**Faculty of Engineering and Technology**

**Department of Electrical and Computer Engineering**

Communication Systems ENEE 339

Instructor: Dr. Wael Hashlamoun

Midterm Exam

First Semester 2017-2018

Date: Wednesday 29/11/2017 Time: 75 minutes

Name: Student #:

**Opening Remarks:**

* Calculators are allowed, but mobile phones, books, notes, formula sheets, and other aids are not allowed.
* You are required to show all your work and provide the necessary explanations everywhere to get full credit.

**Problem 1: 25 Points**

The Fourier transform $G\left(f\right)$ of a signal g(t) is given by:

$$G\left(f\right)=\left\{\begin{matrix}Acos(\frac{πf}{2W})&-W\leq f\leq W\\&\\0&\left|f\right|>W\end{matrix}\right\}$$

1. Find the absolute bandwidth of g(t)
2. Find the equivalent rectangular bandwidth of g(t).
3. Use the time-bandwidth relationship to find the equivalent effective time duration of g(t)
4. The signal $g(t)cos2π\left(3Wt\right)$ is passed through an ideal low pass filter with bandwidth W, find the filter output.

**Problem 2: 25 Points**

The message signal $ m\left(t\right)=2\cos(\left(2π50t\right))+4 cos(2π100t)$ along with the carrier signal $c\left(t\right)=4\cos(\left(2π1000t\right))$ are applied to an upper single sideband modulator to generate the modulated signal s(t):

1. Find the average power of m(t).
2. Find the bandwidth of m(t)
3. Find the time-domain expression of the modulated signal s(t).
4. Explain how m(t) can be recovered from s(t) without distortion. Use a block diagram to illustrate your method.

**Problem 3: 25 Points**

The Fourier transform of a message m(t) is given as:

$$M\left(f\right)=\left\{\begin{matrix}M\_{0}&-W\leq f\leq W\\&\\0&\left|f\right|>W\end{matrix}\right\}$$

This message is applied to a double sideband modulator along with the carrier $c\left(t\right)=10\cos(\left(2π(10000)t\right))$ to produce the modulated signal $s\left(t\right)$

1. Find the message m(t).
2. Find the time-domain representation of s(t)
3. Find and sketch $S\left(f\right)$, the Fourier transform of $s\left(t\right)$.
4. Find the transmission bandwidth
5. If $s\left(t\right)$ is applied to an ideal envelope detector, find its output.

**Problem 4: 25 Points**

Consider the FM signal $s\left(t\right)=10cos⁡[2π(10000)t+1.6sin2π\left(100\right)t]$. The FM modulator sensitivity is $k\_{f}=10 Hz/V$. The modulated signal $s\left(t\right)$ is passed through an ideal bandpass filter with bandwidth 500 Hz centered at the carrier frequency $f\_{c}=10000$ Hz to produce the signal $g\left(t\right)$

1. Find the instantaneous frequency of $s\left(t\right)$
2. Find the message m(t)
3. Find the peak frequency deviation of $s\left(t\right)$.
4. Find the filter output $g\left(t\right)$
5. Find the fraction of the power contained in$ g\left(t\right)$ to that in $s\left(t\right)$.

Good Luck







