NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ECE 111**

**EXAM 2**

**Fall 2014**

FOR GRADERS’ USE ONLY.

|  |  |  |
| --- | --- | --- |
| PROBLEM # | GRADE | POINTS |
| 1 |  | 24 |
| 2 |  | 38 |
| 3 |  | 22 |
| 4 |  | 30 |
| TOTAL |  | 114 |

1. (6 points each, 24 points total) Match the letter of the Configuration with the appropriate circuit diagram and give the output voltage as a function of the input voltage or voltages:

A) Inverting Configuration vo = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B) True Differential Configuration vo = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

C) Non-inverting Configuration vo = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

D) Buffer Configuration vo = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 

Configuration: \_\_\_D**\_\_**\_\_\_ Configuration: \_\_\_A**\_\_**\_\_\_

 

Configuration: \_\_\_**\_C\_**\_\_\_ Configuration: \_\_\_B**\_\_**\_\_\_

2. (38 Points Total)

Given this circuit:



A.) (8 points) What Thevenin Equivalent Circuit is seen by the load resistor RL?

**Convert 0.3A and 50Ω to 15V and 50Ω in series.**

**Combine 50Ω and 100Ω in series to get 150Ω.**

**Convert 15V and 150Ω to 0.1A and 150Ω in parallel.**

**Combine 150Ω and 150Ω in parallel to get 75Ω.**

**Convert 0.1A and 75Ω to get 7.5 and 75Ω in series.**

B.) (4 points)? What value of load resistor would result in the maximum power being delivered to the load resistor RL?

**Max power when load matches source R, so 75Ω.**

C.) (8 points) Under those conditions, how much power would be dissipated by the load resistor?

**Half the source voltage is across the load resistor, so** 

D.) (4 points) Under those conditions, how much power is being DISSIPATED by the voltage source?

**The same amount of power, 0.75W, is being dissipated in the Source Resistor, so the power sourced by the voltage source is -2\*0.75W or 1.5W.**

E.) (6 points) What are the Open Circuit Voltage (VOC) and Short Circuit Current (ISC) of this Thevenin Equivalent?

**VOC=7.5V, ISC=0.1A**

F.) (8 points) The I-V characteristic of an LED is shown in the graph below. If it is put in place of the load resistor of the Equivalent Circuit above, (approximately) what voltage will be across it and what current will flow through it?

VLED = \_\_\_\_\_\_**1.5V**\_\_\_\_\_\_\_\_\_\_\_\_\_

ILED = \_\_\_\_\_\_\_**0.08A=80mA**\_\_\_\_\_ (Read from graph)



3.) (22 points total)

Given this circuit containing an Ideal, 5 terminal Op-Amp, capable of Rail-to-Rail operation (that is, the output is able to go all the way to the supply voltage):



A. (2 points) Is this (CIRCLE ONE): **Non-Inverting**, Inverting, Comparator, Differential, or Buffer Configuration

B. (6 points) Given part A, what is the output Vo in terms of the resistors Ri, Rf, and R3, and the input VS?



C. (4 points) If Rf=100kΩ, Ri=10kΩ, R3=10kΩ, Vcc=15V, -Vcc=-15V, and Vs = 0.3V, what will the output be?

, less than power supply, so it will be the output.

D. (4 points) If Vs is changed to -2V, what will the output be?

**Will try to go to -22V, but that is beyond –Vcc, so will saturate at -15V.**

E.) (6 Points) What input resistance is seen by the voltage source Vs?

**No current flows in or out of the input of an op-amp, so **

4. (30 points total)

Given the circuit below, in which the switch has been closed for a long time and opens at t=0, answer the following questions:



A. (8 points) Sketch the circuit as it is behaving just before the switch opens. Be sure to label the inductor’s state variable:

**Power supply is connected and L is a short ckt.**

B. (4 points) Before the switch opens, how much current is flowing (down) through the inductor, iL?



C. (6 points) How much energy is stored in the inductor just as the switch opens?



D. (6 points) Immediately after the switch opens, sketch the relevant circuit (from the point of view of the inductor.)

**Power supply is removed, L and 100Ω resistor are left.**

E. (4 points) How long would I have to wait to make sure all transients from the switch have died away?



F. (4 points) A long time after the switch opens, sketch the relevant equivalent circuit (from the point of view of the inductor.)

**A 100Ω resistor and the L is again a short circuit.**