

**2020-2024 Amateur Extra Class  
FCC Element 4 Question Pool  
Effective 7/01/2020 – 6/30/2024**

**SUBELEMENT E8** - SIGNALS AND EMISSIONS [4 Exam Questions - 4 Groups]

E8A AC waveforms: sine, square, and irregular waveforms; AC measurements; average power and PEP of RF signals; Fourier analysis; analog to digital conversion: digital to analog conversion; advantages of digital communications

E8A01

**What is the name of the process that shows that a square wave is made up of a sine wave plus all its odd harmonics?**

- A. Fourier analysis
- B. Vector analysis
- C. Numerical analysis
- D. Differential analysis

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E8A02

**Which of the following is a type of analog-to-digital conversion?**

- A. Successive approximation
- B. Harmonic regeneration
- C. Level shifting
- D. Phase reversal

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E8A03

**What type of wave does a Fourier analysis show to be made up of sine waves of a given fundamental frequency plus all its harmonics?**

- A. A sawtooth wave
- B. A square wave
- C. A sine wave
- D. A cosine wave

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E8A04

**What is "dither" with respect to analog-to-digital converters?**

- A. An abnormal condition where the converter cannot settle on a value to represent the signal
- B. A small amount of noise added to the input signal to allow more precise representation of a signal over time
- C. An error caused by irregular quantization step size
- D. A method of decimation by randomly skipping samples

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E8A05

**What of the following instruments would be the most accurate for measuring the RMS voltage of a complex waveform?**

- A. A grid dip meter
- B. A D'Arsonval meter
- C. An absorption wave meter
- D. A true-RMS calculating meter

E8A06

**What is the approximate ratio of PEP-to-average power in a typical single-sideband phone signal?**

- A. 2.5 to 1
- B. 25 to 1
- C. 1 to 1
- D. 100 to 1

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E8A07

**What determines the PEP-to-average power ratio of a single-sideband phone signal?**

- A. The frequency of the modulating signal
- B. Speech characteristics
- C. The degree of carrier suppression
- D. Amplifier gain

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E8A08

**Why would a direct or flash conversion analog-to-digital converter be useful for a software defined radio?**

- A. Very low power consumption decreases frequency drift
- B. Immunity to out-of-sequence coding reduces spurious responses
- C. Very high speed allows digitizing high frequencies
- D. All these choices are correct

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E8A09

**How many different input levels can be encoded by an analog-to-digital converter with 8-bit resolution?**

- A. 8
- B. 8 multiplied by the gain of the input amplifier
- C. 256 divided by the gain of the input amplifier
- D. 256

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E8A10

**What is the purpose of a low-pass filter used in conjunction with a digital-to-analog converter?**

- A. Lower the input bandwidth to increase the effective resolution
- B. Improve accuracy by removing out-of-sequence codes from the input
- C. Remove harmonics from the output caused by the discrete analog levels generated
- D. All these choices are correct

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E8A11

**Which of the following is a measure of the quality of an analog-to-digital converter?**

- A. Total harmonic distortion
- B. Peak envelope power
- C. Reciprocal mixing
- D. Power factor

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E8B Modulation and demodulation: modulation methods; modulation index and deviation ratio; frequency and time division multiplexing; Orthogonal Frequency Division Multiplexing

E8B01

**What is the modulation index of an FM signal?**

- A. The ratio of frequency deviation to modulating signal frequency
- B. The ratio of modulating signal amplitude to frequency deviation
- C. The type of modulation used by the transmitter
- D. The bandwidth of the transmitted signal divided by the modulating signal frequency

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E8B02

**How does the modulation index of a phase-modulated emission vary with RF carrier frequency?**

- A. It increases as the RF carrier frequency increases
- B. It decreases as the RF carrier frequency increases
- C. It varies with the square root of the RF carrier frequency
- D. It does not depend on the RF carrier frequency

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E8B03

**What is the modulation index of an FM-phone signal having a maximum frequency deviation of 3000 Hz either side of the carrier frequency when the modulating frequency is 1000 Hz?**

- A. 3
- B. 0.3
- C. 3000
- D. 1000

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E8B04

**What is the modulation index of an FM-phone signal having a maximum carrier deviation of plus or minus 6 kHz when modulated with a 2 kHz modulating frequency?**

