EXAM

1TE717 Digital Technologies and Electronics
Faculty of Electrical Engineering

2022–10–27, 14:00–19:00

Location: Råbyvägen 95, sal 1

Aids:

- Mathematics and / or Physics handbook
- Two A4 papers (front and back, total 4 pages) with handwritten formulas or notes.
- A non-programmable scientific calculator (e.g. TI-83 and similar)

Observe: Do not treat more than one problem on each page.
Each step in your solutions must be motivated.
Lacking motivation will results in point deductions.
Write a clear answer to each question and clearly indicate which formulas are used.
Mark the total number of pages on the cover or first page
Mention the anonymous exam code on the top of the first page

The exam consists of 5 questions, for a total of 50 points. The points for each problem are also indicated.

Passing Grade: To pass the course, you need to successfully attain the learning goals of the course. This means that you would pass the exam if you obtain **at least 50%** of the combined total points of the final written exam and the assignment. Weight of the Exam = 75% and weight of the assignment = 25%.

Responsible: Arunava Naha, mobile phone: 0764552158.

Good Luck!

Total Points: 50

1

1.a What is the equivalent resistance between points A and B of the circuit shown below.

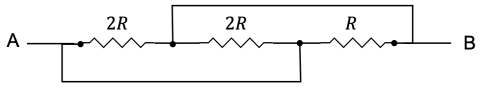

Figure 1: Circuit for Question 1.a.

(1.a: 2 pt)

1.b The switch SW shown in the following circuit is kept at position '1' for a long duration. At $t = 0^+$, The switch is moved to position '2'. Assuming $|V_{02}| > |V_{01}|$, derive the expression of the the voltage $V_c(t)$ across the capacitor. Here $|\cdot|$ denotes the absolute value.

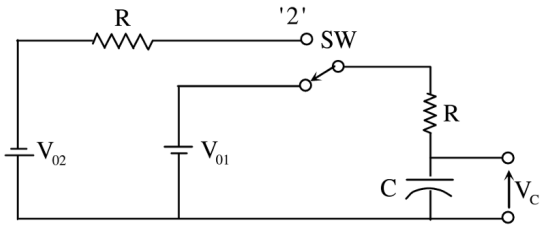

Figure 2: Circuit for Question 1.b.

(1.b: 3 pt)

1.c In the circuit shown below, find the potential difference across the capacitor at the steady state.

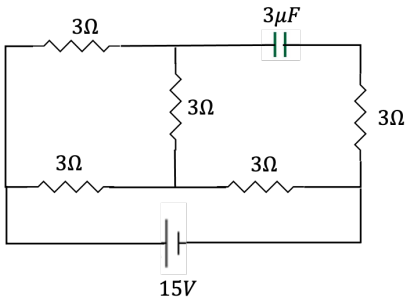

Figure 3: Circuit for Question 1.c.

(1.c: 3 pt)

1.d Determine the node voltages $v1$, $v2$ and $v3$ of the circuit shown below.

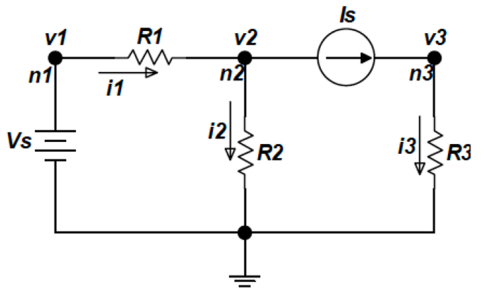

Figure 4: Circuit for Question 1.d.

(1.d: 2 pt)

(Sub-Total Question 1: 10 pt)

2

2.a Derive the expression of the output voltage v_o of the circuit shown below. The Op-Amp shown in figure is ideal.

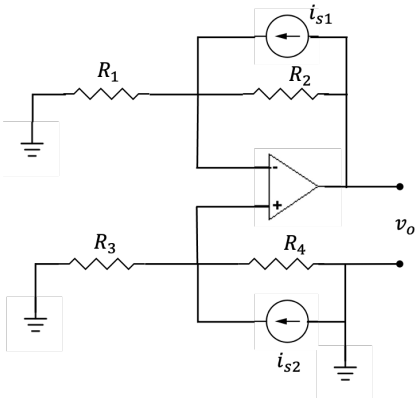

Figure 5: Circuit for Question 2.a.

(2.a: 7 pt)

2.b For the ideal Op-Amp shown below, what should be the value of resistor R_f to obtain a gain of 5, i.e., $\frac{v_o}{v_i} = 5$?

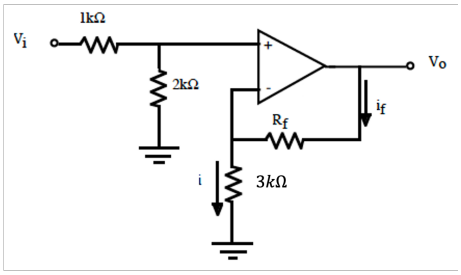

Figure 6: Circuit for Question 2.b.

