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The Open University of Sri Lanka
B.Sc./B.Ed Degree Programme Level - 03
Final Examination – 2013/2014
PCU 1170 – Electronics for Biology Students
Duration : Two (2) hours

Date: 9th June 2014 **Time: 1.00 p.m.- 3.00 p.m**

Answer four(4) questions only

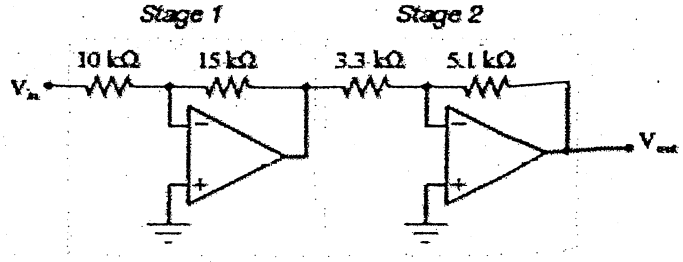
(1) a) Operational amplifiers (op-amps) are used in various circuits in electronics. Why is this device called op-amp?

b) Write down three ideal characteristics of an op-amp, except the infinite voltage gain.

c) An op-amp is powered with a dual dc. power supply (± 18 V). The higher voltage gain of this device causes problems when used in general purposes without the modification (feedback resistors). How do you depict this problem in a graph of output voltage against input voltage ?

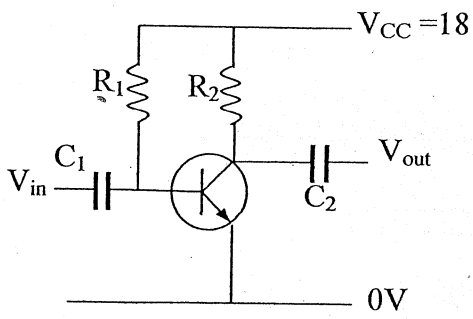
d) Use the two golden rules to derive the equation for the voltage gain of an inverting amplifier ; $\frac{V_{out}}{V_{in}} = -\frac{R_f}{R_{in}}$ where R_{in} and R_f are the values of resistors used at the input and feed back paths, respectively.

e) Calculate the voltage gain for each stage of the following amplifier circuit , then calculate the overall voltage gain.



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(2) The base-emitter voltage drop of the following NPN bipolar junction transistor is 0.7 V and the current gain is 150.



a) Explain briefly , the purpose of each component used in the circuit.

b) Redraw the above circuit diagram on your answer script and mark the directions of current flow in each path.

c) Find a suitable value for the resistor R_1 , if the base current is 35 μA.

d) Under the same condition, what would the current be through the resistor; R_2 ?

e) Then, if you want to maintain the output voltage as half of the supply voltage (18 V) calculate the value of R_2 ?

(3) Electrical bulbs made of high luminance LEDs are popular in Sri Lanka nowadays. A bulb consisted of five 1 W/ 9 V LEDs is sufficient to illuminate a bedroom.

a) Calculate the current drained by the bulb.

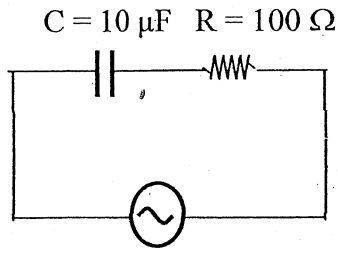
b) What are the components you need to construct a 9 V dc power supply starting from the 230 V/50 Hz main supply?

c) Draw the complete diagram of the above dc power supply circuit.

d) If the smoothing capacitor value is 100 μF, calculate the ripple voltage after connecting the bulb.

e) How do you modify the power supply to maintain a stable voltage (9 V) ?

(4) A capacitor (C) and a resistor (R) are connected in series with a signal generator, which produces sinusoidal voltage signal.



$I = 10x\ 10^{-3} \sin(5.3x\ 10^{-3}\ t)$ Amp

a) Find the impedance of each component and hence the total impedance of the above circuit.

b) Calculate the peak voltage across each component.

c) Draw the voltage variation pattern across each component on the same graph.

d) Find the suitable value for an inductor to maintain the impedance of the circuit as low as possible at the given frequency.

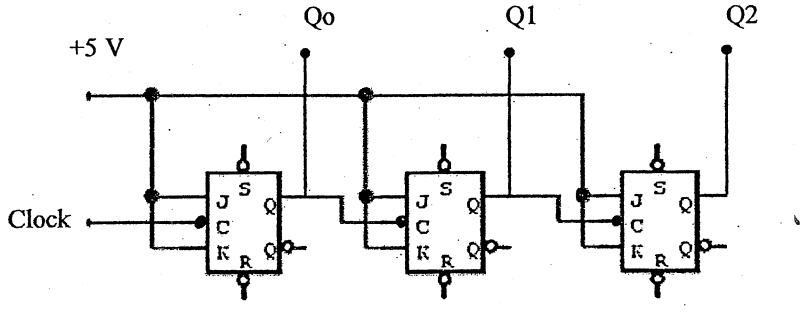
e) Calculate the new current signal in the circuit.

(5)

a) Explain the difference between combinational and sequential logic circuits.

b) Write down the truth table of a J-K Flip flop.

c) The following diagram shows a three bit ripple counter.

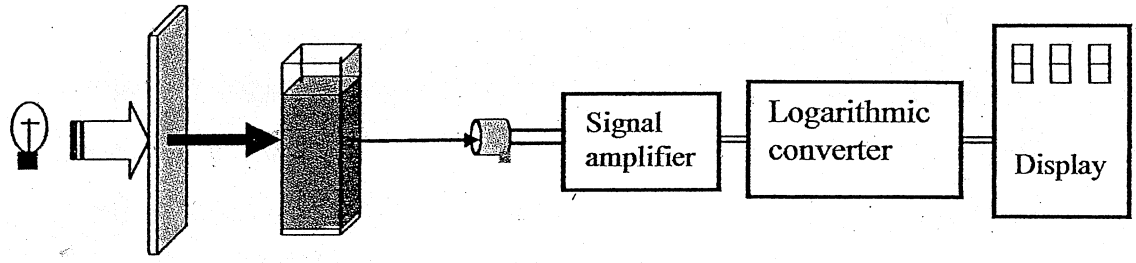


(3)

(i) If each J-K flip flop activates at the falling edge of the clock pulse, draw the waveform at each binary output ; Qo, Q1 and Q2 for seven clock pulses.

(ii) How do you modify this circuit to reset the output after 4 clock pulses ?

(6) Colorimeter is a analytical instrument to measure the concentration of solutions according to their color absorption.



a) Briefly explain the purpose of each component shown in the figure.

b) Write down the Beer-Lambert's law and describe the parameters you used.

c) Why is it important to have monochromatic radiation for accurate measurements

d) Draw a circuit diagram for a signal amplifier or for a logarithmic converter.

e) Propose a method to use as the black solution adjustment.

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