GLASGOW COLLEGE UESTC

Exam paper

Circuits Analysis and Design (UESTC 2022)

Date: 6th Jan. 2020
Time: 09:30-11:30am

Attempt all PARTS. Total 100 marks

Use one answer sheet for each of the questions in this exam.
Show all work on the answer sheet.
For Multiple Choice Questions, use the dedicated answer sheet provided.

Make sure that your University of Glasgow and UESTC Student Identification Numbers are on all answer sheets.

An electronic calculator may be used provided that it does not allow text storage or display, or graphical display.

All graphs should be clearly labelled and sufficiently large so that all elements are easy to read.

The numbers in square brackets in the right-hand margin indicate the marks allotted to the part of the question against which the mark is shown. These marks are for guidance only.

Attempt all PARTS

Q1 Choose a single answer to each of the following Multiple Choice Questions in the answer sheet provided. Make sure that you provide your answers in the answer sheet, not on this paper.

(1) The work to do per unit of charge in order to move this from one point to another in the presence of an electric field is the definition of: [2]

A. Power
B. Electric charge
C. Current
D. Voltage
E. None of the above

(2) A circuit has two resistors and a voltage source connected in series. If I = 2 mA, R_1 = 2 kΩ and R_2 = 3 kΩ, value of V_1 i.e. voltage drop across resistor 1 would be: [2]

A. 1 V
B. 2 V
C. 3 V
D. 4 V
E. 2 W

(3) An AC signal having a time period of 1 ms has a corresponding angular frequency of? [2]

A. 6283 rad/s
B. 628 rad/s
C. 6283 Hz
D. 628 Hz
E. None of these answers

(4) A mesh is a loop that does not contain [2]

A. A node inside it
B. Another loop inside it
C. A voltage source
D. A current source
E. None of these answers

(5) The capacitor acts as _____ circuit for a dc voltage. [2]

A. Short
B. Open
C. Low pass filter
D. High pass filter
E. None of these answers

(6) If terminals *a* and *b* are short-circuit, the Thévenin equivalent resistance is given by: [2]

A. $R_{th} = V_{oc}/I_{sc}$
B. $R_{th} = V_{sc}/I_{oc}$
C. $R_{th} = V_{oc}/I_{oc}$
D. $R_{th} = V_{sc}/I_{sc}$
E. None of these answers

(7) Three capacitors with capacitance values of C_1 = 0.1 μF, C_2 = 0.22 μF, and C_3 = 0.47 μF are connected in series. The equivalent capacitance value is: [2]

A. 0.06 μF
B. 0.6 μF
C. 6 μF
D. 60 μF
E. None of these answers

(8) In practical filters, the gain in the stopband cannot be ____ for all frequencies. [2]

A. Same
B. Different
C. Zero
D. ∞
E. None of these answers

(9) An operational amplifier (commonly called OP-AMP) is a device that can be used to perform: (choose the answer that covers most of the OP-AMP's abilities) [2]

A. Addition
B. Addition, amplification
C. Addition, amplification, integration
D. Addition, amplification, integration, differentiation
E. None of the above

(10) In the following circuit, the resistor is R = 3 kΩ and the capacitor is C = 0.5 μF, what is the value of the time constant for this RC circuit?

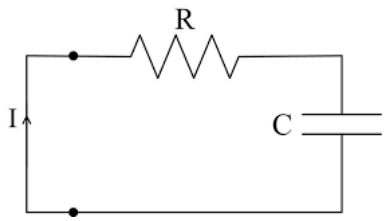

Figure 1

[4]

A. 0.0015 s
B. 0.015 s
C. 0.006 s
D. 0.06 s
E. None of these answers

(11) In the ideal op amp model shown below, assuming infinite input resistance, zero output resistance and large gain. Then, the current flowing into (or out of) the two input terminals is zero. The voltage at the negative input terminal is _____ the voltage at the positive input terminal. This is called virtual short.

