THE PNG UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL & COMMUNICATIONS ENGINEERING

FIRST (1st) SEMESTER EXAMINATION (2021)

EE311 SIGNALS AND SYSTEMS

TIME ALLOWED: 3 HOURS

INFORMATION FOR STUDENTS:

1. You have **TEN (10) MINUTES to** read this paper. Do not write during this allocated time

2. There are **a total of five (5) Questions** in this Exam Booklet. **Answer ALL Questions from Part A and ANY Two Questions from Part B.**

3. All answers must be written in the **Answer Booklet**

4. **COMPLETE STUDENT DETAILS ARE TO BE FILLED ON THE ANSWER BOOKLET-DO THIS NOW**

5. Only drawing instruments and calculators are allowed on your desk. Textbooks and notebooks are **NOT** allowed

6. If you are found **Cheating** in this Exam, penalties specified by the **University** shall be applied.

7. TURN OFF all your mobile phones and place them on the floor under your seat before you start the examination

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PART A. ANSWER All QUESTIONS

QUESTION ONE

a) (i) Explain on the three basic signal processing operations
(ii) In sequential order with examples elaborate on the three basic signal processing operations

[10 marks]

b) Express the waveforms shown in Figure 1 in terms of unit step function

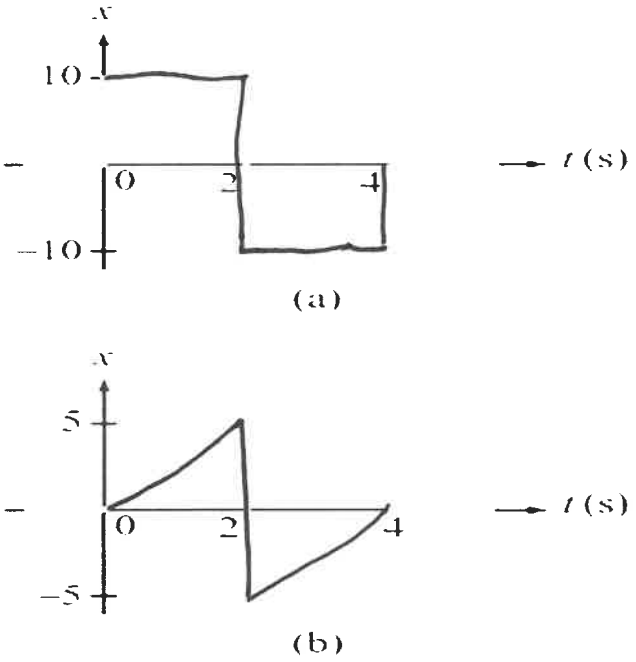

Figure 1

[15 marks]

[Total 25 marks]

QUESTION TWO

a) Evaluate $u(t) * \delta(t-3) - u(t-4) * \delta(t+1)$

[5 marks]

b) Apply graphical convolution to the waveforms of $x(t)$ and $h(t)$ shown in Figure 2 to determine $y(t) = h(t) * x(t)$

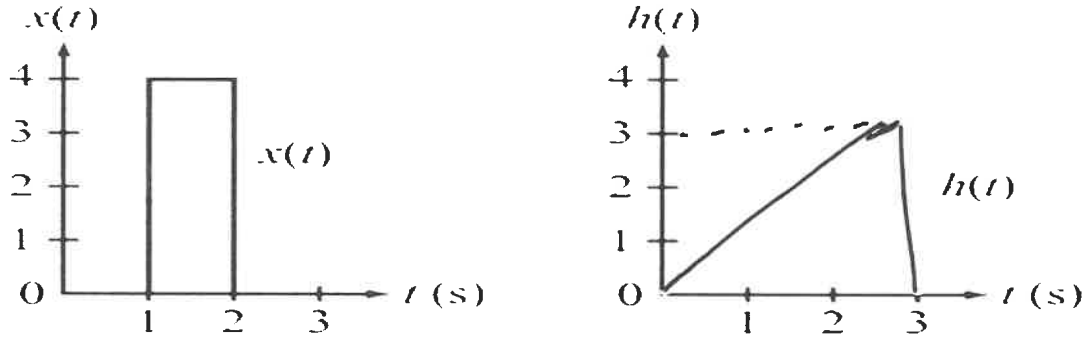

Figure 2

[10 marks]

c) The RC circuit in Figure 3 is excited by $x(t) = (1-1000t)[u(t) - u(t-0.001)]$

