The Open University of Sri Lanka
B.Sc. Degree Programme -Level 05- 2023/2024
Final Examination
Electronics for Biology Students- PHU5318
Duration : Two (2) hours

Date : 14th October 2023 **Time: 9.30 a.m to 11.30 a.m**

Answer four (4) questions

(1) The radiation emission spectrum of a tungsten filament bulb is more colourful than a LED but LED is more efficient. A 12 W/ 36 V LED is enough to illuminate a normal bedroom.

(i) Calculate the current drained by such a bulb.

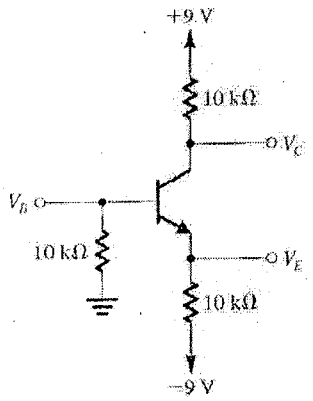
(ii) A dc power supply is constructed starting from 230 V/50 Hz main supply and using a bridge rectifier , 1000 μF capacitor . Calculate the ripple voltage when the above current is drained .

(iii) If the peak voltage of the power supply with the ripple is 42 V, draw the voltage vs time graph indicating the ripple voltage and peak voltage.

(iv) Draw the circuit diagram of the above circuit indicating the ratio of number of turns in input and output coils of the transformer and their current ratings of the coils (Hint: consider the peak voltage of the input voltage signal of 230 V).

(v) How do you modify the above power supply to maintain a stable voltage 36 V at the output? Modify the same diagram given in question (IV).

(2) The following figure shows a correctly biased npn transistor circuit.



(i)Redraw the above circuit on your answer scrip and mark the directions of current at the each terminal of the transistor (I_B, I_E and I_C)

(ii)If the voltage at the base (V_B) is -1.5 V, calculate the current through the Base (I_B- Hint: apply the ohms law across the resistor connected to the Base).

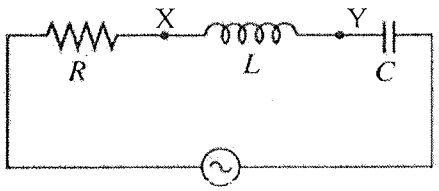
(iii)What would be the voltage at the Emitter (V_E) to maintain the Base-Emitter voltage (V_{BE}) as 0.7 V ?

(iv) Calculate the Emitter current (I_E) , considering the current through the resistor connected to the Emitter,

(v) Considering the currents I_B and I_E calculate I_C.

(vi) What is the current gain of the transistor (β)?

(3) Following diagram shows a LCR circuit connected to a signal generator , where R = 50 Ω , L = 100 mH and C = 10 μF.



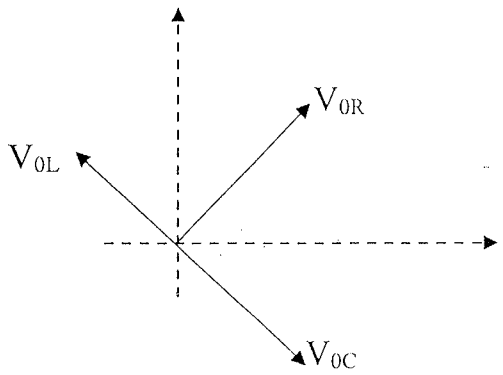
(i) If the frequency of the generator is 1400 Hz, calculate the total impedance of the circuit.

(ii) When the voltage is measured across the resistor using a digital multimeter (ac mode; $V_{rms} = V_o/\sqrt{2}$) , it is displayed as 8.2 mV ,

(a) What would be the peak voltage(V_{0R}) across the resistor and the peak current through the circuit ?

(b) Calculate the peak voltages across the other components (L and C).

(iii) The following figure shows the phasor diagram of voltages across each L, C and R component.



