Physics 228 (Electronics) **Final Exam** June 29,1996

I- a) Sketch the digital signal waveforms corresponding to the binary numbers A = 1101, B = 1001 and their arithmetic sum A + B.

b) Compare the waveform of the sum to the output waveform of an ***AND*** gate with A and B as input signals.

II- a) Using only ***NAND*** gates, devise a circuit to perform ***OR*** logic.

b) Using only ***NOR*** gates, devise a circuit to perform ***AND*** logic.

III- What value should R be in Fig.1 (see last page) to set up a diode current of 0.25 mA?

IV- Figure 2 has these circuits values: V_s = 18 V, V_z = 10 V, R_s = 270 Ω, and R_L = 1k Ω.

(a) Is the zener diode operating in the breakdown region? (b) If so, what does the zener current equal?

V- (a) Determine the collecter-emitter voltage for the transistor in Fig.3.

(b) What advantage does such a circuit configuration present, as far as the transistor is concerned?

VI- The transistor switch circuit shown in Fig.4 is used to control the current through a relay coil. The relay coil has a resistance of 200 Ω and requires 20 mA to operate.

a) Does the transistor have to be in saturation to energize the relay coil? Explain.

b) If a +4-V signal at the control input is to turn the relay on, what current is drawn from the source ($V_{BE(on)}$ = 0.6 V)?

c) What is the minimum value of β that the transistor must have to operate the relay?

VII- Evaluate E_{out} in the circuit shown in Fig.5,as a function of time, for the marked values of circuit components.

VIII- Write the expression for the output voltage in terms of the input voltages for the circuit shown in Fig.6.

IX- What is the output voltage of the Op-Amp circuit in Fig.7?

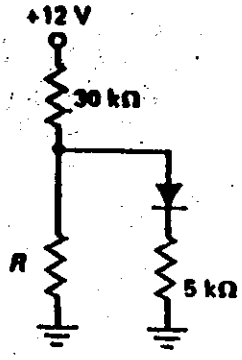

Fig. 1

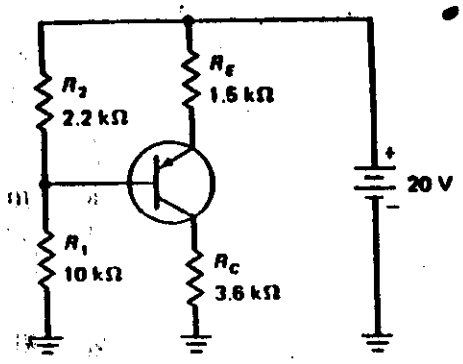

Fig. 3

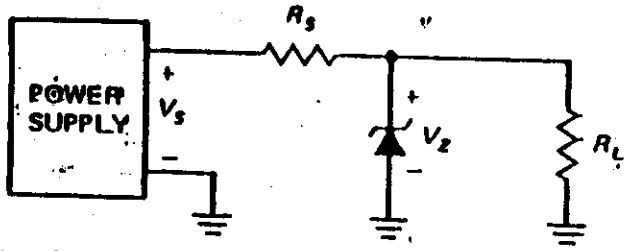

Fig. 2

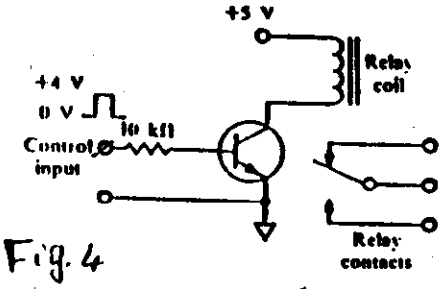

Fig. 4

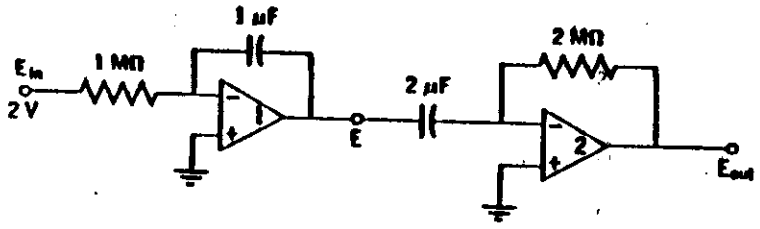

Fig. 5

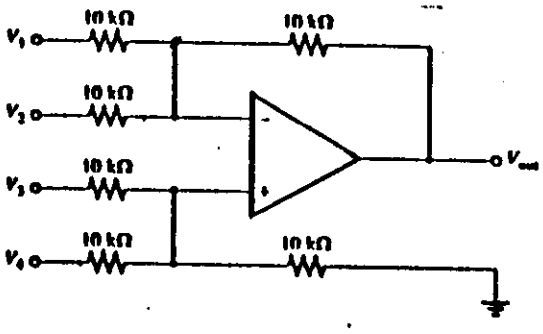

Fig. 6

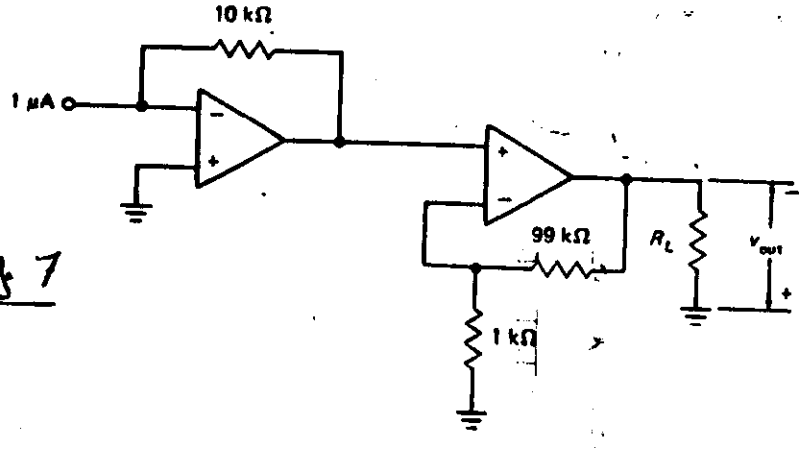

Fig. 7