SINGAPORE POLYTECHNIC **ET0930**

SAMPLE MID SEMESTER TEST

Diploma in Electrical & Electronic Engineering (DEEE)
3rd Year FT

PRINCIPLES OF COMMUNICATION Time Allowed: 1.5 Hours

Instructions to Candidates

1. The examination rules set out on the last page of the answer booklet are to be complied with.

2. This paper consist of **TWO** sections:
   Section A - 10 Multiple Choice Questions (30 marks).
   Section B - 5 Short Questions (70 marks)

3. **ALL** questions are **COMPULSORY**.

4. All questions are to be answered in the answer booklet. Start each question in Section B on a new page.

5. This paper consists of **6** pages, including 1 page of Formula List.

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SECTION A

MULTIPLE CHOICE QUESTIONS (3 Marks each)

1. Please **write** your answers in the **answer booklet**.

2. No marks will be deducted for incorrect answers.

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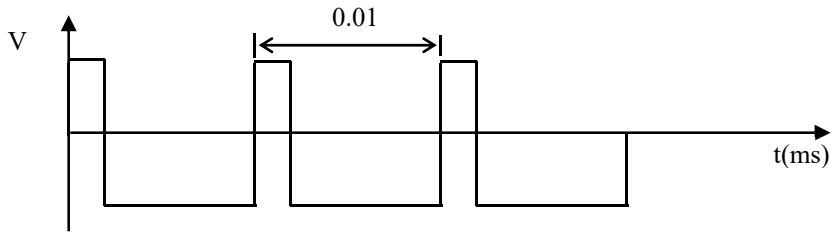
1. For the rectangular signal shown below, the fifth harmonic is
   a) 50 kHz.
   b) 500 kHz.
   c) 90 kHz.
   d) 900 kHz.



2. 100W is the same as _____.
   a) 10 dBW
   b) 20 dBm
   c) 20 dBW
   d) none of the above

3. Which one of the following signals does not have continuous spectrum?
   a) Sine wave
   b) Speech
   c) Music
   d) Video

4. A 2 kHz sawtooth signal is input to a BPF with a passband from 3 kHz to 11 kHz. The resulting components present at the filter output will be
   a) ±6 kHz, ±10 kHz.
   b) ±4 kHz, ±6 kHz, ±8 kHz, ±10 kHz.
   c) ±4 kHz, ±8 kHz.
   d) ±3 kHz, ±5 kHz, ±7 kHz, ±9 kHz, ±11 kHz.

5. A filter only allows signals from dc to 10 kHz to pass through. Name the filter.
   a) LPF
   b) BPF
   c) HPF
   d) BSF

6. At a particular point in a circuit, a 1 W signal is corrupted by 1 μW of noise. What is the Signal to Noise ratio at this point?
   a) 30 dB
   b) 60 dB
   c) 40 dB
   d) 1000 dB

7. Which one of the following is an external noise?
   a) flicker noise
   b) shot noise
   c) cosmic noise
   d) thermal noise

8. Frequencies between 3 kHz and 300 GHz are called
   a) Audio frequency.
   b) Modulating frequency.
   c) Radio frequency.
   d) Voice frequency.

9. Amplitude Modulation is named such because
   a) the *amplitude* of the carrier is changed according to the *amplitude* of the modulating signal.
   b) the *frequency* of the carrier is changed according to the *amplitude* of the modulating signal.
   c) the *amplitude* of the carrier is changed according to the *frequency* of the modulating signal.
   b) the *frequency* of the carrier is changed according to the *frequency* of the modulating signal.

10. The modulating signal of a DSBSC modulator is $v_s(t) = 2\cos100t + 3\sin200t$. How many frequency components does the output of the DSBSC modulator have on the double-sided amplitude spectrum?
    a) 2 frequency components
    b) 4 pairs of frequency components
    c) 8 pairs of frequency components
    d) 16 pairs of frequency components

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SECTION B [14 marks each]

B1.

(a) Draw a well-labelled block diagram of an electronic communication system. (6 marks)

(b) Define analog signals. Give two examples of analog signals. (4 marks)

(c) Briefly describe the difference between analog communication systems and digital communication systems? (4 marks)

B2.

