The Open University of Sri Lanka
B.Sc./ B.Ed Degree Programme Level 05
Final Examination - 2016/2017
PCU 3170 – Electronics for Biology Students
Duration : Two (2) hours

Date: 23rd July 2017   Time : 1.00 pm - 3.00 pm

Answer four (4) questions only

(1) Electrical power is the energy source for any electronic circuit. DC voltage power supply is used to provide this power in most of the electronic circuits.

(i) Name the stages ; (P), (Q) , (R) and (S) of the following block diagram which can be used to convert the AC voltage signal into a regulated DC voltage signal.
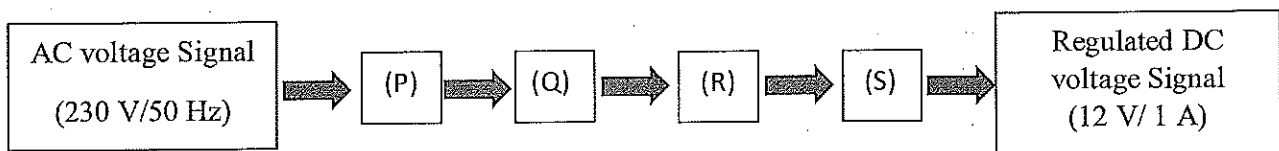
(ii) Draw the complete diagram of the above circuit, clearly indicating the stages; (P), (Q) , (R) and (S).

(iii) The AC voltage signal of the above circuit is given bellow.
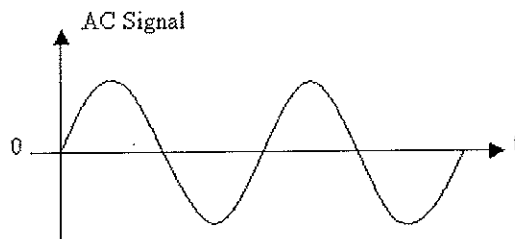
Redraw this on your answer script and sketch the voltage signal pattern just after each stage.

(iv) The output of the above DC power supply is connected with an LED (2.3 V/ 40 mA). What is the additional component and its value needed for this circuit?

(v) If a series of LEDS are directly connected with the above AC voltage signal (230 V/50 Hz) to illuminate a room, give an advantage and a disadvantage, compared to a tungsten filament bulb.

(2) The following figure shows an alternative current circuit consisted of an AC voltage source ; V, an inductor ;L (100 mH) and a resistor ; R (120 Ω) .
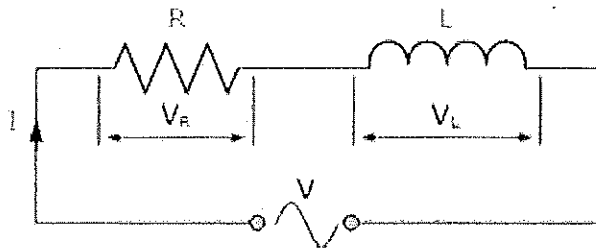

(i) What is the impedance of each component given in the circuit ?

(ii) If the current passing through the circuit is given by $I = 100\ cos(1600t)$ mA, What are the peak voltages across each component ?

(iii) Draw the voltage pattern with time across each component (V_R and V_L) compared to the phase of current.

(iv) Calculate the magnitude of the total impedance of the circuit and give the phase of it with respect to the phase of current.

(v) Why can not this circuit be used as a resonant circuit ?

(vi) Explain how the voltage across the inductor can be used to filter the voltage signal with high frequencies .

(3) Bipolar junction transistors are made up of P and N type semiconductor materials.

(i) Draw the atomic arrangement in any P and N type semiconductor material.

(ii) Draw the I-V characteristic curve of forward and reverse biased PN junction diode.

(iii) The following diagram shows a single stage transistor amplifier circuit.
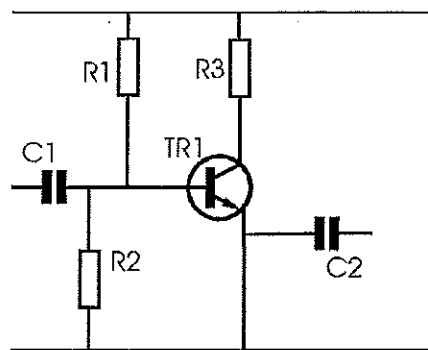
This circuit is activated with a dc power supply of 12 V. The base- emitter voltage of the transistor is 0.7 V and the base current ; I_B= 30 μA .

(iv) Considering the current through R1 and R2 are equivale and R1= 10 kΩ, find the value of R2.

(v) If the current gain of the transistor is 120, calculate the current through the resistor R3.

(vi) What is the purpose of having C1 and C2 capacitors in this circuit ?

(vii) Explain the effect on linear current amplification of the above circuit for a higher resistor value at R3 (or lower voltage across collector -Emitter).

(4) (i) Write down the golden rules for operational amplifiers.

(ii) Why it is necessary to use a negative feedback path in a general purpose operational amplifier circuit ?

(iii) Draw the circuit diagram of an inverting amplifier circuit and derive the equation for the voltage gain using the values of resistors you used.

(iv) Give an advantage of a non-inverting amplifier arrangement compared to an inverting amplifier considering the input impedance.

(v) In a colorimeter a photodiode is used with an opamp to measure the transmitted radiation. Why it is more suitable compared to the following arrangement
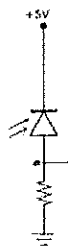
(5)

(i) What is the main difference between a combinational and a sequential logic circuit ?

(ii) Comparing the truth tables of OR gate and Ex-OR gate ,explain the output of an Ex-OR gate is the addition of single bit -two binary numbers.

(iii) Give the combinational logic circuit to add single bit- two binary numbers to produce the sum and carrier at the output.

(iv) Extend your circuit for a full adder circuit.

(v) An air conditioner in a room is automatically operated when the following conditions are satisfied.

(a) the temperature in the room is higher than a particular value (T1) and

(b) the door is closed

Suggest a circuit diagram for the above purpose using logic gates and other necessary components.

(6) (i) write down short notes on the following .

(a) Positive voltage clipping circuit

(b) Low pass filter circuit

(c) colorimeter

(ii) Name and give diagrams for an electronic component or a circuit for each of the following

(a) to measure the light intensity

(b) to store electrical chargers

(c) to increase the output impedance of an audio amplifier without changing the voltage amplification.

(iii) Explain how the Thevenin's theorem is used to simplify a voltage resistor network.