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

SUBELEMENT E5 – ELECTRICAL PRINCIPLES [4 Exam Questions - 4 Groups]

E5A Resonance and Q: characteristics of resonant circuits: series and parallel resonance; definitions and effects of Q; half-power bandwidth; phase relationships in reactive circuits

E5A01
What can cause the voltage across reactances in a series RLC circuit to be higher than the voltage applied to the entire circuit?
A. Resonance
B. Capacitance
C. Conductance
D. Resistance
~~

E5A02
What is resonance in an LC or RLC circuit?
A. The highest frequency that will pass current
B. The lowest frequency that will pass current
C. The frequency at which the capacitive reactance equals the inductive reactance
D. The frequency at which the reactive impedance equals the resistive impedance
~~

E5A03
What is the magnitude of the impedance of a series RLC circuit at resonance?
A. High, as compared to the circuit resistance
B. Approximately equal to capacitive reactance
C. Approximately equal to inductive reactance
D. Approximately equal to circuit resistance
~~

E5A04
What is the magnitude of the impedance of a parallel RLC circuit at resonance?
A. Approximately equal to circuit resistance
B. Approximately equal to inductive reactance
C. Low compared to the circuit resistance
D. High compared to the circuit resistance
~~

E5A05
What is the result of increasing the Q of an impedance-matching circuit?
A. Matching bandwidth is decreased
B. Matching bandwidth is increased
C. Matching range is increased
D. It has no effect on impedance matching
~~

E5A06

What is the magnitude of the circulating current within the components of a parallel LC circuit at resonance?

A. It is at a minimum
B. It is at a maximum
C. It equals 1 divided by the quantity 2 times pi, multiplied by the square root of inductance L multiplied by capacitance C
D. It equals 2 multiplied by pi, multiplied by frequency, multiplied by inductance
~~

E5A07

What is the magnitude of the current at the input of a parallel RLC circuit at resonance?

A. Minimum
B. Maximum
C. R/L
D. L/R
~~

E5A08

What is the phase relationship between the current through and the voltage across a series resonant circuit at resonance?

A. The voltage leads the current by 90 degrees
B. The current leads the voltage by 90 degrees
C. The voltage and current are in phase
D. The voltage and current are 180 degrees out of phase
~~

E5A09

How is the Q of an RLC parallel resonant circuit calculated?

A. Reactance of either the inductance or capacitance divided by the resistance
B. Reactance of either the inductance or capacitance multiplied by the resistance
C. Resistance divided by the reactance of either the inductance or capacitance
D. Reactance of the inductance multiplied by the reactance of the capacitance
~~

E5A10

How is the Q of an RLC series resonant circuit calculated?

A. Reactance of either the inductance or capacitance divided by the resistance
B. Reactance of either the inductance or capacitance multiplied by the resistance
C. Resistance divided by the reactance of either the inductance or capacitance
D. Reactance of the inductance multiplied by the reactance of the capacitance
~~

E5A11
What is the half-power bandwidth of a resonant circuit that has a resonant frequency of 7.1 MHz and a Q of 150?
A. 157.8 Hz
B. 315.6 Hz
C. 47.3 kHz
D. 23.67 kHz
~~

E5A12
What is the half-power bandwidth of a resonant circuit that has a resonant frequency of 3.7 MHz and a Q of 118?
A. 436.6 kHz
B. 218.3 kHz
C. 31.4 kHz
D. 15.7 kHz
~~

E5A13
What is an effect of increasing Q in a series resonant circuit?
A. Fewer components are needed for the same performance
B. Parasitic effects are minimized
C. Internal voltages increase
D. Phase shift can become uncontrolled
~~

E5A14
What is the resonant frequency of an RLC circuit if R is 22 ohms, L is 50 microhenries and C is 40 picofarads?
A. 44.72 MHz
B. 22.36 MHz
C. 3.56 MHz
D. 1.78 MHz
~~

E5A15
Which of the following increases Q for inductors and capacitors?
A. Lower losses
B. Lower reactance
C. Lower self-resonant frequency
D. Higher self-resonant frequency
~~

E5A16
What is the resonant frequency of an RLC circuit if R is 33 ohms, L is 50 microhenries and C is 10 picofarads?
A. 23.5 MHz
B. 23.5 kHz
C. 7.12 kHz
D. 7.12 MHz
~~

E5B Time constants and phase relationships: RL and RC time constants; phase angle in reactive circuits and components; admittance and susceptance

E5B01
What is the term for the time required for the capacitor in an RC circuit to be charged to 63.2% of the applied voltage or to discharge to 36.8% of its initial voltage?
A. An exponential rate of one
B. One time constant
C. One exponential period
D. A time factor of one
~~

E5B02
What letter is commonly used to represent susceptance?
A. G
B. X
C. Y
D. B
~~

E5B03
How is impedance in polar form converted to an equivalent admittance?
A. Take the reciprocal of the angle and change the sign of the magnitude
B. Take the reciprocal of the magnitude and change the sign of the angle
C. Take the square root of the magnitude and add 180 degrees to the angle
D. Square the magnitude and subtract 90 degrees from the angle
~~

