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B. Sc. in EEE, 6th Semester 22 February 2023(Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination **Summer Semester: A. Y.2021 - 22**
Course Number: EEE 4601 **Time: 90 Minutes**
Course Title: Signals and Systems **Full Marks: 75**

There are **03 (Three)** questions. Answer **all** questions. Question 3 has an alternative. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

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1. a) Define a Linear Time Variant (LTI) system. The output $y(t)$ of an LTI system for the input $x(t)$ is shown in Fig. 1(a). Sketch the output of the system for the input $x_1(t)$. **(5) (CO1) (PO1)**

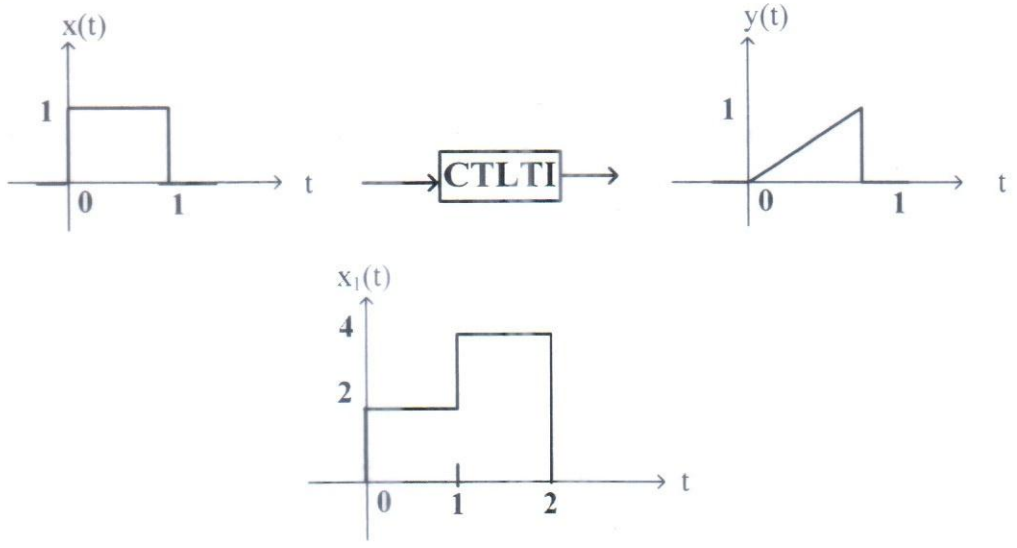

Fig. 1(a)

b) Sketch the even and odd parts of the DT signal $x[n]$ and calculate their energy. **(10) (CO1) (PO1)**

$$x[n] = \begin{cases} 5 - n \; for \; 0 \leq n \leq 5 \\ 0 \; otherwise \end{cases}$$

c) Determine the energy of the signals $x(t)$ (Fig. 1(c)) and $y(t) = x(4t + 3)$. **(10) (CO1) (PO1)**

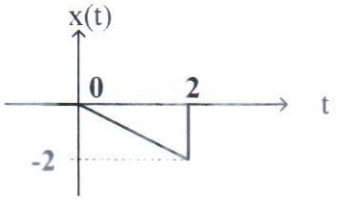

Fig. 1(c)

2. a) Show that the impulse response of an RC high pass filter with RC=1 (s) is $h(t) = \delta(t) - e^{-t}u(t)$. Determine and sketch the output of the filter if the input $x(t)$ is as shown in Fig. 2(a) below. **(10) (CO1) (PO1)**

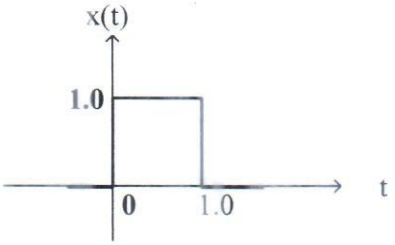

Fig. 2(a)

b) A DTLTI system having impulse response $h[n] = \{1, 1, 1, 1\}$ ($\uparrow$ at the first 1) is excited by a unit step sequence $u[n]$. Determine and draw stem diagram of the ZSR of the system. **(10) (CO1) (PO1)**

c) Define an invertible system. Show that the impulse response of an invertible system is an impulse. **(5) (CO1) (PO1)**

3. **a)** Write a differential equation relating the output $y(t)$ with input $x(t)$ for the circuit shown in Fig. 3(a) and find the step response by applying $x(t) = u(t)$. Then, use the step response to obtain the impulse response. **(13) (CO2) (PO2)**

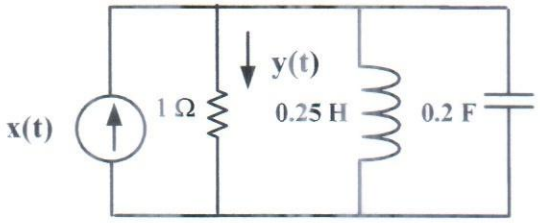

Fig. 3(a)

b) Identify the natural (ZIR) and forced (ZSR) of the DTLTI system described by the following difference equation with initial conditions and input specified. **(12) (CO2) (PO2)**

$$y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = 2x[n]$$

$$y[-1] = 1, y[-2] = -1 \text{ and } x[n] = 2u[n].$$

OR

a) The impulse response $h(t)$ of an LTI system and its input $x(t)$ are shown in Fig. 3(a-OR) below. Find and sketch the ZSR ($y(t)$) of the system. **(13) (CO2) (PO2)**

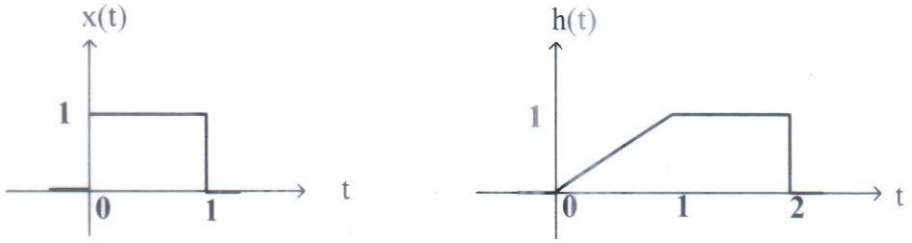

Fig. 3(a-OR)

b) Identify the natural (ZIR) and forced (ZSR) of the DTLTI system described by the following difference equation with initial conditions and input specified. **(12) (CO2) (PO2)**

$$y[n] - \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = x[n] + \frac{11}{8}x[n-1]$$

$$y[-1] = -1, y[-2] = 26 \; and \; x[n] = \left(\frac{1}{2}\right)^n u[n].$$