BITS Pilani
Hyderabad Campus
Department of Electrical Engineering

EEE/ECE F311
Communication Systems
Tutorial-4

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1. The signal $x(t) = 4 \sin(\pi t/2)$ is transmitted by DSB. What range of the carrier frequencies can be used?

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Solution 1

$$10B < f_c < 100B$$

$$\left(10 \times \frac{1}{2}\right) \text{ kHz} < f_c < \left(100 \times \frac{1}{2}\right) \text{ kHz}$$

$$\boxed{5 \text{ kHz} < f_c < 50 \text{ kHz}}$$

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2. An AM transmitter has a carrier power of 30 W. The percentage of modulation is 85 percent. Calculate (a) the power in DSB signal and (b) the power in SSBSC.

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Solution 2

As per the definition we have Power in DSB (Double sideband with full carrier),

$$P_{DSB} = 40.8\ \text{W}$$

$$P_{DSBSC} = 10.8\ \text{W}$$

Power of the single sideband, SSB

$$P_{SSB} = 5.4\ \text{W}$$

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3. An SSB transmitter has a 24-V dc supply. On voice peaks the current achieves a maximum of 9.3 A. What is the PEP? What is the average power of the transmitter?

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Solution 3

Concept 1

In SSB, the transmitter output is expressed in terms of peak envelope power (PEP), the maximum power produced on voice amplitude peaks. PEP is computed by the equation $P = V^2/R$.

The PEP input power is simply the dc input power of the transmitter's final amplifier stage at the instant of the voice envelope peak. It is the final amplifier stage dc supply voltage multiplied by the maximum amplifier current that occurs at the peak, $PEP = V_S I_{max}$

Concept 2

Note that voice amplitude peaks are produced only when very loud sounds are generated during certain speech patterns or when some word or sound is emphasized. During normal speech levels, the input and output power levels are much less than the PEP level. The average power is typically only one-fourth to one-third of the PEP value with typical human speech.

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Solution 3

a. What is the PEP?

$$\text{PEP} = V_s I_m = 24(9.3) = 223.2 \text{ W}$$

b. What is the average power of the transmitter?

$$P_{\text{avg}} = \frac{\text{PEP}}{3} = \frac{223.2}{3} = 74.4 \text{ W}$$

$$P_{\text{avg}} = \frac{\text{PEP}}{4} = \frac{223.2}{4} = 55.8 \text{ W}$$

$$P_{\text{avg}} = 55.8 \text{ to } 74.4 \text{ W}$$

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4. An SSB transmitter produces a peak-to-peak voltage of 178 V across a 75Ω antenna load. What is the PEP?

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Solution 4

$$PEP = 52.8\ W$$

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5. Find the power in each sideband of a DSB-SC signal with the carrier signal at 1 MHz and of a peak signal voltage of 100 V modulated simultaneously by three different signals. The frequencies of the modulating signals are 2 kHz, 3 kHz and 5 kHz, respectively, and peak modulating voltages are 10 V, 20 V, and 30 V, respectively. Assume a load resistance of 100 Ω.

Solution 5

Power in each sideband of a DSB-SC= P_{SB}= 1.75 W