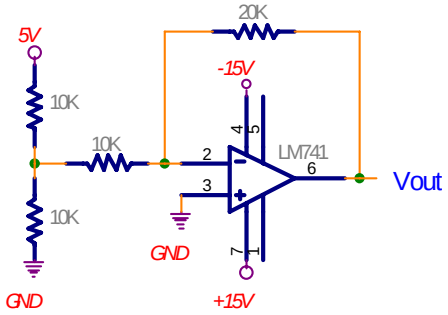
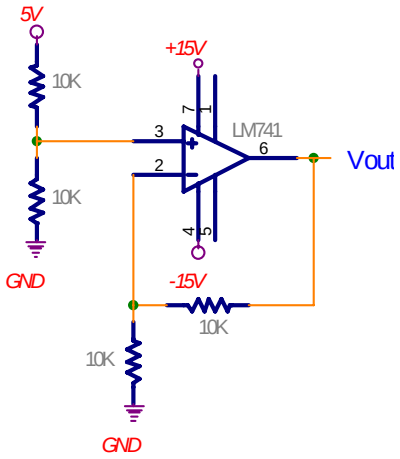
PHYS 483/683 Review for Final

1) What is the output voltage of the following two circuits?

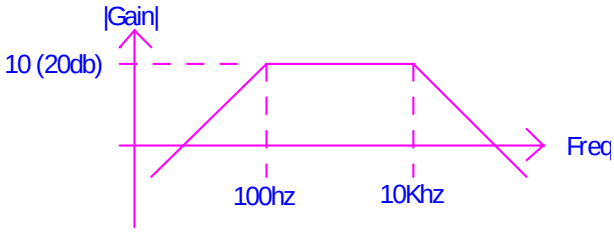
a)



b)



2) Design a single op-amp amplifier with the following frequency response. Draw a complete schematic including power connections and decoupling caps. Show calculations for the cutoff frequency and gain. You can use any power supply.



3) Given the following three op-amp choices, which op-amp would be the best choice if the main requirement is to design an:

Op-Amp	Input Off-Set Voltage (mv)	Gain Bandwidth Product (Mhz)
A	0.1	1
B	1	20
C	3	1

a) Audio amplifier with a gain of 100 from 20hz-20Khz.

b) Thermocouple amplifier where Vin is a few mV

4) You are asked to design a circuit to count objects on an assembly line. There is already an LED mounted on one side of the conveyor belt and a matching photodiode on the other. As objects move past the light beam is broken. They have a digital counter (with a schmitt trigger input) that will register a count whenever the input is greater than 3V (the counter can handle input voltages up to 15V without damage). Design a circuit that will drive the LED and amplify the photodiode signal such that it will count when the light beam is blocked. You can assume that 100% of the light leaving the led hits the photodiode (lenses are used). Draw a complete schematic including power and decoupling caps. Use any power supply you want.

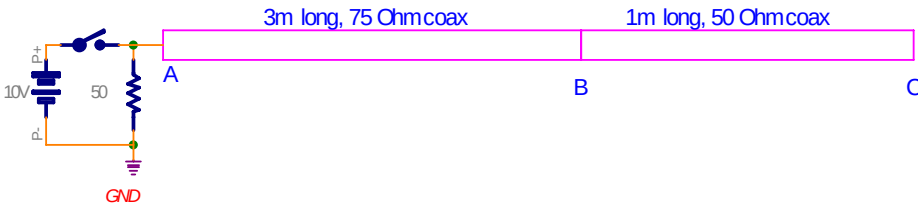
LED specs:
2V forward drop
Imax = 20mA
Efficiency = 0.1mw/mA

Photodiode Specs:
Idark = 1nA
Sensitivity = 1A/W
Capacitance = 1nF@0V reverse bias (0.1nF@15V reverse bias).

About how fast can your circuit respond with no reverse bias?

What is the maximum count rate for your circuit with a 15V reverse bias?

5) At t=0 the switch is closed. At t = 5ns the switch is opened. The propagations speed in the coax is 2E8m/s (1m/5ns). The right side of the 50Ω cable isn't connected to anything.



a) What is the voltage at B at t = 17ns?

b) What is the voltage at A at t = 32ns?

c) What is the voltage at C at t = 22ns?

d) What is the voltage at A at t = 42ns?

6) The skin depth of Aluminum (in inches) is $3.3/\sqrt{f}$.

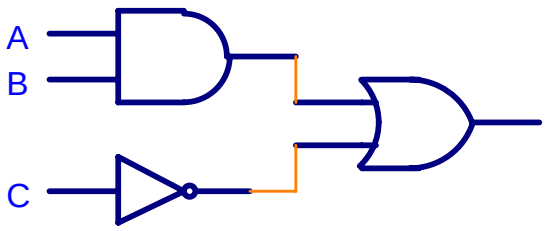
a) How thick would an aluminum enclosure have to be to attenuate a 10Mhz signal by a factor of 10 (20db)?

b) How large of a hole could there be in the enclosure and still attenuate a 10Mhz signal by a factor of 10 (20db)?

7) Which has a lower DC resistance, one 2mm diameter wire or two 1mm diameter wires?

8) Which would have a lower AC resistance (say at 1Ghz)? The one 2mm diameter wire or two 1mm diameter wires (or does it matter)?

9) Fill out the truth table for the following logic circuit:



A B C	D
0 0 0	
0 0 1	
0 1 0	
0 1 1	
1 0 0	
1 0 1	
1 1 0	
1 1 1	

10) Draw the simplest logic circuit that will implement the following truth table:

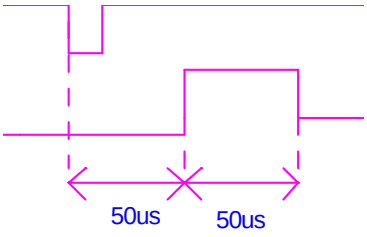
A	B	C	D
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

Use the pin-out diagrams at http://www.physics.unlv.edu/~bill/PHYS483/final_review.pdf for questions 11 & 12.

11) When configured as an oscillator the frequency of the 555 timer is $f = \frac{1.44}{(R1 + 2R2)C}$

Draw the schematic of a 555 timer that will oscillate at 1Khz.

12) Configure a 74HC123 to provide a 50us pulse after a 50us delay when triggered by a falling edge on the input (see diagram). Draw the schematic and label the input and output. You can assume the width of the pulse is equal to the RC time constant.



13) Fill out the timing diagram for C after t = 0. Note: C is high before t = 0.