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DEPARTMENT OF COMPUTER AND ELECTRICAL ENGINEERING

MIDSEM EXAMINATION, 2018/2019

ELNG 307: Analog and Digital Communications

November, 2018 **Time: 1 Hrs:15 Mins**

Instructions: *Answer all questions in SECTION A and ONE in SECTION B.*

SECTION A – Answer all questions.

Circle well the letter corresponding to the correct option on the question paper and submit it. Any correct answer carries 1 mark.

1. Which of these is not a characteristic of frequency modulated carrier?
   - A. The higher the modulating amplitude, the greater is the amount of frequency shift away from the carrier frequency
   - B. The amplitude of the FM modulated carrier remains constant as the amplitude of the modulating source varies
   - C. As the amplitude of the modulating source decreases, the frequency of the carrier decreases
   - D. The amplitude of the carrier varies as the frequency of the modulating signal increases

2. Determine the modulation index when a 97.1 MHz carrier frequency is modulated by a 10 kHz audio signal source. The frequency deviation produce is ± 40 kHz.
   - A. 0.04
   - B. 4
   - C. 1
   - D. 0.25

3. The recovery of baseband signal from transmitted signal is _____.
   - A. Demultiplexing
   - B. Passband multiplexing
   - C. Demodulation
   - D. Translation

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4. Which of the following is the odd one out in the choice of modulation techniques use for communication system?
   A. The amount of bandwidth allocated
   B. Channel characteristics
   C. Effective Radiated Power (ERP) of the antenna
   D. Types of noise and/or interference the signal will encounter during transmission

5. To effectively detect the envelope of an DSB-FC wave, one of the conditions below should be satisfied.
   A. $A_c \ll A_m$
   B. $f_c \simeq f_m$ and $\phi_c = 0$
   C. $f_m \gg f_c$
   D. $W \ll f_c$

6. The frequency spectrum of an *OAM* contains the following except _____.
   A. A component at f_c fc
   B. Sidebands at $f_c + f_m$ and $f_c - f_m$
   C. Sidebands at $f_c \pm nf_m$; $n = 1, 2, \ldots$
   D. A and C

7. In linear modulation, the intelligent signal is conveyed in _____.
   A. The amplitude of the transmitted signal
   B. The sideband components of the transmitted wave
   C. The phase deviation modulated signal
   D. None of the above

8. Which of these is true about periodic signal based on Parseval's theorem?
   I. If a periodic signal is power signal, then, it means that every term of the Fourier series is also power signal as the original
   II. The power of the signal is equal to the powers of its Fourier series
   III. The total power of the signal is equal to the sum of the powers of the first term, and the second term squared of the Fourier series component for all even functions of the signal
   IV. Fourier series of the signal is mutually orthogonal

A. I only
B. All except II and IV
C. All except III
D. II, III, and IV

9. Which of these analog modulation schemes trade bandwidth for noise immunity?
   A. Vestigial sideband modulation
   B. Single sideband full carrier modulation
   C. Wideband FM modulation
   D. Old Short-Wave (SW) modulation

10. Narrowband FM and AM share a lot of similarities except that _____.
   A. The lower side frequencies are 180° out of phase
   B. The upper side frequencies are 180° out of phase
   C. The sideband frequencies are 180° out of phase
   D. None of the above

11. An intelligence signal is amplified by a 65% efficient amplifier before being combined with a 250W carrier to generate an AM signal. If it is desired to operate at 100% modulation, what must be the DC input power to the final intelligence signal's amplifier?
   A. 384.6 W
   B. 192.3 W
   C. 162.5 W
   D. 83.3 W

$\eta = 0.65$ $\eta = \frac{P_{out}}{P_{in}}$

$P_c = 250$

$u = 1$ P_{in}

$P_i =$

P_{in}

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Section B – *Answer any question in this section.*

QUESTION ONE [20 MARKS]

a) With the help of a block diagram, explain in your own words, what an electronic communication system is? **[5 marks]**

b) With a diagram describe signal attenuation. **[3 marks]**

c) A single toned message, $m(t) = 4\sin(2\pi \times 100t)$, where time, t is measured in seconds, is amplitude modulated (DSB-FC) onto a carrier $c(t) = 20\cos(\omega_c t)$. The carrier frequency is $f_c = 25$ kHz.

i. Give one key advantage of DSB-SC over DSB-FC. **[2 marks]**

ii. Sketch the spectrum of the modulated AM signal showing all numerical values. **[4 marks]**

iii. What is the power of the modulated signal in watts? **[3 marks]**

iv. What is the transmission efficiency of AM wave? **[3 marks]**

QUESTION TWO [20 MARKS]

a. Briefly explain how NBFM is similar to Ordinary Amplitude Modulation. **[4 marks]**

b. Given a PM modulator of exponential modulation technique, briefly explain with diagram(s), how an FM wave can be generated from PM modulator. Support your answer with mathematical expression(s) at key stage(s) of the conversion process. **[6 marks]**

c. Determine the normalized average power and rms values of $f(t) = C_1\cos(\omega_1 t + \theta_1) + C_2\cos(\omega_2 t + \theta)$, $\omega_1 \neq \omega_2$. **[5 marks]**

d. Given a signal, $r(t) = 15 + \cos(40\pi t + 60^\circ)\cdot 10 - 4\sin 120\pi t$, find the phase and amplitude spectra of the signal. **[5 marks]**