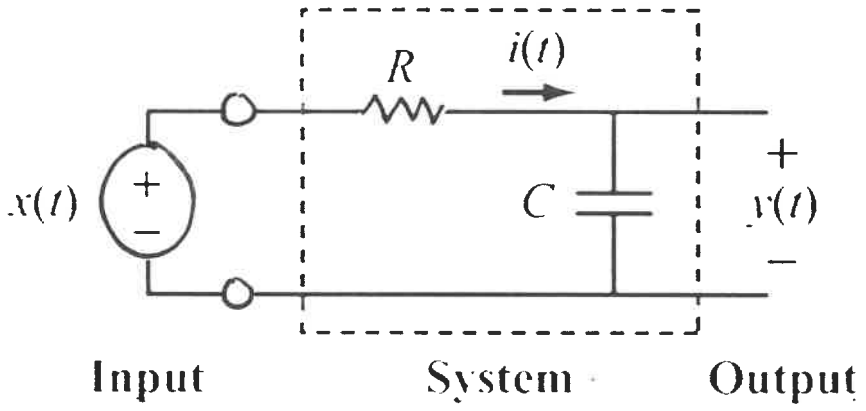

Figure 3

[10 marks]

[Total 25 marks]

PART B. ANSWER ANY TWO QUESTIONS

QUESTION THREE

d) Determine whether the signals $x_1(t)$, $x_2(t)$ and $x_3(t)$ are periodic or aperiodic. If periodic, determine the period.
(i) $x_1(t)= 2\cos(4\pi t) + 3\sin(3\pi t)$
(ii) $x_2(t)= 2\cos(4\pi t) + 3\sin(10t)$

[10 Marks]

e) A Discrete to Continuous time signal converter takes a sequence y[n] as input and produces a continuous time output y(t), using a reconstruction function p(t). For a sampling time Ts = 0.1 s, and $y[n]= n+ (0.5)^n$ for $0\leq n \leq 5$, with y[n]= 0 elsewhere, show how y(t) may be obtained, using
(i) a rectangular reconstruction pulse, and
(ii) a triangular reconstruction pulse.

[15 Marks]
[TOTAL 25 MARKS]

QUESTION FOUR

a) Write a simple MATLAB™ program to generate the following continuous time signals, and sketch the resent the expected simulation result: an exponentially damped sinusoidal signal

$x(t)=10\sin(1000\pi t)\exp(-0.5t)$

[10 Marks]

b) A linear time invariant filter is described by the difference equation y[n]= x[n]+2x[n-1]+x[n-2]
(i) Obtain an expression for the frequency response of the system
(ii) Sketch the frequency response as a function of frequency
(iii) Determine the output when the input is $x[n]= 10+10\cos(0.4\pi n+\pi/2)$
(iv) Determine the output when the input is the unit impulse sequence $\delta[n]$.

[15 Marks]
[TOTAL 25 MARKS]

QUESTION FIVE

a) Determine whether the following signals are (i) memoryless, (ii) time-invariant (iii) linear (iv) causal (v) BIBO stable:

(i) $y[n]= x[n-2]$

(ii)Volt drop across a resistor R in terms of current and resistance $v(t)= 100\ i(t)$

(iii)$y(t)= x(t)/(1+x(t-2))$

[10 MARKS]

b) An LTI system is described by the difference equation

$$y[n]= (1/3)(x[n]+x[n-1]+x[n-2])$$

(i) Determine the system function H(z).

(ii) Sketch the poles and zeros of H(z) in the z-plane

(iii) From H(z) obtain an expression for the frequency response of the system.

(iv) Sketch the frequency response of the system as a function of frequency.

[15 MARKS]

[TOTAL 25 MARKS]