SUBELEMENT G5 – ELECTRICAL PRINCIPLES [3 exam questions – 3 groups]
G5A - Resistance; reactance; inductance; capacitance; impedance; impedance matching

G5A01 (C)
What is impedance?
A. The electric charge stored by a capacitor
B. The inverse of resistance
C. The opposition to the flow of current in an AC circuit
D. The force of repulsion between two similar electric fields
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G5A02 (B)
What is reactance?
A. Opposition to the flow of direct current caused by resistance
B. Opposition to the flow of alternating current caused by capacitance or inductance
C. A property of ideal resistors in AC circuits
D. A large spark produced at switch contacts when an inductor is de-energized
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G5A03 (D)
Which of the following causes opposition to the flow of alternating current in an inductor?
A. Conductance
B. Reluctance
C. Admittance
D. Reactance
~~
G5A04 (C)
Which of the following causes opposition to the flow of alternating current in a capacitor?
A. Conductance
B. Reluctance
C. Reactance
D. Admittance
~~
G5A05 (D)
How does a coil react to AC?
A. As the frequency of the applied AC increases, the reactance decreases
B. As the amplitude of the applied AC increases, the reactance increases
C. As the amplitude of the applied AC increases, the reactance decreases
D. As the frequency of the applied AC increases, the reactance increases

X_L = 2_fl
= 2 * 3.14 * 60hz * 0.2henrys
= 75.4_

X_L = 2_fl
= 2 * 3.13 * 120hz *0.2henrys
= 158.8_

~~

G5A06 (A)
How does a capacitor react to AC?
A. As the frequency of the applied AC increases, the reactance decreases
B. As the frequency of the applied AC increases, the reactance increases
C. As the amplitude of the applied AC increases, the reactance increases
D. As the amplitude of the applied AC increases, the reactance decreases

$X_C = 10^6$ / 2_fC(µ farad)
= 1,000,000 / 2 * 3.14 * 60hz * 2µf
= 1,000,000 / 753.98
= 1326.3_

$X_C = 10^6$ / 2_fC(µ farad)
= 1,000,000 / 2 * 3.14 * 120hz * 2µf
= 1,000,000 / 1507.9
= 663.14_

G5A07 (D)
What happens when the impedance of an electrical load is equal to the internal impedance of the power source?
A. The source delivers minimum power to the load
B. The electrical load is shorted
C. No current can flow through the circuit
D. The source can deliver maximum power to the load
~~
G5A08 (A)
Why is impedance matching important?
A. So the source can deliver maximum power to the load
B. So the load will draw minimum power from the source
C. To ensure that there is less resistance than reactance in the circuit
D. To ensure that the resistance and reactance in the circuit are equal
~~
G5A09 (B)
What unit is used to measure reactance?
A. Farad
B. Ohm
C. Ampere
D. Siemens
~~
G5A10 (B)
What unit is used to measure impedance?
A. Volt
B. Ohm
C. Ampere
D. Watt
~~

G5A11 (A)
Why should core saturation of a conventional impedance matching transformer be avoided?
A. Harmonics and distortion could result
B. Magnetic flux would increase with frequency
C. RF susceptance would increase
D. Temporary changes of the core permeability could result
~~
G5A12 (B)
What is one reason to use an impedance matching transformer?
A. To reduce power dissipation in the transmitter
B. To maximize the transfer of power
C. To minimize SWR at the antenna
D. To minimize SWR in the transmission line
~~
G5A13 (D)
Which of the following devices can be used for impedance matching at radio frequencies?
A. A transformer
B. A Pi-network
C. A length of transmission line
D. All of these choices are correct
~~
G5A14 (A)
Which of the following describes one method of impedance matching between two AC circuits?
A. Insert an LC network between the two circuits
B. Reduce the power output of the first circuit
C. Increase the power output of the first circuit
D. Insert a circulator between the two circuits
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G5B - The Decibel; current and voltage dividers; electrical power calculations; sine wave, root-mean-square (RMS) values; PEP calculations

G5B01 (B)
A two-times increase or decrease in power results in a change of how many dB?
A. 2 dB
B. 3 dB
C. 6 dB
D. 12 dB

$$dB = 10 \log_{10} P_1 / P_2 = 10 * \log_{10} 4/2 = 10 * \log_{10} 2 = 10 * .30103 = 3.0103$$

$$dB = 10 \log_{10} P_1 / P_2 = 10 * \log_{10} 4/2 = 10 * \log_{10} .5 = 10 * -.30103 = -3.0103$$

~~
G5B02 (C)
How does the total current relate to the individual currents in each branch of a parallel circuit?
A. It equals the average of each branch current
B. It decreases as more parallel branches are added to the circuit
C. It equals the sum of the currents through each branch
D. It is the sum of the reciprocal of each individual voltage drop
~~

G5B03 (B)
How many watts of electrical power are used if 400 VDC is supplied to an 800-ohm load?
A. 0.5 watts
B. 200 watts
C. 400 watts
D. 3200 watts
~~