E5B04
What is the time constant of a circuit having two 220-microfarad capacitors and two 1-megohm resistors, all in parallel?
A. 55 seconds
B. 110 seconds
C. 440 seconds
D. 220 seconds
~~

E5B05
What happens to the magnitude of a pure reactance when it is converted to a susceptance?
A. It is unchanged
B. The sign is reversed
C. It is shifted by 90 degrees
D. It becomes the reciprocal
~~

E5B06
What is susceptance?
A. The magnetic impedance of a circuit
B. The ratio of magnetic field to electric field
C. The imaginary part of admittance
D. A measure of the efficiency of a transformer
~~

E5B07

What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 500 ohms, R is 1 kilohm, and XL is 250 ohms?

A. 68.2 degrees with the voltage leading the current
B. 14.0 degrees with the voltage leading the current
C. 14.0 degrees with the voltage lagging the current
D. 68.2 degrees with the voltage lagging the current
~~

E5B08

What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 100 ohms, R is 100 ohms, and XL is 75 ohms?

A. 14 degrees with the voltage lagging the current
B. 14 degrees with the voltage leading the current
C. 76 degrees with the voltage leading the current
D. 76 degrees with the voltage lagging the current
~~

E5B09

What is the relationship between the AC current through a capacitor and the voltage across a capacitor?

A. Voltage and current are in phase
B. Voltage and current are 180 degrees out of phase
C. Voltage leads current by 90 degrees
D. Current leads voltage by 90 degrees
~~

E5B10

What is the relationship between the AC current through an inductor and the voltage across an inductor?

A. Voltage leads current by 90 degrees
B. Current leads voltage by 90 degrees
C. Voltage and current are 180 degrees out of phase
D. Voltage and current are in phase
~~

E5B11

What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 25 ohms, R is 100 ohms, and XL is 50 ohms?

A. 14 degrees with the voltage lagging the current
B. 14 degrees with the voltage leading the current
C. 76 degrees with the voltage lagging the current
D. 76 degrees with the voltage leading the current
~~

E5B12

What is admittance?

A. The inverse of impedance
B. The term for the gain of a field effect transistor
C. The turns ratio of a transformer
D. The inverse of Q factor
~~

E5C Coordinate systems and phasors in electronics: Rectangular Coordinates; Polar Coordinates; Phasors

E5C01
Which of the following represents capacitive reactance in rectangular notation?
A. -jX
B. +jX
C. Delta
D. Omega
~~

E5C02
How are impedances described in polar coordinates?
A. By X and R values
B. By real and imaginary parts
C. By phase angle and magnitude
D. By Y and G values
~~

E5C03
Which of the following represents an inductive reactance in polar coordinates?
A. A positive magnitude
B. A negative magnitude
C. A positive phase angle
D. A negative phase angle
~~

E5C04
What coordinate system is often used to display the resistive, inductive, and/or capacitive reactance components of impedance?
A. Maidenhead grid
B. Faraday grid
C. Elliptical coordinates
D. Rectangular coordinates
~~

E5C05
What is the name of the diagram used to show the phase relationship between impedances at a given frequency?
A. Venn diagram
B. Near field diagram
C. Phasor diagram
D. Far field diagram
~~

E5C06
What does the impedance 50-j25 represent?
A. 50 ohms resistance in series with 25 ohms inductive reactance
B. 50 ohms resistance in series with 25 ohms capacitive reactance
C. 25 ohms resistance in series with 50 ohms inductive reactance
D. 25 ohms resistance in series with 50 ohms capacitive reactance
~~

E5C07

Where is the impedance of a pure resistance plotted on rectangular coordinates?

A. On the vertical axis
B. On a line through the origin, slanted at 45 degrees
C. On a horizontal line, offset vertically above the horizontal axis
D. On the horizontal axis
~~

E5C08

What coordinate system is often used to display the phase angle of a circuit containing resistance, inductive and/or capacitive reactance?

A. Maidenhead grid
B. Faraday grid
C. Elliptical coordinates
D. Polar coordinates
~~

E5C09

When using rectangular coordinates to graph the impedance of a circuit, what do the axes represent?

A. The X axis represents the resistive component and the Y axis represents the reactive component
B. The X axis represents the reactive component and the Y axis represents the resistive component
C. The X axis represents the phase angle and the Y axis represents the magnitude
D. The X axis represents the magnitude and the Y axis represents the phase angle
~~

E5C10

Which point on Figure E5-1 best represents the impedance of a series circuit consisting of a 400-ohm resistor and a 38-picofarad capacitor at 14 MHz?

