Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

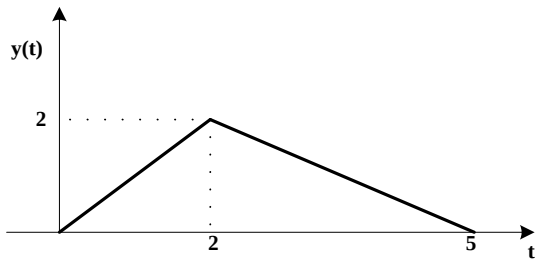
Course: Signals and Systems **Semester: IV**
Program: B Tech Aerospace Engg. Spl Avionics **Duration: 03 hrs.**
Course Code: ECEG2010 **Max. Marks: 100**

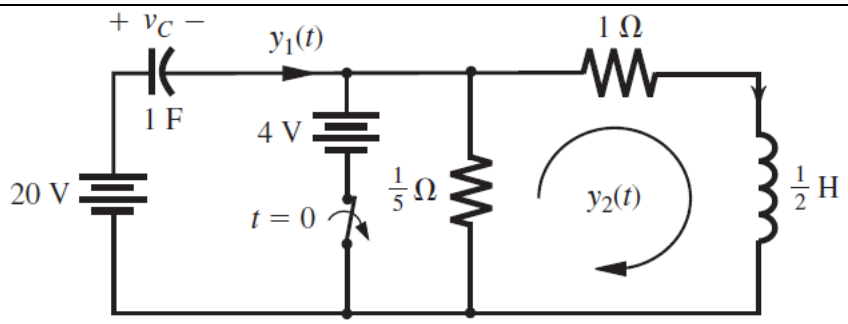
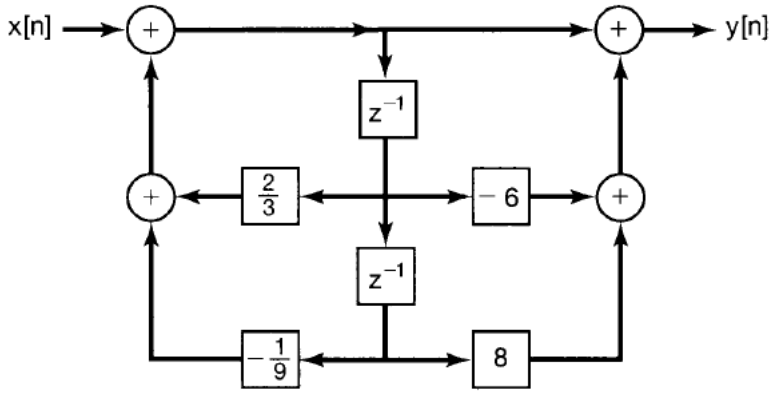
Instructions:

- Attempt all questions as per the instruction.
- Assume any data if required and indicate the same clearly.
- Unless otherwise indicated symbols and notations have their usual meanings.
- Strike off all unused blank pages

SECTION A (5Qx4 = 20 Marks)

S. No.		**Marks**	**CO**
Q 1	Define convolution integral and convolution sum. Also mention the properties of the convolution integral.	**4**	**CO1**
Q 2	Sketch the waveforms of the following signals: (a) $x(t) = u(t+3) + 2u(t+1) - 2u(t-1) + u(t-3)$ (b) $y(t) = r(t+2) - r(t+1) - r(t-1) + r(t-2)$	**4**	**CO1**
Q 3	Find the Fourier transform of the signal $x(t) = e^{-a\|t\|}; a > 0$	**4**	**CO2**
Q 4	Find the energy of a signal $x(t) = e^{-2t}u(t)$. Determine the frequency W (rad/sec) so that the energy contributed by the spectral components of all the frequencies below W is 90% of the signal energy.	**4**	**CO2**
Q 5	Consider the signal $x(t) = e^{-5t}u(t-1)$. Evaluate the Laplace transform X(s) of x(t) using the integral formula and specify its region of convergence	**4**	**CO3**
	SECTION B (4Qx10 = 40 Marks)		
Q 6	Consider a linear time invariant (LTI) system with the output response y(t) as shown in **Fig. 1** to the input signal $x(t) = u(t) - u(t-2)$. Determine and sketch the output response of the system to the following inputs: (a) $x_1(t) = x(t) - x(t-4)$ (b) $x_2(t) = x(t) - x(t+4)$	**10**	**CO1**

	 **Fig. 1**		
Q 7	**(a)** State at least four properties of the Fourier transform. **(b)** Determine the inverse Fourier transform of the following function: (i) $X(\omega) = \frac{j\omega}{(3+j\omega)^2}$ (ii) $X(\omega) = \begin{cases} 1; & \lvert\omega\rvert < 2 \\ 0; & elsewhere \end{cases}$ (iii) $\frac{6}{\omega^2+9}$	**10**	**CO2**
Q 8	Suppose the following facts are given about the signal x(t) with Laplace transform X(s): 1. x(t) is real and even; 2. X(s) has four poles and no zeros in the finite s-plane; 3. X(s) has a pole at $s = \frac{1}{2}e^{j\pi/4}$; 4. $\int_{-\infty}^{+\infty} x(t)dt = 4$. Determine X(s) and its regions of convergence (ROC). **OR** Solve the second-order linear differential equation $$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = \frac{dx}{dt} + x(t)$$ for the initial conditions $y(0^-) = 2\ and\ \dot{y}(0^-) = 1$ and the input $x(t) = e^{-4t}u(t)$	**10**	**CO3**
Q 9	Suppose that the algebraic expression for the z-transform of *x[n]* is $$X(z) = \frac{1 - \frac{1}{4}z^{-2}}{\left(1 + \frac{1}{4}z^{-2}\right)\left(1 + \frac{5}{4}z^{-1} + \frac{3}{8}z^{-2}\right)}$$ How many different ROCs could correspond to X(z)? also determine the corresponding inverse z-transform of X(z)	**10**	**CO4**
SECTION C (2Qx20 = 40 Marks)			
Q 10	The switch in the circuit shown in **Fig. 2** is in the closed position for a long time before t = 0, when it is opened instantaneously. Find the currents $y_1(t)$ and $y_2(t)$ for $t \geq 0$	**20**	**CO3**

	 **Fig. 2**		
Q 11	**(a)** An LTI system is characterized by the system function $H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$. Specify the region of convergence and determine h[n] when **(i)** the system is stable **(ii)** the system is causal **(b)** realize the structure of the system described in (a) with direct form-I and direct form-II. Also write the corresponding difference equations. **OR** **(c)** Consider a causal LTI system whose input *x[n]* and output *y[n]* are related through the block diagram representation shown in **Fig. 3** **(i)** Determine a difference equation relating *y[n]* and *x[n] and* hence find the system transfer function H(z). **(ii)** Determine h[n] **(iii)** Is this system stable? **(iv)** is this system causal?  **Fig. 3**	**20**	**CO4**