If the same multimeter is connected across L-C components (X and Y points)to measure the voltage,

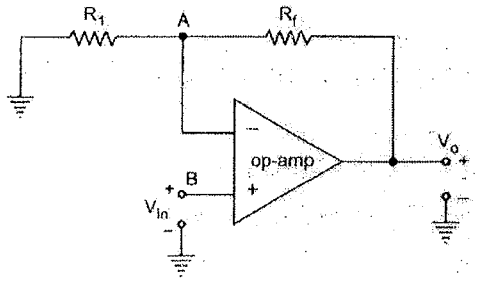
(a) What would be the voltage reding of the multimeter ?

(b) If the frequency of the generator changes from lower to higher values , then sketch the graph for the multimeter readings (voltage vs frequency).

(c) At which value of the frequency, the voltage becomes zero ?

(4) (i) What are the two golden rules for operational amplifiers which are in closed loop arrangements ?

(ii) The following diagram shows the non-inverting arrangement of an operational amplifier.



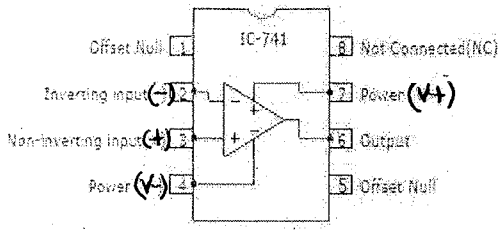
Derive the equation for the output voltage for the above circuit.

(iii) A sinusoidal voltage signal with 0.1 V amplitude is connected to the input of the above circuit, where R_1 = 1 kΩ and R_f = 100 kΩ. If the op amp is activated with a ± 12 V dual power supply , sketch the input and output signals on the same voltage -time graph.

(iv) If the amplitude of input signal is doubled , then sketch the output signal on the same graph.

(v) Draw a circuit diagram modifying the above amplifier to use in a radio which has the volume controlling facility.

(vi) Draw a non-inverting amplifier circuit showing the components and instruments connecting to the following diagram to compare the input and output voltage signals .

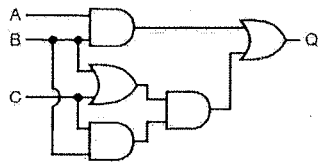


Op-Amp IC 741 Pin Diagram

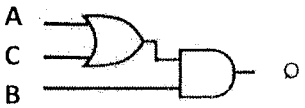
(5) (i) Write down the two Boolean expressions of the De Morgen theorem.

(ii) For one of the above Boolean expressions, construct two combinational logic circuits for the both sides of the expression. Using their truth tables , very the selected expression of the theorem.

(iii) Write down the Boolean expression for the output of the following combinational logic circuit.



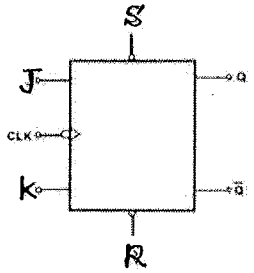
(iv)Simplifying the Boolean expression of the above logic circuit and show that it can be simplified to the following .



(v) Draw the half adder circuit with logic gates and then extend it into a full adder.

(6) (i) What is the difference between a positive-edged-triggered and a negative-edged-triggered J-K Flip-Flops ?

(ii) Following figure shows the symbol of a negative-edged-triggered J-K Flip-Flop .



This flip flop is active when S = R = 5 V . If S = 0 V then the output (Q) goes to 5 V (Set to logic 1) and if R = 0 V then the output (Q) goes to 0 V (Reset to logic 0) . Give the truth table of it when S= R= 5 V

(iii)Connect 4 flip-flops to construct an up counter (All the input pins should be connected to required voltages)

(iv) Draw a timing diagram for the Q output of the 2nd flip-flop (which represents the 2^1 digit of the output number) for 12 CLK pulses.

(v) Modify your diagram given in question (a) to reset all the outputs after 13 CLk pulses.