

Quiz Review

Question 1

Didn't use secondaries on the power transformers. This makes it used as an autotransformer.

DIAGRAM

Can find autotransformers in rural areas, like a transmitter remotely located on a mountain.

Question 2

Advantages

No DC, so would not be any DC to block.

Isolation provided.

Can use two 10:1 transformers if don't have a 1:1 available.

Disadvantages

Would have to have substantial size transformers for high current.

Would have a voltage drop and IR losses with a long line in the 12V section.

Question 3

DIAGRAM

Question 4

$$C_T = C_1 C_2 / (C_1 + C_2)$$

Answer will be less than the capacitance of the smallest capacitor.

Capacitors in series combine like resistors in parallel.

Question 5

Answer will be less than the resistance of the smallest resistor.

$$R_T = 1 / ((1 / R_1) + (1 / R_2) + (1 / R_3))$$

Question 6

What is IT for #5? $I = E / R = 12/91 = .13A$

Question 7

What is total power (PT)? $P = EI = (12) (.13) = 1.6 \text{ watts}$

Question 8

Voltage across R1? Same as across all the other resistors (12V).

Question 9

Draw an integrator and show the output waveform with a square wave input.
This question is under review. The answer given is for a differentiator circuit.

Question 10

Skip this – see question 9.

Question 11

What is resonance? In a circuit with a capacitor and an inductor, at a specific frequency, when $X_C = X_L$ (when inductive reactance equals and is opposite to capacitive reactance).

Question 12

X_c for 100 mF, 120V, $t=5$? After 5 time constants, the capacitor is considered to be fully charged, so no current flow since there is no AC and the capacitor is charged, capacitive reactance is infinite (approaches infinity).

Question 13

The capacitor would attenuate the flow of the lower frequency signal **through** the capacitor, but it would attenuate the flow of the higher frequency signal **around** the capacitor (in the case where the output of the circuit is taken across the capacitor). Capacitors will pass higher frequency signals because capacitive reactance is inversely proportional to frequency (i.e., high frequency, low capacitive reactance).

Question 14

Ohms.

Question 15

Reactance is frequency-sensitive, resistance is not.

Question 16

The square root of -1.

Question 17

$C = 80 \text{ nF}$, $f = 42 \text{ Hz}$. The abbreviation nF stands for nanofarads (10^{-9} farads).

$X_c = 1 / (2 \pi f C) = 1 / (2 * \pi * 42 * 80 * 10^{-9}) = 47 \text{ k ohms}$.

Question 18

Increases

Question 19

I leads E by 90 degrees for capacitive reactance circuits. Recall ELI the ICE man as a mnemonic phrase. ICE means that I leads E for Capacitive reactance circuits.

Question 20

Hybrid transformer converts 2-wire to 4-wire.

Transistors

Will discuss transistor amplifier configurations.

Configurations

Common Emitter

Most widely used configuration.

Advantages: current, voltage, and power gain.

180 degree phase shift between input and output.

DIAGRAM

Neither input nor output flows through the emitter.

Can be used for comb filtering.

Common Base

Low input impedance, high output impedance.

No phase shift between input and output.

DIAGRAM.

Common Collector

Also known as emitter follower.

High input impedance, low output impedance.

No phase shift between input and output.

Used in video circuits, for example, when going out to 75 ohms output.

DIAGRAM

Additional

Can use Common Emitter and Common Collector simultaneously.

DIAGRAM

History

1948 – June 30th – when transistor first introduced/reported.

John Pierce at Bell Labs.

Transistor = transfer resistor.

First transistor large, didn't handle much current.

Became popular in the mid-1960's.

Advantages of Transistors over Tubes

Smaller size.

Generate less heat.

No warmup time.

More durable.

Could use a lot lower DC voltage in transistor circuits.

Portable tube radios required three batteries: heater, plate, bias.

Joke

“transistor put in circuit to protect the fuse” - an example of Murphy's law

Categories

Bipolar

NPN or PNP. NPN is used more often because of noise – they are quieter.

Field Effect (FET)

Terminals are gate, drain, source.

DIAGRAM of schematic symbol for FET.

Has a substrate connecting drain and source. The gate constricts flow through electrostatic field.

FET is higher impedance than bipolar. Found where don't want a lot of load on the circuit, like capacitive circuits where resistance of the capacitor is significant.

Types include MOSFET (metal oxide silicon) and JFET (junction).

End Notes

Remainder of transistor lecture on Tuesday.

Moving away from discrete components toward integrated components.