- A. 6000
- B. 3
- C. 2000
- D. 1/3

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E8B05

**What is the deviation ratio of an FM-phone signal having a maximum frequency swing of plus-or-minus 5 kHz when the maximum modulation frequency is 3 kHz?**

- A. 60
- B. 0.167
- C. 0.6
- D. 1.67

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E8B06

**What is the deviation ratio of an FM-phone signal having a maximum frequency swing of plus or minus 7.5 kHz when the maximum modulation frequency is 3.5 kHz?**

- A. 2.14
- B. 0.214
- C. 0.47
- D. 47

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E8B07

**Orthogonal Frequency Division Multiplexing is a technique used for which type of amateur communication?**

- A. High-speed digital modes
- B. Extremely low-power contacts
- C. EME
- D. OFDM signals are not allowed on amateur bands

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E8B08

**What describes Orthogonal Frequency Division Multiplexing?**

- A. A frequency modulation technique that uses non-harmonically related frequencies
- B. A bandwidth compression technique using Fourier transforms
- C. A digital mode for narrow-band, slow-speed transmissions
- D. A digital modulation technique using subcarriers at frequencies chosen to avoid intersymbol interference

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E8B09

**What is deviation ratio?**

- A. The ratio of the audio modulating frequency to the center carrier frequency
- B. The ratio of the maximum carrier frequency deviation to the highest audio modulating frequency
- C. The ratio of the carrier center frequency to the audio modulating frequency
- D. The ratio of the highest audio modulating frequency to the average audio modulating frequency

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E8B10

**What is frequency division multiplexing?**

- A. The transmitted signal jumps from band to band at a predetermined rate
- B. Two or more information streams are merged into a baseband, which then modulates the transmitter
- C. The transmitted signal is divided into packets of information
- D. Two or more information streams are merged into a digital combiner, which then pulse position modulates the transmitter

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E8B11

**What is digital time division multiplexing?**

- A. Two or more data streams are assigned to discrete sub-carriers on an FM transmitter
- B. Two or more signals are arranged to share discrete time slots of a data transmission
- C. Two or more data streams share the same channel by transmitting time of transmission as the sub-carrier
- D. Two or more signals are quadrature modulated to increase bandwidth efficiency

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E8C Digital signals: digital communication modes; information rate vs. bandwidth; error correction

E8C01

**How is Forward Error Correction implemented?**

- A. By the receiving station repeating each block of three data characters
- B. By transmitting a special algorithm to the receiving station along with the data characters
- C. By transmitting extra data that may be used to detect and correct transmission errors
- D. By varying the frequency shift of the transmitted signal according to a predefined algorithm

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E8C02

**What is the definition of symbol rate in a digital transmission?**

- A. The number of control characters in a message packet
- B. The duration of each bit in a message sent over the air
- C. The rate at which the waveform changes to convey information
- D. The number of characters carried per second by the station-to-station link

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E8C03

**Why should phase-shifting of a PSK signal be done at the zero crossing of the RF signal?**

- A. To minimize bandwidth
- B. To simplify modulation
- C. To improve carrier suppression
- D. All these choices are correct

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E8C04

**What technique minimizes the bandwidth of a PSK31 signal?**

- A. Zero-sum character encoding
- B. Reed-Solomon character encoding
- C. Use of sinusoidal data pulses
- D. Use of trapezoidal data pulses

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E8C05

**What is the approximate bandwidth of a 13-WPM International Morse Code transmission?**

- A. 13 Hz
- B. 26 Hz
- C. 52 Hz
- D. 104 Hz

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E8C06

**What is the bandwidth of a 170-hertz shift, 300-baud ASCII transmission?**

- A. 0.1 Hz
- B. 0.3 kHz
- C. 0.5 kHz
- D. 1.0 kHz

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E8C07

**What is the bandwidth of a 4800-Hz frequency shift, 9600-baud ASCII FM transmission?**

- A. 15.36 kHz
- B. 9.6 kHz
- C. 4.8 kHz
- D. 5.76 kHz

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E8C08

**How does ARQ accomplish error correction?**

- A. Special binary codes provide automatic correction
- B. Special polynomial codes provide automatic correction
- C. If errors are detected, redundant data is substituted
- D. If errors are detected, a retransmission is requested

