UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
MAIN EXAMINATION 2011

TITLE OF PAPER	:	COMMUNICATION SYSTEM PRINCIPLES
COURSE NUMBER	:	EE442
TIME ALLOWED	:	THREE HOURS
INSTRUCTIONS	:	READ EACH CAREFULLY ANSWER ANY **FOUR** QUESTIONS. EACH QUESTION CARRIES **25 MARKS** MARKS FOR EACH SECTION ARE SHOWN ON THE RIGHT-HAND MARGIN

THIS PAPER HAS SIX PAGES INCLUDING THIS PAGE.

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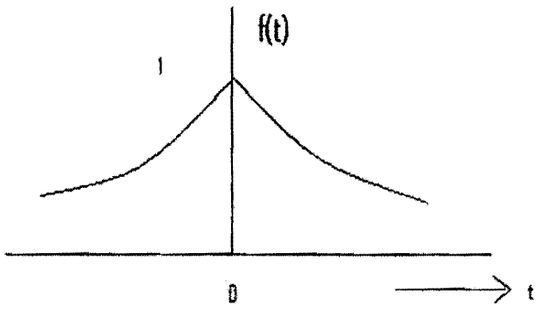
Question No. 1

a) Write short notes on each of the following:
   i) Complex Fourier spectrum (Discrete spectrum)
   ii) Continuous spectrum

[10Marks]

b) Find the Fourier transform of a double-sided exponential signal $e^{-b|t|}$ as shown in the figure below and sketch its spectrum.



[5Marks]

c) i) Starting from a complex Fourier series representation of a periodic function, derive the Fourier Transform of a non-periodic function.

   ii) Name two advantages of using a Fourier Transform.

[10Marks]

Question No.2

a) Write short notes on the origin of each of the following in communication systems:

i) Shot noise
ii) Thermal noise

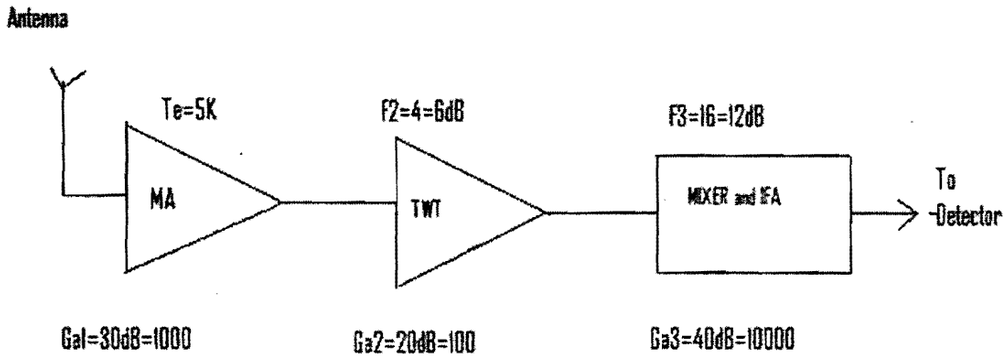
[5Marks]

b) Explain how noise bandwidth is an important parameter for specifying the noise power at the output of a band pass linear system

[12Marks]

c) Figure below shows a model of a microwave receiver used in satellite communication. Evaluate
i) Overall noise- figure of the receiver and
ii) Overall equivalent temperature of the receiver.
Assume that ambient temperature T= 17^0C

[5marks]



d) Find the SNR in a baseband system with a bandwidth of 5 kHz and with $N_0/2 = 10^{-14}$ W/Hz. The transmitter power is one kilowatt and the channel attenuation is 10^{-12}.

[3Marks]

Question No.3

a) Considering the modulating and carrier waves as sinusoids, explain, with necessary expressions and waveforms the Double-sideband suppressed – carrier (DSB-SC) amplitude modulated signal.

[16marks]

b) A sinusoidal carrier $c(t) = A_c \cos(2\pi f_c t)$ is modulated by the signal $m(t) = A_m \cos(2\pi f_m t)$ where $f_m \ll f_c$. If the modulation is DSB-SC, determine the amplitude spectrum of the modulated signal, and its upper and lower side bands.

[5Marks]

c) A sinusoidal carrier voltage of frequency 1MHz and amplitude 100V is 50% amplitude modulated by a sinusoidal voltage of frequency 5 kHz; calculate the frequency and amplitude of the lower and upper side bands.

[4Marks]

Question No.4

a) i) What is signal multiplexing?
ii) Explain frequency – division multiplexing with the aid of a neat sketch.

[8Marks]

b) Explain the relationship between phase and frequency modulation. In each case sketch the modulated output signal when the modulating signal is:
i) A Square Wave, and
ii) A Triangular wave

[12Marks]

c) A 93.2MHz carrier is frequency modulated by a sine wave. The resultant FM signal has a frequency deviation of 40 kHz (narrow-band FM).
Find:
i) Carrier swing of the FM signal.
ii) The highest and lowest frequencies attained by the frequency modulated signal.
iii) The modulation Index for the wave.

[5Marks]

Question No.5

a) i) Explain the principle of pulse amplitude modulation.
ii) Discuss the natural sampling method and hence discuss its spectral characteristics.

[15Marks]

b) Figure shows the block diagram of the frequency multiplication and heterodyne section of an FM transmitter. Determine the carrier frequency and frequency deviation at points 1, 2, and 3. Assume that Δf=8.5 kHz and that at point 3, additive frequency is selected by the mixer.

[10Marks]