E
I * R

I = E/R
= 400v / 800_
= .5a

P = I * E
= .5 A * 400v
= 200 watts

G5B04 (A)
How many watts of electrical power are used by a 12-VDC light bulb that draws 0.2 amperes?
A. 2.4 watts
B. 24 watts
C. 6 watts
D. 60 watts
~~

P = I * E
= 0.2a * 12v
= 2.4 watts

G5B05 (A)
How many watts are being dissipated when a current of 7.0 milliamperes flows through 1.25 kilohms?
A. Approximately 61 milliwatts
B. Approximately 39 milliwatts
C. Approximately 11 milliwatts
D. Approximately 9 milliwatts
~~

E = I * R
= 0.007a * 1250_
= 8.75v

P = I * E
= 0.007a * 8.75v
= 0.06125w

watts * 1000 = milliwatts **.06125w * 1000 = 61.25 milliwatts**

G5B06 (B)
What is the output PEP from a transmitter if an oscilloscope measures 200 volts peak-to-peak across a 50-ohm dummy load connected to the transmitter output?
A. 1.4 watts
B. 100 watts
C. 353.5 watts
D. 400 watts

watts output (PEP) = $\frac{(PEPv/2 * .707)^2}{}$

= $\frac{(200v / \sqrt{2} * .707)^2}{50\_}$

= 99.96 watts or 100 watts

~~
G5B07 (C)
Which measurement of an AC signal is equivalent to a DC voltage of the same value?
A. The peak-to-peak value
B. The peak value
C. The RMS value
D. The reciprocal of the RMS value

When a voltmeter is placed into an AC Circuit, the RMS is measured.
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G5B08 (D)
What is the peak-to-peak voltage of a sine wave that has an RMS voltage of 120 volts?
A. 84.8 volts
B. 169.7 volts
C. 240.0 volts
D. 339.4 volts

$$PEP_V = \frac{RMS}{0.707} * 2$$
$$= \frac{120}{0.707} * 2$$
$$= 169.7 * 2$$
$$= 339.4$$

~~
G5B09 (B)
What is the RMS voltage of sine wave with a value of 17 volts peak?
A. 8.5 volts
B. 12 volts
C. 24 volts
D. 34 volts

$$RMS_V = PEP_V * 0.707$$
$$= 17v * 0.707$$
$$= 12v$$

~~
G5B11 (B)
What is the ratio of peak envelope power to average power for an unmodulated carrier?
A. .707
B. 1.00 **Peak Envelope Power = Average Power**
C. 1.414
D. 2.00
~~
G5B12 (B)
What would be the voltage across a 50-ohm dummy load dissipating 1200 watts?
A. 173 volts
B. 245 volts
C. 346 volts
D. 692 volts

$I^2 = P / R$
$= 1200w / 50\Omega$
$= 24a$
$I = \sqrt{24a}$
$= 4.9a$

$E = P / I$
$= 1200w / 4.9a$
$= 244.9v$ OR $245v$

~~
G5B13 (C)
What percentage of power loss would result from a transmission line loss of 1 dB?
A. 10.9 %
B. 12.2 %
C. 20.5 %
D. 25.9

$$dB = 10 \log_{10} \frac{P_1}{P_2}$$
$$\text{Therefore } 10^{.1} = \log_{10} \frac{P_1}{P_2}$$
$$= \frac{1}{1.259}$$
$$= .794$$
$$1 - .794 = .205$$
$$.205 * 100 = 20.5$$

~~
G5B14 (B)
What is the output PEP from a transmitter if an oscilloscope measures 500 volts peak-to-peak across a 50-ohm resistor connected to the transmitter output?
A. 8.75 watts
B. 625 watts
C. 2500 watts
D. 5000 watts

Watts = $\frac{(PEP / 2 * .707)^2}{50\ \Omega}$

= $\frac{(500 / \sqrt{2} * .707)^2}{50\ \Omega}$

= $\frac{3124.5}{50}$

= 624.8 OR 625

~~
G5B15 (B)
What is the output PEP of an unmodulated carrier if an average reading wattmeter connected to the transmitter output indicates 1060 watts?
A. 530 watts
B. 1060 watts
C. 1500 watts
D. 2120 watts

Peak Power = Average Power

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G5C – Resistors, capacitors, and inductors in series and parallel; transformers
G5C01 (C)
What causes a voltage to appear across the secondary winding of a transformer when an AC voltage source is connected across its primary winding?
A. Capacitive coupling
B. Displacement current coupling
C. Mutual inductance
D. Mutual capacitance
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G5C02 (B)
Where is the source of energy normally connected in a transformer?
A. To the secondary winding
B. To the primary winding
C. To the core
D. To the plates
~~
G5C03 (A)
What is current in the primary winding of a transformer called if no load is attached to the secondary?
A. Magnetizing current
B. Direct current
C. Excitation current
D. Stabilizing current
~~
G5C04 (C)
What is the total resistance of three 100-ohm resistors in parallel?
A. .30 ohms
B. .33 ohms
C. 33.3 ohms
D. 300 ohms