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E8C09

**Which digital code allows only one bit to change between sequential code values?**

- A. Binary Coded Decimal Code
- B. Extended Binary Coded Decimal Interchange Code
- C. Excess 3 code
- D. Gray code

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E8C10

**How may data rate be increased without increasing bandwidth?**

- A. It is impossible
- B. Increasing analog-to-digital conversion resolution
- C. Using a more efficient digital code
- D. Using forward error correction

E8C11

**What is the relationship between symbol rate and baud?**

- A. They are the same
- B. Baud is twice the symbol rate
- C. Symbol rate is only used for packet-based modes
- D. Baud is only used for RTTY

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E8C12

**What factors affect the bandwidth of a transmitted CW signal?**

- A. IF bandwidth and Q
- B. Modulation index and output power
- C. Keying speed and shape factor (rise and fall time)
- D. All these choices are correct

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E8D Keying defects and overmodulation of digital signals; digital codes; spread spectrum

E8D01

**Why are received spread spectrum signals resistant to interference?**

- A. Signals not using the spread spectrum algorithm are suppressed in the receiver
- B. The high power used by a spread spectrum transmitter keeps its signal from being easily overpowered
- C. The receiver is always equipped with a digital blanker
- D. If interference is detected by the receiver it will signal the transmitter to change frequencies

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E8D02

**What spread spectrum communications technique uses a high-speed binary bit stream to shift the phase of an RF carrier?**

- A. Frequency hopping
- B. Direct sequence
- C. Binary phase-shift keying
- D. Phase compandored spread spectrum

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E8D03

**How does the spread spectrum technique of frequency hopping work?**

- A. If interference is detected by the receiver it will signal the transmitter to change frequencies
- B. If interference is detected by the receiver it will signal the transmitter to wait until the frequency is clear
- C. A binary bit stream is used to shift the phase of an RF carrier very rapidly in a pseudorandom sequence
- D. The frequency of the transmitted signal is changed very rapidly according to a pseudorandom sequence also used by the receiving station

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E8D04

**What is the primary effect of extremely short rise or fall time on a CW signal?**

- A. More difficult to copy
- B. The generation of RF harmonics
- C. The generation of key clicks
- D. Limits data speed

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E8D05

**What is the most common method of reducing key clicks?**

- A. Increase keying waveform rise and fall times
- B. Low-pass filters at the transmitter output
- C. Reduce keying waveform rise and fall times
- D. High-pass filters at the transmitter output

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E8D06

**What is the advantage of including parity bits in ASCII characters?**

- A. Faster transmission rate
- B. The signal can overpower interfering signals
- C. Foreign language characters can be sent
- D. Some types of errors can be detected

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E8D07

**What is a common cause of overmodulation of AFSK signals?**

- A. Excessive numbers of retries
- B. Ground loops
- C. Bit errors in the modem
- D. Excessive transmit audio levels

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E8D08

**What parameter evaluates distortion of an AFSK signal caused by excessive input audio levels?**

- A. Signal-to-noise ratio
- B. Baud rate
- C. Repeat Request Rate (RRR)
- D. Intermodulation Distortion (IMD)

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E8D09

**What is considered an acceptable maximum IMD level for an idling PSK signal?**

- A. +10 dB
- B. +15 dB
- C. -20 dB
- D. -30 dB

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E8D10

**What are some of the differences between the Baudot digital code and ASCII?**

- A. Baudot uses 4 data bits per character, ASCII uses 7 or 8; Baudot uses 1 character as a letters/figures shift code, ASCII has no letters/figures code
- B. Baudot uses 5 data bits per character, ASCII uses 7 or 8; Baudot uses 2 characters as letters/figures shift codes, ASCII has no letters/figures shift code
- C. Baudot uses 6 data bits per character, ASCII uses 7 or 8; Baudot has no letters/figures shift code, ASCII uses 2 letters/figures shift codes
- D. Baudot uses 7 data bits per character, ASCII uses 8; Baudot has no letters/figures shift code, ASCII uses 2 letters/figures shift codes

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E8D11

**What is one advantage of using ASCII code for data communications?**

- A. It includes built-in error correction features
- B. It contains fewer information bits per character than any other code
- C. It is possible to transmit both upper and lower case text
- D. It uses one character as a shift code to send numeric and special characters

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