0{}'$ for (i) $y(t) = x(3t)$ (ii) y(t) = $dx(t)/dt$ (iii) y(t) = $x(t-1)$. (9 marks) (ECT204 SIG... p. 2)

b) Find time domain signal represented by $X(k) = j\delta(k-1) - j\delta(k+1) + \delta(k-3) + \delta(k+3), \omega_0 = 2\pi$. (5 marks) (ECT204 SIG... p. 2)

Module - 3

15. a) A second order LTI system is described by $\frac{d^2}{dt^2}y(t) + 4\frac{d}{dt}y(t) + 3y(t) = 4x(t) + 2\frac{d}{dt}x(t)$. Determine the transfer function and the output y(t) for $x(t) = e^{-2t}u(t)$. (8 marks) (ECT204 SIG... p. 2)

b) For an arbitrary band-limited continuous time signal $x(t)$ sampled with an impulse train, explain (i) Oversampling (ii) Critical Rate (iii) Aliasing. (6 marks) (ECT204 SIG... p. 2)

OR

16. a) Determine a differential equation description for $H(s) = \frac{2(s-2)}{(s+1)^2(s+3)}$**. (6 marks) (ECT204 SIG... p. 3)**

b) For $H(s) = \frac{(s+1)(s+2)}{(s+1)(s^2+2s+10)}$**, determine if the system is (i) both causal and stable (ii) whether a causal and stable inverse system exists. (8 marks) (ECT204 SIG... p. 3)**

Module - 4

17. a) (i) Find convolution of $x_1[n] = [1,2,3,1]$ and $x_2[n] = [1,2,1,-1]$ **using DTFT. (ii) Find Inverse DTFT of** $|H(\omega)| = 1$ for $-\omega_0 \leq \omega \leq \omega_0$ **and 0 otherwise. (8 marks) (ECT204 SIG... p. 3)**

b) Compute DTFS coefficients of $x[n] = \cos(\frac{6\pi}{13}n + \frac{\pi}{6})$ **and plot the spectrum. (6 marks) (ECT204 SIG... p. 3)**

OR

18. a) Determine the time domain signal for $X[k] = 2j\sin(\frac{4\pi}{19}k) + \cos(\frac{10\pi}{19}k)$**. (7 marks) (ECT204 SIG... p. 3)**

b) Given DTFT of

$$x[n] = n(3/4)^n u[n] \leftrightarrow X(e^{j\Omega}), \text{ find } y[n] \text{ for (i) } Y(e^{j\Omega}) = \frac{d}{d\Omega} X(e^{j\Omega})$$

(ii) $Y(e^{j\Omega}) = X(e^{j\Omega}) * X(e^{j(\Omega-\pi/2)})$**. (7 marks) (ECT204 SIG... p. 3)**

Module - 5

19. a) Determine Z Transform and ROC for $x[n] = (2/3)^n$ **(ECT204 SIG... p. 3). Sketch the ROC, poles, and zeroes. (8 marks)**

b) Write the impulse response for

$$H(z) = \frac{1}{(1 - \frac{1}{2} z^{-1})} + \frac{1}{(1 - 2z^{-1})} \text{ for } \frac{1}{2} < |z| < 2.$$

Justify causality and stability. (6 marks) (ECT204 SIG... p. 4)

OR

20. a) Evaluate the inverse Z-Transform by partial fraction for

$$X(z) = \frac{3 - \frac{5}{6} z^{-1}}{(1 - \frac{1}{2} z^{-1})(1 - \frac{1}{3} z^{-1})}, |z| > \frac{1}{2}$$

. (7 marks) (ECT204 SIG... p. 4)

b) Evaluate Z-Transform of (i)

$$x[n] = [r^n \cos\omega_0 n]u[n] \text{ (ii) } x[n] = n(\frac{1}{3})^n u[n]$$

. (7 marks) (ECT204 SIG... p. 4)