100Ω / 3 = 33.3Ω

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G5C05 (C)
What is the value of each resistor if three equal value resistors in parallel produce 50 ohms of resistance, and the same three resistors in series produce 450 ohms?
A. 1500 ohms **Parallel 50_ * 3 = 150_**
B. 90 ohms
C. 150 ohms Series 150_ * 3 450_
D. 175 ohms
~~
G5C06 (C)
What is the voltage across a 500-turn secondary winding in a transformer if the 2250-turn primary is connected to 120 VAC?
A. 2370 volts $\frac{T_P}{T_S} = \frac{V_P}{V_S}$ $\frac{2250}{500} = \frac{120}{V_S}$
B. 540 volts
C. 26.7 volts
D. 5.9 volts **=500 * 120 / 2250**
= 60,000 / 2250
= 26.7v
~~
G5C07 (A)
What is the turn's ratio of a transformer used to match an audio amplifier having a 600-ohm output impedance to a speaker having a 4-ohm impedance?
A. 12.2 to 1 $\frac{\_1}{\_2} = \frac{\sqrt{T_1}}{\sqrt{T_2}}$ $\frac{\sqrt{600}}{\sqrt{4\_}} = \sqrt{150}$
B. 24.4 to 1
C. 150 to 1
D. 300 to 1 **= 12.2**

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G5C08 (D)
What is the equivalent capacitance of two 5000 picofarad capacitors and one 750 picofarad capacitor connected in parallel?
A. 576.9 picofarads
B. 1733 picofarads $X_{CT} = C_1 + C_2 + C_3 \ldots$
C. 3583 picofarads $= 5000_{\mu\mu f} + 5000_{\mu\mu f} + 750_{\mu\mu f}$
D. 10750 picofarads $= 10750_{\mu\mu f}$
~~
G5C09 (C)
What is the capacitance of three 100 microfarad capacitors connected in series?
A. .30 microfarads $X_{C\mu t} = \frac{X_{C\mu}}{3}$
B. .33 microfarads
C. 33.3 microfarads $= \frac{100_{\mu f}}{3}$
D. 300 microfarads $= 33.3_{\mu f}$

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G5C10 (C)
What is the inductance of three 10 millihenry inductors connected in parallel?
A. .30 Henrys
B. 3.3 Henrys
C. 3.3 millihenrys
D. 30 millihenrys

$$\frac{1}{X_{lt}} = \frac{1}{X_{l1}} + \frac{1}{X_{l2}} + \frac{1}{X_{l3}}$$

$$= \frac{1}{10} + \frac{1}{10} + \frac{1}{10}$$

$$= \frac{1}{.3}$$

$$= 3.3$$

~~
G5C11 (C)
What is the inductance of a 20 millihenry inductor in series with a 50 millihenry inductor?
A. .07 millihenrys
B. 14.3 millihenrys
C. 70 millihenrys
D. 1000 millihenrys

$$X_{Lt} = X_{L1} + X_{L2}$$

= .020h + .050h

= .070h

.07h * 1000 = 7 millihenrys

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G5C12 (B)
What is the capacitance of a 20 microfarad capacitor in series with a 50 microfarad capacitor?
A. .07 microfarads
B. 14.3 microfarads
C. 70 microfarads
D. 1000 microfarads

$$\frac{1}{X_{Ct}} = \frac{1}{X_{c1}} + \frac{1}{X_{c2}}$$

$$\frac{1}{X_{ct\mu f}} = \frac{1}{20_{\mu f}} + \frac{1}{50_{\mu f}}$$

$$\frac{1}{X_{C\mu t}} = 0.05\mu f + 0.02$$

$$XCt = \frac{1}{0.07}$$

$$= 14.28_{\mu f} \quad \text{or } 14.3_{\mu f}$$

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G5C13 (C)
What component should be added to a capacitor in a circuit to increase the circuit capacitance?
A. An inductor in series
B. A resistor in series
C. A capacitor in parallel
D. A capacitor in series
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G5C14 (D)
What component should be added to an inductor in a circuit to increase the circuit inductance?
A. A capacitor in series
B. A resistor in parallel
C. An inductor in parallel
D. An inductor in series

$$X_{Lt} = X_{L1} + X_{L2} + X_{L2} \ldots$$

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G5C15 (A)
What is the total resistance of a 10 ohm, a 20 ohm, and a 50 ohm resistor in parallel?

A. 5.9 ohms
B. 0.17 ohms
C. 10000 ohms
D. 80 ohms

$$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}...$$

$$\frac{1}{R_t} = \frac{1}{10} + \frac{1}{20} + \frac{1}{50}$$

$$\frac{1}{R_t} = 0.1 + 0.05 + 0.02$$

$$\frac{1}{R_t} = 0.17$$

$$R_t = \frac{1}{0.17}$$

$$= 5.88 \text{ or } 5.9$$

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G5C16 (B)
What component should be added to an existing resistor in a circuit to increase circuit resistance?
A. A resistor in parallel
B. A resistor in series $R_t = R_1 + R_2 + R_3...$
C. A capacitor in series
D. A capacitor in parallel
~~