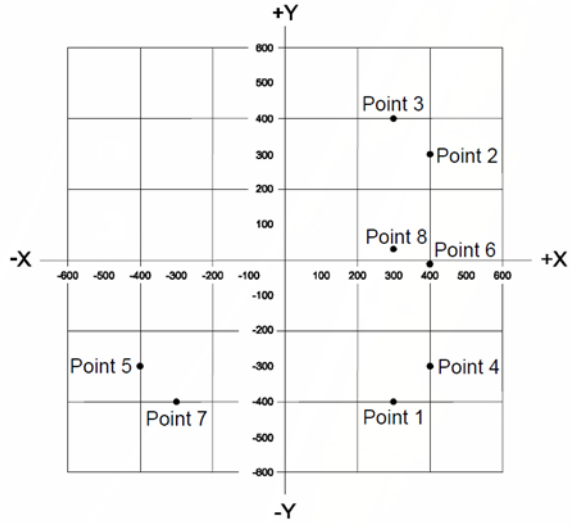
A. Point 2
B. Point 4
C. Point 5
D. Point 6
~~

E5C11

Which point in Figure E5-1 best represents the impedance of a series circuit consisting of a 300-ohm resistor and an 18-microhenry inductor at 3.505 MHz?

A. Point 1
B. Point 3
C. Point 7
D. Point 8
~~

Figure E5-1



E5C12

Which point on Figure E5-1 best represents the impedance of a series circuit consisting of a 300-ohm resistor and a 19-picofarad capacitor at 21.200 MHz?

A. Point 1
B. Point 3
C. Point 7
D. Point 8
~~

E5D AC and RF energy in real circuits: skin effect; electromagnetic fields; reactive power; power factor; electrical length of conductors at UHF and microwave frequencies; microstrip

E5D01

What is the result of skin effect?

A. As frequency increases, RF current flows in a thinner layer of the conductor, closer to the surface
B. As frequency decreases, RF current flows in a thinner layer of the conductor, closer to the surface
C. Thermal effects on the surface of the conductor increase the impedance
D. Thermal effects on the surface of the conductor decrease the impedance
~~

E5D02

Why is it important to keep lead lengths short for components used in circuits for VHF and above?

A. To increase the thermal time constant
B. To avoid unwanted inductive reactance
C. To maintain component lifetime
D. All these choices are correct
~~

E5D03

What is microstrip?

A. Lightweight transmission line made of common zip cord
B. Miniature coax used for low power applications
C. Short lengths of coax mounted on printed circuit boards to minimize time delay between microwave circuits
D. Precision printed circuit conductors above a ground plane that provide constant impedance interconnects at microwave frequencies
~~

E5D04

Why are short connections used at microwave frequencies?

A. To increase neutralizing resistance
B. To reduce phase shift along the connection
C. To increase compensating capacitance
D. To reduce noise figure
~~

E5D05

What is the power factor of an RL circuit having a 30-degree phase angle between the voltage and the current?

A. 1.73
B. 0.5
C. 0.866
D. 0.577

E5D06
In what direction is the magnetic field oriented about a conductor in relation to the direction of electron flow?
A. In the same direction as the current
B. In a direction opposite to the current
C. In all directions; omni-directional
D. In a circle around the conductor
~~

E5D07
How many watts are consumed in a circuit having a power factor of 0.71 if the apparent power is 500VA?
A. 704 W
B. 355 W
C. 252 W
D. 1.42 mW
~~

E5D08
How many watts are consumed in a circuit having a power factor of 0.6 if the input is 200VAC at 5 amperes?
A. 200 watts
B. 1000 watts
C. 1600 watts
D. 600 watts
~~

E5D09
What happens to reactive power in an AC circuit that has both ideal inductors and ideal capacitors?
A. It is dissipated as heat in the circuit
B. It is repeatedly exchanged between the associated magnetic and electric fields, but is not dissipated
C. It is dissipated as kinetic energy in the circuit
D. It is dissipated in the formation of inductive and capacitive fields
~~

E5D10
How can the true power be determined in an AC circuit where the voltage and current are out of phase?
A. By multiplying the apparent power by the power factor
B. By dividing the reactive power by the power factor
C. By dividing the apparent power by the power factor
D. By multiplying the reactive power by the power factor
~~

E5D11
What is the power factor of an RL circuit having a 60-degree phase angle between the voltage and the current?
A. 1.414
B. 0.866
C. 0.5
D. 1.73
~~

E5D12

How many watts are consumed in a circuit having a power factor of 0.2 if the input is 100 VAC at 4 amperes?

A. 400 watts
B. 80 watts
C. 2000 watts
D. 50 watts
~~

E5D13

How many watts are consumed in a circuit consisting of a 100-ohm resistor in series with a 100-ohm inductive reactance drawing 1 ampere?

A. 70.7 watts
B. 100 watts
C. 141.4 watts
D. 200 watts
~~

E5D14

What is reactive power?

A. Wattless, nonproductive power
B. Power consumed in wire resistance in an inductor
C. Power lost because of capacitor leakage
D. Power consumed in circuit Q
~~

E5D15

What is the power factor of an RL circuit having a 45-degree phase angle between the voltage and the current?

A. 0.866
B. 1.0
C. 0.5
D. 0.707
~~