(2.b: 3 pt)

(Sub-Total Question 2: 10 pt)

3

3.a For the circuit shown below, draw input-output plot. A hand sketch of the plot with clearly written coordinates of the important points on the plot should be sufficient. Assume the forward voltage drop across the diode is 0.7V.

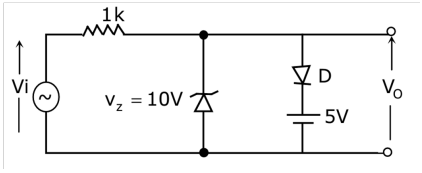

Figure 7: Circuit for Question 3.a.

(3.a: 3 pt)

3.b Find the value of the collector current in the circuit shown below. $V_{BE_{ON}} = 0.7V$ and $\beta = 80$.

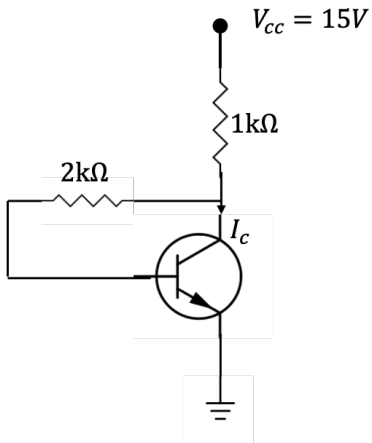

Figure 8: Circuit for Question 3.b.

(3.b: 3 pt)

3.c For the circuit shown below, find the value of V_{BB} that just puts the transistor into saturation. $\beta = 200$.

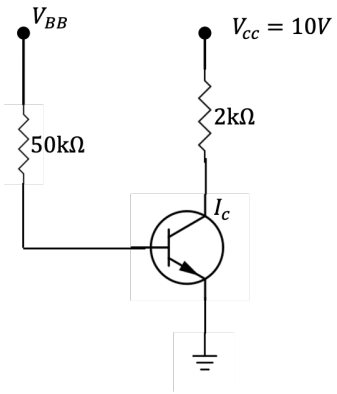

Figure 9: Circuit for Question 3.c.

(3.c: 4 pt)

(Sub-Total Question 3: 10 pt)

4

4.a Consider the sequential circuit shown below. Fill in the waveform for output in the timing diagram.

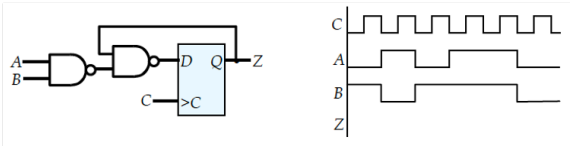

Figure 10: Circuit for Question 4.a.

(4.a: 2 pt)

4.b Simplify the following logic expression and draw a schematic for the circuit that implements the simplified expression.

$$Y = A + B^{'}C + A(B + C^{'})$$

(4.b: 1 pt)

4.c The sum of products form (SOP) of a Boolean function is $\Sigma(0, 1, 3, 7, 11)$, where inputs are A, B, C, and D (A is MSB and D is LSB). Find the equivalent minimized expression of the function in SOP form. Convert the SOP into equivalent POS form.

(4.d: 3 pt)

4.d Draw a schematic of a sequential circuit, which implements the system shown in the below state-flow diagram. Use as less number of components as possible for your design. Nodes a, b, c, and d denote 4 states.

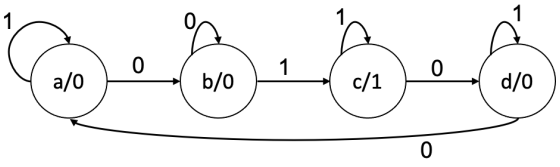

Figure 11: Circuit for Question 4.d.

(4.d: 4 pt)

(Sub-Total Question 4: 10 pt)

5

5.a Find the voltage drop across 2Ω resistor in the network shown below.

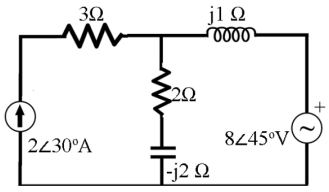

Figure 12: Circuit for Question 5.a.

(5.a: 3 pt)

5.b Find the peak value of the current $i(t)$ in the circuit given below.

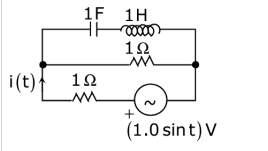

Figure 13: Circuit for Question 5.b.

(5.b: 2 pt)

5.c Find the value of the voltage V_{ab} in the circuit shown below.

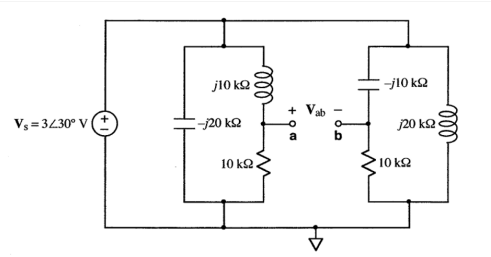

Figure 14: Circuit for Question 5.c.

(5.c: 5 pt)

(Sub-Total Question 5: 10 pt)

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