Electroholics
Electronics Club | IIITD

Tech-Quiz

27th October, 2015

Co-sponsored by -

ElectronicsForYou

Rules

- Max team size: 3 (any batch).
- Each question has equal weightage and only 1 min is allowed to answer.
- We have two cash prizes 500 Rs each and follow up teams will get gifts from EFY.
- Decision of referee will be final (Referee: Sanchit).
- Any queries can be relayed to manojg@iiitd.ac.in.

Signal Processing

Question 1

Why do we transmit bandpass signals, why not baseband ?

Question 2

In communication systems, if a message signal is multiplied with a carrier signal (sinusoidal), list two changes in its spectrum ?

Question 3

What is the spectral change from moving from sine wave to square wave ?

Question 4

Why we prefer to have long T_{rise} and T_{decay} time (almost 10% of T_{ON}) while making any digital sq. wave clock ?

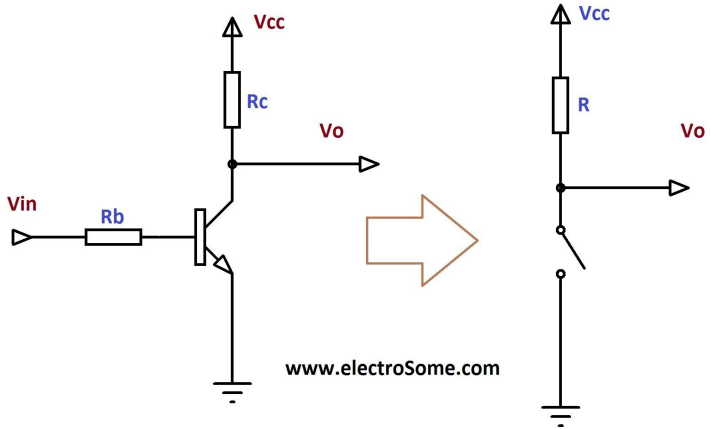
Analog Circuits

Question 1

In a CMOS inverter, if input changes abruptly from 0v to 5v then output has a spike in it. Why does it happen?

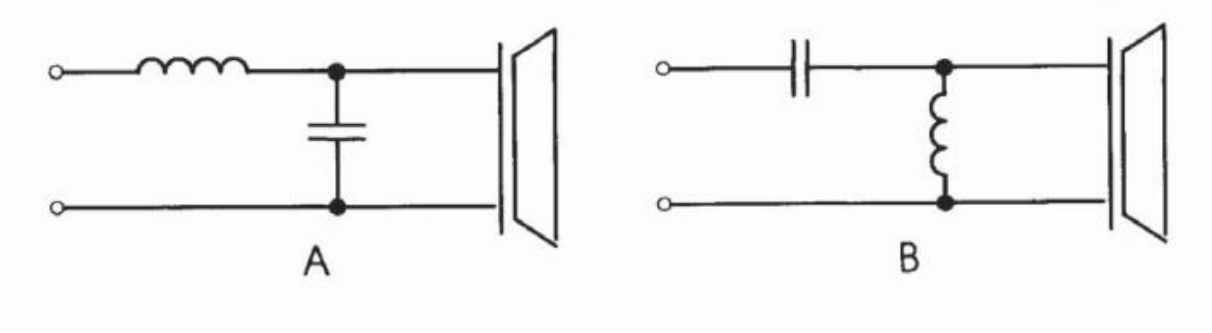
Question 2

While using transistor as a switch why we need a 10k/1k resistor in series before base terminal (Rb)?



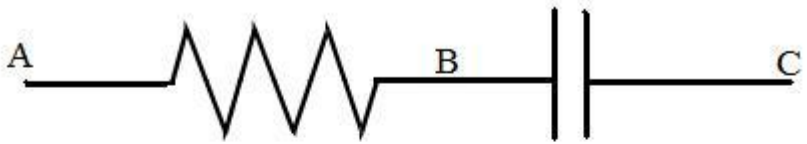
Question 3

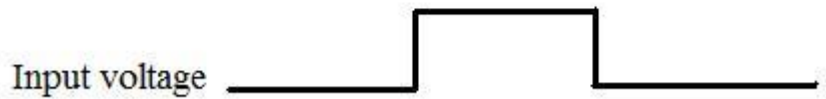
Two loudspeakers with a passive input filter are shown below Figure (a) and (b). Which one is the woofer and which one is tweeter ?



Question 4

If the input voltage was connected to node C and node A was grounded, What is the behavior on node B. Now reverse the connections on nodes A and C.





Question 5

Ideal power supplies are meant to provide regulated (stable/non-fluctuating) power supply. However in power supply design, you have lots of analog circuits and you need a stable bias/power supply for these analog circuits. How you will provide this stable bias from a fluctuating un-regulated raw power ?

Embedded Systems

Question 1

Why 32.768kHz crystal is used in RTC circuits?

Question 2

We can make a midi player using AVR microcontroller but list two ways to generate polytones using only AVR microcontroller ?

Question 3

What is the use of volatile keyword?

Question 4

Determine two mistakes in this macro declaration

```
#define SECONDS_PER_YEAR  (60 * 60 * 24 *365);
```

Robotics

Question 1

What happens when both the wires (positive and negative) of a DC motor are shorted physically ?

Question 2

How can I drive a MOSFET based H-Bridge which requires min. 1A current on its GATE terminals for control action of H-Bridge ?

Question 3

Pneumatics systems require _____.

a. fluids such as oil or water to operate
b. carbon Dioxide
c. nitric Oxide
d. a compressor

Question 4

There are many measures that can be used to characterize sensors. Which measure would be best to distinguish two ampere meters (Current meters) that can measure 1mA-1A and 0.1mA-10A?