(a) Define periodic and non-periodic signals. Give one example for each. (4 marks)

(b) The Fourier series of a signal is given by

$$v(t) = \frac{1}{4} + \frac{1}{2\pi}\cos(4000\pi t) + \frac{1}{4\pi}\cos(8000\pi t) + \frac{1}{6\pi}\cos(12000\pi t) + \frac{1}{8\pi}\cos(12000\pi t) + \ldots$$

(i) Determine frequency and the peak voltage of the 2nd harmonic. (2 marks)

(ii) Sketch the double-sided amplitude spectrum of the signal up to the 3th harmonic showing the frequency of each component and its peak amplitude. (8 marks)

B3.

(a) Sketch the power spectrum density of the thermal noise generated by a 2 kΩ resistor at 27^{O}C. Indicate the density value on the spectrum. (4 marks)

(b) Find the thermal noise power and rms noise voltage generated by the above resistor over the frequency band from 300 Hz to 3.4 kHz. (4 marks)

(c) The input signal and noise power of the amplifier shown in Figure B3 are 2mW and 0.1mW, respectively. The amplifier has a power gain (G) of 10. Given that $N_1 = kT_oB$, determine the Noise Factor if the noise power at the output of the amplifier is 1.2mW. (4 marks)

(d) State the two ways in which noise can spread. (2 marks)

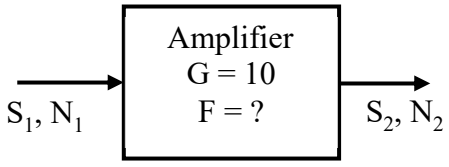

Figure B3

B4.

(a) State three reasons for the need of modulation. (3 marks)

(b) Determine the minimum transmitter antenna length for efficient transmission of signals from 88 MHz to 108 MHz. (4 marks)

(c) What is baseband signal? Briefly describe the difference between baseband signal transmission and passband signal transmission. (4 marks)

(d) Name three digital modulation techniques. (3 marks)

B5. Figure B5 shows an AM waveform.

(a) Write an equation for the waveform. (6 marks)

(b) Draw double-sided amplitude spectrum of AM signal. (6 marks)

(c) Determine the bandwidth of the AM signal. (2 marks)

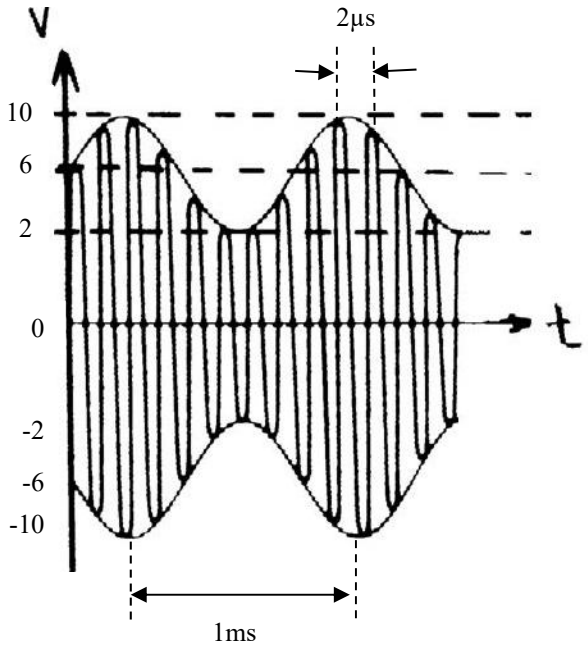

Figure B5

**** End of the Paper ****

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Formula Sheet:

$P_n = kTB$ $E_n = \sqrt{4kTBR}$

Boltzmann's constant, k = 1.38 x 10^{-23} J/K

Room Temperature, T_0 = 290 K

$$F_t = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 G_2} + \frac{F_4 - 1}{G_1 G_2 G_3} + \cdots + \frac{F_n - 1}{G_1 G_2 G_3 \cdots G_{(n-1)}}$$

Velocity of light in free space, c = 3 x 10^8 m/s

$\cos A \cos B = \frac{1}{2}\cos(A+B) + \frac{1}{2}\cos(A-B)$

Positive envelope = $\left[V_c + v_s(t)\right]$ Negative envelope = $-\left[V_c + v_s(t)\right]$

$m = \frac{A-B}{A+B}$ $B_{FM} = 2(m_f + 1)f_s$, for integer values of m_f.