Data Provided: None

The University Of Sheffield.

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Spring Semester 2012-13 (2.0 hours)

EEE206OR 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.** Briefly describe the advantages and disadvantages of amplitude modulation AM and frequency modulation FM. **(6)**

b. Explain why the expression $V_{AM} = V_c\left(1+m\sin\omega_m t\right)\sin\omega_c t$ **(2)**

describes an amplitude modulated signal.

Sketch the waveforms and the frequency components for V_{AM}. **(4)**

c. An AM-DSB transmitter develops an unmodulated average power output of 2kW across a 50 Ω resistive load. When a sinusoidal test tone with a peak amplitude of 8 V is applied to the input of the modulator, it is found that the amplitude of the spectral line for each sideband is 40 % of the amplitude of the carrier line. Determine **(8)**

(i) the peak amplitude of the lower sideband

(ii) the ratio of total sideband to carrier power

(iii) the total average power output if the peak amplitude of the modulation sinusoid is reduced to 6 V

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

3. **a.** Explain what is meant by quantisation noise and quantisation errors in pulse code modulation (PCM) systems. **(6)**

b. Describe with the aid of a circuit diagram how a PCM signal is obtained using an A/D convertor. **(6)**

c. A continuous data signal is to be linearly quantised and transmitted using PCM. If each data sample at the receiver must be known to within ± 1 % of the peak-to-peak full-scale value, how many bits must be transmitted to represent each data sample?

Calculate the resulting signal-to-quantisation noise ratio and estimate the minimum channel bandwidth if a 20 kHz channel is encoded. **(8)**

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 2^{nd} IF image problems?

(8)

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