Reg. No.										

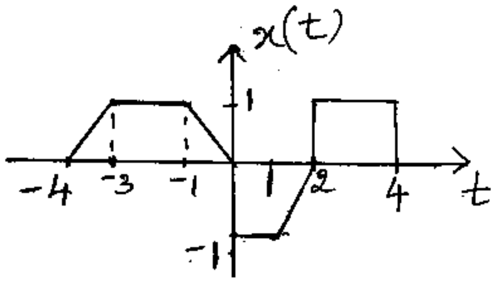
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

THIRD SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
MARCH 2021
SUBJECT: SIGNALS AND SYSTEMS (ECE - 2155)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Determine energy of the signal x(t) shown in figure below. Plot odd and even part of the signal x(t). Also compute energy of odd and even part of x(t).



1B. Sketch the CT signal defined by x(t) = u(t+2)-2u(t+1)+u(t)+ r(t)-r(t-1)-r(t-2)+r(t-3), where u(t) is unit step function and *r(t)* is the unit ramp signal.

1C. For the DT signal x[n] =u[n+10] - 2u[n+1]+u[n-11], sketch the following signals:
i. x[2n-3] ii. x[n/2 -3] iii. x[-n/3 +2]

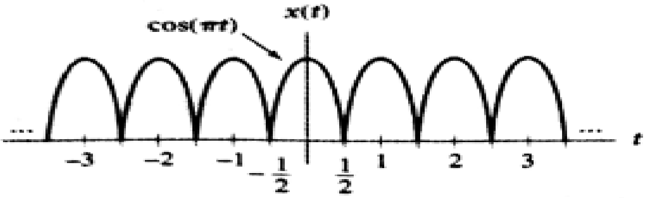
(4+3+3)

2A. Prove that the DTFT of the product of two non- periodic discrete signals is the convolution between the individual DTFTs. Using this concept illustrate with spectral plot, the effect on spectrum of signal x[n] when truncated in time by multiplying with rectangular window of length N. The signal x[n] has spectrum as given below (assume $\Omega_c > 2\pi/N$)

$$X(e^{j\Omega}) = 1, |\Omega| \leq \Omega_c$$
$$= 0 \quad elsewhere$$

2B. Using the defining equations, determine

i. Fourier series coefficients for the rectified cosine wave shown below



ii. Time domain signal corresponding to discrete time Fourier series given by
$X(k) = \sum_{m=-\infty}^{\infty}(-1)^m[\delta(k-2m) - 2\delta(k+3m)]$; with fundamental frequency $\Omega_0 = \pi/6$

2C. Using appropriate properties of the Fourier representations, determine

i. Discrete time Fourier transform of $x[n] = e^{j\left(\frac{\pi}{2}\right)n}\left(\frac{1}{2}\right)^n u(n-2)$

ii. Inverse Fourier transform of $X(j\omega) = 2e^{-j\omega}\frac{sin(\omega)}{\omega}$

(4+3+3)

3A. Let input to the LTI system having impulse response $h[n] = \alpha^n\{u[n-2]-u[n-13]\}$ be $x[n] = 2\{u[n+2]-u[n-12]\}$. Compute the output y[n] using convolution.

3B. Determine whether following systems described by input-output relation are linear, time-invariant, causal and stable.

i. $y(t) = (t+1)x(t)$

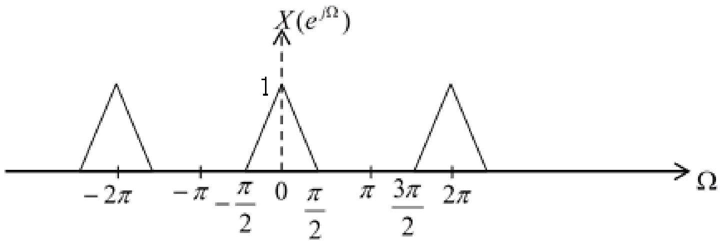
ii. $y[n] = e^{-x[n]}$

3C. Certain continuous-time LTI system has the unit step response given by $s(t) = \begin{cases} 1-e^{-t}, t \geq 0 \\ 0\ ,\ t < 0 \end{cases}$

Compute the response of the system for an input $x(t) = e^{-3t}\{u(t)-u(t-2)\}$

(4+3+3)

4A. Certain system is described by the input-output relation y[n] = x[n] {1+2cos(πn/2)}.Obtain and plot the spectrum of the output if the input signal x[n] has spectrum as shown in figure below.



4B. Determine the Laplace transform of the signal $x(t)=3e^{-3t}u(t)-2e^{2t}u(-t)$. Sketch the ROC and pole location.

4C. An LTI system has transfer function $H(s) = \frac{-5s+12}{s^2-5s+6}$. Determine the impulse response of a system (if exist) that is

i. Stable ii. Causal iii. Causal and Stable

(4+3+3)

5A. The continuous time signal x(t) = cos(ω_ot) is sampled (impulse sampling) with sampling frequency of 2π radians/sec to get the sampled signal $x_\delta(t)$. Sketch the spectrum of the sampled signal for $-5\pi \leq \omega \leq 5\pi$ when (i) $\omega_o = \pi/2$ (ii) $\omega_o = \pi$ (iii) $\omega_o = 3\pi/2$. In each case mention whether the original signal can be reconstructed from $x_\delta(t)$ or not.

5B. Determine the z-transform of $x[n] = \{n(-0.25)^n u[n]\} * \{(0.5)^{-n} u[-n]\}$. Plot the poles and zeros in z-plane and indicate ROC.

5C. The step response of certain LTI system is $2\left(\frac{1}{3}\right)^n u[n]$. Using z-transform, determine the output y[n] when the input is $\left(\frac{1}{2}\right)^n u[n]$

(4+3+3)