The Open University of Sri Lanka
B.Sc. Degree Programme – Level 04
Final Examination- 2010
PHU 2144/PHE 4144 - Practical Physics

Duration: Two and a Half ($2^1/_2$) Hours

Date: 16th December 2010 Time: 1.00 am – 3.30 pm

ANSWER FOUR QUESTIONS ONLY

1.(a) Draw circuit diagrams of half wave and full wave rectifier circuits (without the voltage smoothing and regulation) and plot the output voltage of each circuit for a sinusoidal input voltage.

(b) When a load resistor is connected across the output of the full wave rectifier circuit how do you connect an ammeter and a volt meter to measure current and voltage of the load resister?

(c) If you use a multimeter to measure the current in (b), do you expect the readings to be the same at *dc* and *ac* scales of the multimeter. Explain your answer by deriving expressions for *dc* and *ac* current of the above circuit. In your derivation assume that the current in the circuit is $I = I_0 \sin \omega t$ for a half cycle.

(d) How do you regulate the voltage of a full wave rectifier circuit with a capacitor? Show that the regulated voltage, $V_{dc} = V_m - \frac{I_{dc}}{4fC}$ for a full wave rectifier circuit with a capacitor filter of capacitance C, where f is the frequency of the *ac* signal and V_m maximum output voltage of the full wave rectifier circuit.

(e) How do you remove the ripple in the *dc* voltage of a full wave rectifier after connecting a capacitor filter? Suppose 12 V step down transformer is used to reduce the 230 V, 50 Hz main voltage. Find the ripple voltage of the full wave rectifier circuit with a capacitor of capacitance C = 1000 μF when the load draws 100 mA current from the circuit. Calculate the *dc* voltage of this circuit assuming 0.7 V drop across the rectifier diodes.

2.(a) Draw a circuit diagram of a LCR series circuit connected to a sinusoidal signal generator.

(b) If the current in the circuit is $I = I_0 \sin \omega t$, write down expressions for voltage across inductor, capacitor, and resistor of the above circuit.

(c) Draw the voltages across each element in a phasor (vector) diagram and find the resultant voltage of the circuit. Hence show that the total impedance of the circuit is, $Z = \sqrt{r^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$.

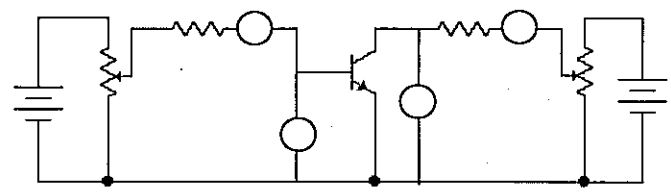
(d) What is the condition for resonance of this circuit? Show that this circuit resonates at the frequency $f_0 = \frac{1}{2\pi}\frac{1}{\sqrt{LC}}$ by applying the resonance condition.

(e) For a LCR series circuit consisting of L = 10 mH, C = 0.01 μF, R =100 Ω, a student recorded the following voltages across the resistor at different frequencies.

Voltage across Resistor mV	76	255	450	245	65
Frequency kHz	5.0	10.0	15.0	20.0	25.0

Plot a suitable graph and find out the resonance frequency of the circuit.

3.(a) A student wishes to construct the following circuit to study the input and output characteristics of a transistor. He is given a BC 547 transistor, two *dc* power supplies, resistors (150 Ω and 1 kΩ), micro ammeter, miliammeter, milivolt meter and a voltmeter. Label the diagram with these components.



(b) Briefly write down the experimental procedure to find out the input and output characteristics of the transistor.

(c) Plot the shape of the input characteristic curves that you obtain in this experiment when V_{CE} = 2.0 V and 4.0 V and output characteristics curves when I_B = 10 μA and 20 μA.

(d) Draw the *h* parameter equivalent circuit of an n-p-n transistor in common emitter configuration and derive expressions for the *h* parameters.

(e) Explain briefly, how you are going to calculate *h* parameters from the graphs potted in part (c)

4. You are provided with a CA 741 IC, 10 kΩ and 100 kΩ resistors, 10 kΩ variable resistor and a dual voltage power supply (-15 V/ 0 V/+15 V).

(a) Label the pin configuration of the CA 741 IC that comes as dual line integrated package.

(b) After supplying power to the above IC, you have observed that the output of this IC is not zero without any input voltage (i.e. connecting pin 2 and 3 to the ground). How do you correct this manufacturing error using the given components? Explain your answer with a help of a circuit diagram.

(c) Draw a circuit diagram of an inverting amplifier constructed using CA 741 IC.

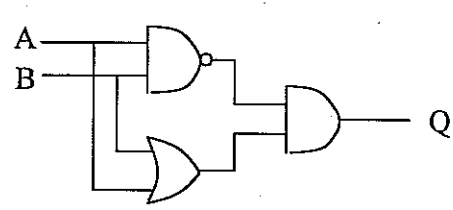
(d) Derive an expression for the output voltage of the above circuit stating the rules that you use in your derivation.

(e) How do you construct an inverting amplifier of voltage gain of 10 with the given components? Explain briefly, how you are going to show experimentally that the gain of your amplifier is 10 if you are provided a signal generator and a cathode ray oscilloscope?

5. (a) Draw the circuit symbols of all the logic gates used in digital electronics.

(b) Explain the difference between OR gate and XOR gate by drawing their truth tables.

(c) Write down an expression for output Q of the following circuit with the inputs A and B and draw the truth table for Q. Compare this truth table with the truth table of XOR gate.

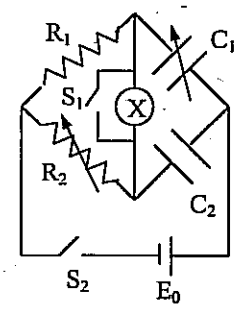


(d) How do you construct a half adder with AND gate and EOR gate.

(e) Construct a full adder circuit with two half adders and an OR gate.

6.(a) Briefly explain the difference between moving coil galvanometer and ballistic galvanometer.

(b) What is the instrument you use in the place of X in the following bridge circuit to find the capacitor C_2?



(c) If the current through a R-C circuit is given by $I = \frac{E}{R} e^{-t/RC}$, show that the $R_2 = \frac{R_1}{C_2} C_1$ at the balance condition of the above circuit.

(d) Write down the experimental procedure to determine the unknown capacitor C_2 of the above figure.

(e) A student collected the following data by conducting this experiment. Draw a suitable graph and find out the unknown capacitor.

C_1	0.02 μF	0.04 μF	0.06 μF	0.08 μF	0.1 μF
R_2	1000 Ω	1980 Ω	3015 Ω	4018 Ω	5012 Ω