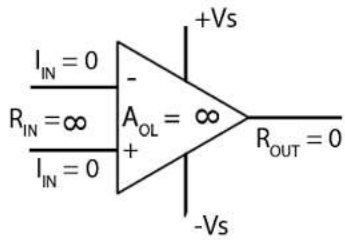

Figure 2

[3]

A. Greater than
B. Less than
C. Equal to
D. Zero
E. None of these answers

Q2 Let R = 2 kΩ, L = 50 mH, and C = 0.01 μF for the circuit given in Figure 3.

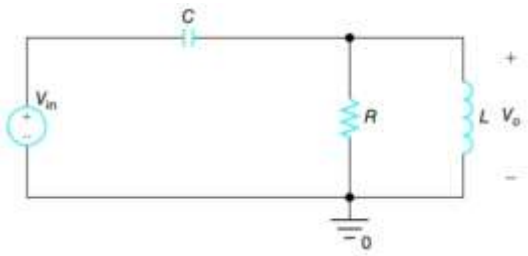

Figure 3

A. Find the transfer function H(s). [10]

B. Find ω_o. [3]

C. Find Q. [3]

D. Find the 3-dB cut-off frequency. [3]

E. Plot the magnitude response and phase response in linear scale. [6]

Q3 For the circuit shown in Figure 4:

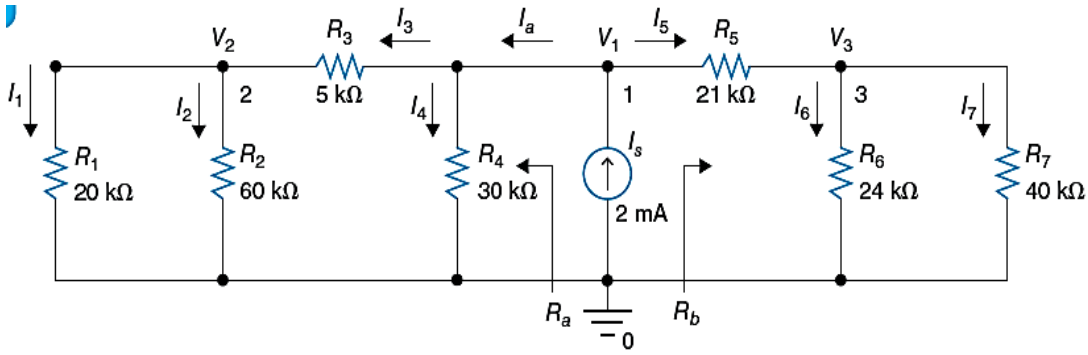

Figure 4

A. Calculate the equivalent resistance R_a and R_b. [8]

B. Calculate the current I_3 and I_4 using KCL. [4]

C. Voltage across R_4. [3]

D. Apply current divider rule to find I_1, I_2, I_5, I_6, I_7 [6]

E. Calculate voltage V_3 and V_2. [4]

Q4 Switch 1 in the circuit shown in Figure 5 has been closed for a long time before it is opened at $t = 0$. Switch 2 is closed at $t = 4$ ms.

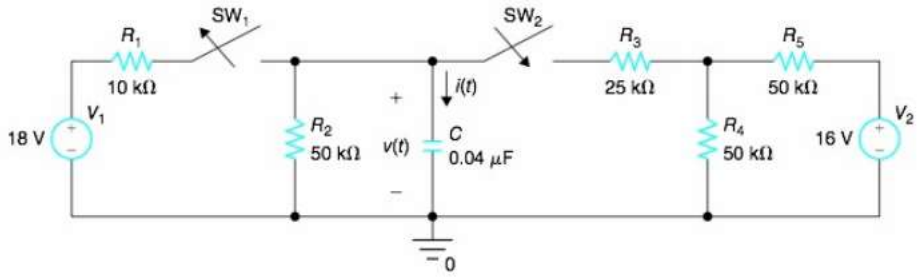

Figure 5

A. Find the initial voltage V0 across the capacitor at $t = 0$. [5]

B. Find voltage v(t) across the capacitor for $0 \leq t < 4$ ms. [5]

C. Find voltage v(t) across the capacitor for $t \geq 4$ ms. [10]

D. Plot v(t) for $0 \leq t < 10$ ms. [5]

End of question paper