



- Answer all the following question
- Illustrate your answers with sketches when necessary.
- The exam consists of two page
- No. of questions: 3
- Total Mark: 90 Marks
- Examiner: Dr. Michael Nasief

Question (1): Signal Manipulation: [30 Marks]

A. For the signal shown in figure (1) draw: [10 Marks]

- $x(0.5t)$.
- $x(2(0.5-2t))$.

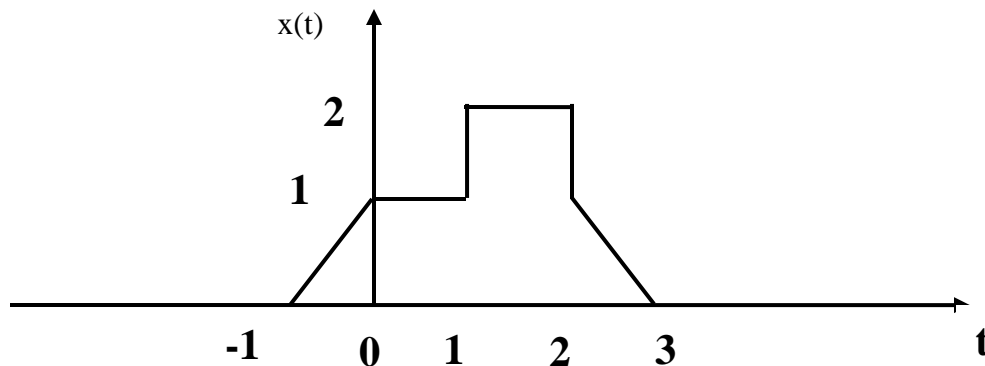


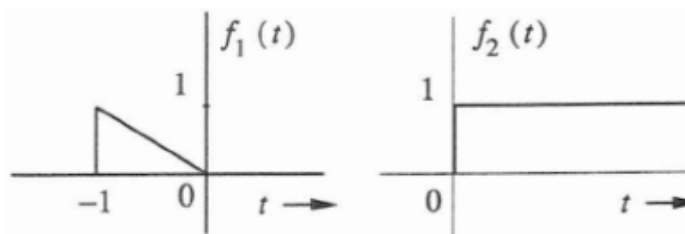
Figure (1)

- B. Sketch and label the even and odd components of the signal shown in figure (1).[6 Marks]
- C. Express the signal shown in figure (1) as a sum of unit step functions.[6 Marks]
- D. State with a brief explanation if the following systems are linear/non-linear, causal/non-causal, timeinvariant/time-varying: [8 Marks]
- $y(t) = x(t) \sin(w_0t)$.
 - $y(t) = x(-2t)$.

Question (2): Convolution and Fourier: [30 Marks]

- A. Explain the difference between: Convolution, Cross Correlation and autocorrelation.[6 Marks]
- B. Convolve the signals shown in figure(2): [8 Marks]

Figure (2)



C. Use direct integration find expression for: [4 Marks]

$$y(t) = e^{-at} u(t) * e^{-bt} u(t).$$

D. Find the fourier transform of the signal shown in figure (3): [6 Marks]

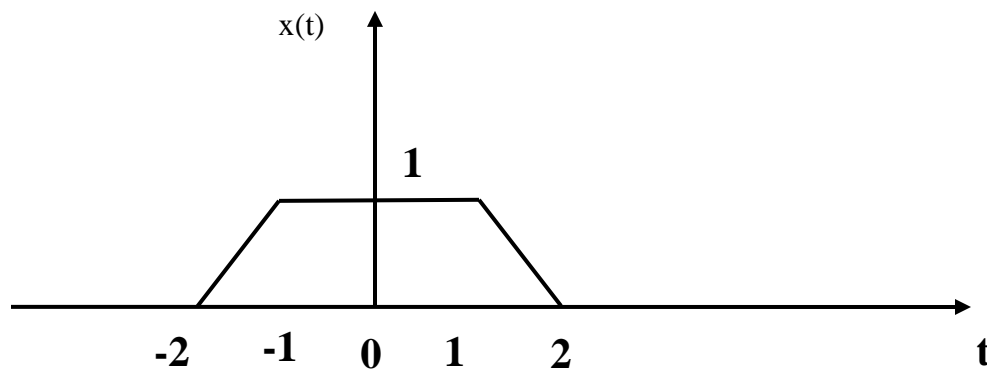


Figure (3)

E. Use Harmonics Tabular Method to find the Fourier series coefficients for the signal samples shown in the next table: [6 Marks]

$V(t)$	3	5	7	2	1	1	2	6	7	11	14	13
wt	30	60	90	120	150	180	210	240	270	300	330	360

Question (3): Sampling Theory: [30 Marks]

A. State the sampling theory. [3 Marks]

B. Proof (mathematically) that the output spectrum of the sampled signal will be a duplicated version of the original spectrum. [8 Marks]

C. Explain the spectral folding effect of aliasing and the proposed solution. [6 Marks]

D. If $x(t)$ is the input signal to PCM encoder: [8 Marks]

$x(t)$ = speech signal with peak to peak (10 v)

Find:

- Sampling frequency according to the Nyquist rate.
- If the step voltage between 2 consecutive quantum levels $(\Delta v) = 5$ mv:
 - What is the number of levels?
 - What is the number of bits per sample?
 - What is the bit rate?

E. Explain the relation between the quantization error and the number of bits per sample and the final bit rate. [5 Marks]

GOOD LUCK

DR. MICHAEL NASIEF