Question 5

What is it that you can get when you use two cameras that might be worth the effort of processing two images instead of one?

Our Team

- Hemanth Sabbella
- Aneesh Kumar
- Sanchit Agarwal
- Manoj Gulati

Slides: http://electroholics.github.io/

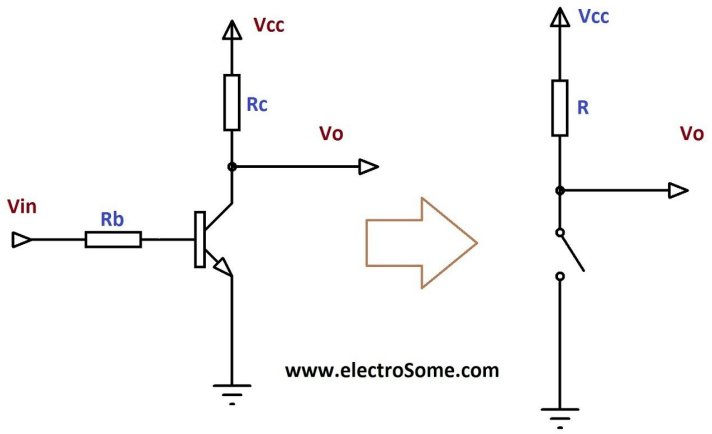
Solutions

Signal Processing:

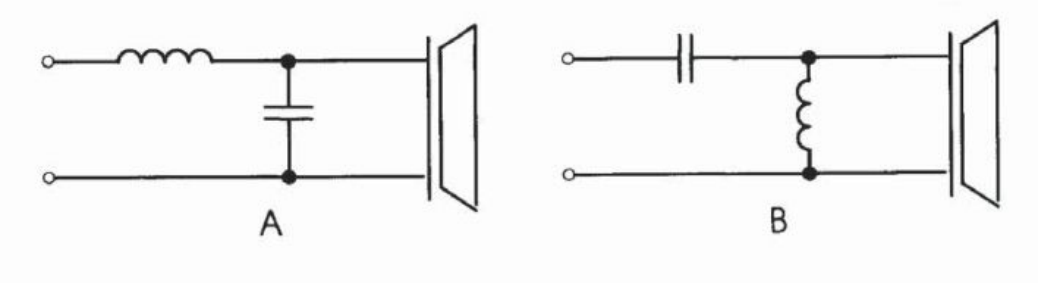
1. Why do we transmit bandpass signals, why not baseband ?
   Ans: Baseband signals can cause Interference, higher frequency signals have smaller antenna size.
2. In communication systems, if a message signal is multiplied with a carrier signal(sinusoidal), list two changes in its spectrum ?
   Ans: Bandwidth(w/2 -> w), Frequency shift.
3. What is the spectral change from moving from sine wave to square wave ?
   Ans: Narrow band to wide band.
4. Why we prefer to have long T_{rise} and T_{decay} time (almost 10% of T_{ON}) while making any digital sq. wave clock ?

Analog:

1. In a CMOS inverter, if input changes abruptly from 0v to 5v then output has a spike in it. Why does it happen?
   Ans: When input changes abruptly from 0v to 5v then the voltage across the parasitic capacitance between input and output can not change instantaneously. So some of the input is coupled with output. Hence the spikes occur in the output.
2. While using transistor as a switch why we need a 10k/1k resistor in series before base terminal (Rb)?
   Figure:

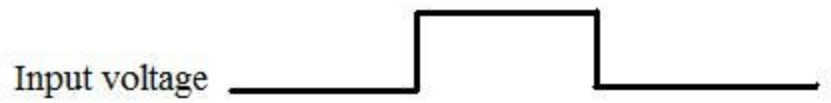


   Ans: To reduce base current by providing high input impedance.
3. Two loudspeakers with a passive input filter are shown below Figure (a) and (b). Which one is the woofer and which one is tweeter ?



Ans: (a) Woofer (b) Tweeter

4. If the input voltage was connected to node C and node A was grounded, What is the behavior on node B. Now reverse the connections on nodes A and C.



Ans: (a) High Pass Filter (b) Low Pass Filter

5. Ideal power supplies are meant to provide regulated (stable/non-fluctuating) power supply. However in power supply design, you have lots of analog circuits and you need a stable bias/power supply for these analog circuits. How you will provide this stable bias from a fluctuating un-regulated raw power ? Think twice before shouting :)
   Ans: Low O/P current Voltage reference ICs

Embedded:

1. Why 32.768kHz crystal is used in RTC circuits? Nice
   Ans: 2^15 = 32786. To get a precise one second period (1 Hz) by using 4-bit binary counter.
2. We can make a midi player using AVR microcontroller but list two ways to generate polytones using only AVR microcontroller ?
3. What is the use of volatile keyword?
   Ans: To prevent the compiler optimization.
4. Determine two mistakes in this macro declaration
   #define SECONDS_PER_YEAR (60 * 60 * 24 * 365);
   Ans: Integer overflows(UL), No semicolon.

Robotics

1. What happens when both the wires (positive and negative) of a DC motor are shorted physically ? Ans: Motor will be jammed
2. How can I drive a MOSFET based H-Bridge which requires min. 1A current on it's GATE terminals for control action of H-Bridge ? Ans: Using another motor driver (L298/L293 based)
3. Pneumatics systems require _____.
    a. fluids such as oil or water to operate
    b. carbon Dioxide
    c. nitric Oxide
    d. a compressor

    Ans: All 3 except first
4. There are many measures that can be used to characterize sensors. Which measure would be best to distinguish two ampere meters (Current meters) that can measure 1mA-1A and 0.1mA-10A? Ans: Dynamic range
5. What is it that you can get when you use two cameras that might be worth the effort of processing two images instead of one? Ans: Depth, i.e. distance