Data Provided: None

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Spring Semester 2010-2011   (2 hours)

EEE206 Communication Systems 2

Answer **THREE** questions. **No marks will be awarded for solutions to a fourth question.** Solutions will be considered in the order that they are presented in the answer book. Trial answers will be ignored if they are clearly crossed out. **The numbers given after each section of a question indicate the relative weighting of that section.**

1. **a.** Explain the terms "Baseband signal" and "Carrier wave" in terms of a communication system.

    (2)

    b. What affects the choice of transmission frequency for a communication system?   **(3)**

    c. Explain the terms double sideband (DSB) modulation and single side band (SSB) modulation for an amplitude modulated (AM) system. What are the advantages and disadvantages of using double sideband modulation?   **(5)**

    d. An AM DSB transmitter has an output power of 2.1 kW when sinusoidally modulated to a depth of 100 %. Determine the power output when   **(2)**

    (i) the carrier is unmodulated

    (ii) after sinusoidal modulation to a depth of 60 %, one sideband is suppressed and the carrier component is reduced by 26 dB.   **(4)**

    If the transmitter is now sinusoidally modulated to a depth of 50 % and a second sine wave, corresponding to 35 % modulation, is transmitted simultaneously, determine the total radiated power.   **(4)**

2. **a.** Write down an expression for a frequency modulated (FM) wave and explain the frequency deviation and modulation index of the wave.

    Draw the frequency spectrum of the wave.   **(6)**

    b. Explain the application of Pre-emphasis and De-emphasis in an FM modulation system and how it improves the performance.   **(4)**

2. **c.** A 101.4 MHz carrier is frequency modulated by a 8 kHz sine wave. The resultant FM signal has a frequency deviation of 75 kHz. Calculate:

    i.   the peak-to-peak carrier variation;
    ii.   the maximum and minimum frequencies of the modulated signal;
    iii. the modulation index;
    iv. the approximate bandwidth of the signal. **(8)**

Is this a narrow band or wide band FM signal? **(2)**

3. **a.**   i.   State the "Nyquist Sampling theorem" for a communications system.
    ii.   What is meant by the term "aliasing"? **(4)**

b. What is line coding and why is it used?

Give an example of a line code. **(6)**

c. State the Hartley-Shannon Law and define the quantities within it. **(4)**

A system has a bandwidth of 20 kHz and a signal-to-noise ratio of 30 dB at the input to the receiver. Calculate

(a) its information-carrying capacity

(b) the capacity of the channel if its bandwidth is doubled, while the transmitted signal power remains constant. **(6)**

Note : $\log_2(x) = \log_{10}(x)/\log_{10}(2)$

4. **a.** Draw a block diagram of a dual stage superhet receiver with automatic gain control and explain the function of each block. **(8)**

b. Explain what factors you would consider in choosing the IF (intermediate) frequency. **(4)**

c. A receiver, of the double superhet type, receives signals from a base station at 900 MHz. The receiver first and second IFs are 70 MHz and 10 MHz, respectively. The first local oscillator operates below the signal frequency and the second operates above the first IF. Determine all possible image frequencies.

What other signal frequencies received will cause 2nd IF image problems?

(8)