Adama Science and Technology University
School of Electrical Engineering and Computing
Electrical Power and Control Engineering

Final Exam for Electrical Engineering and Computing

2nd Year students

Course Name: Fundamentals of Electrical Engineering
Year: II

Course code: EPCE2101
Time Allotted: 3:00 Hrs
Date of Exam: Apr 13th, 2022

Name: _____

I.D: _____

Group: _____

Instructions!!

- Make sure that the Exam has **3 Parts and 13 Questions.**
- Possession of any kind of Cellphone/Tablet during exam is strictly forbidden.
- Solutions/Answers to questions should be **clear** and **to the point**.
- **Unclear/Unreadable answers will be considered as wrong answers.**

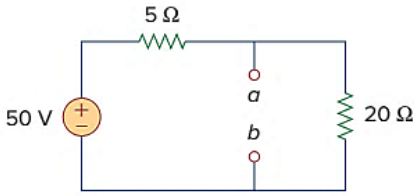
For Instructors Use Only!

Question Category	Part-I	Part-II (10%)				Part-III (20%)				
Question #	(6%)	1	2	3	4	1	2	3	4	Total
Marks Allotted	6 %	2.5%	2%	2.5%	3%	6%	6%	6%	6%	40%
Marks Obtained										

Good Luck!!

PART I. Choose the BEST answer among the given alternatives **[6 Pts]**

1. The Thevenin resistance at terminals a and b is:



A) 5 Ω **B) 25 Ω** **C) 4 Ω** **D) 15 Ω**

2. When the voltage across a **Capacitor** is **doubled**, the energy stored is:

A) The same **B) Quadrupled** **C) Halved** **D) Doubled**

3. If $\mathbf{v_1=30Sin(\omega t + 10°)}$ and $\mathbf{v_2=-20Cos(\omega t+50°)}$, which of these statements is true?

A) $\mathbf{v_1}$ **leads** $\mathbf{v_2}$ **by 130°** **B)** $\mathbf{v_1}$ **and** $\mathbf{v_2}$ **are in phase**
C) $\mathbf{v_1}$ **lags** $\mathbf{v_2}$ **by 130°** **D) None**

PART II. Answer the following questions precisely **[10 Pts]**

1. What is Superposition Principle? **[2.5 Pts]**
2. What is Step Response? **[2 Pts]**
3. Define the following terms? **[2.5 Pts]**

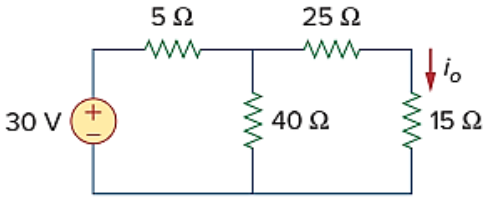
A) Impedance **B)** Admittance **C)** Conductance
D) Reactance **E)** Susceptance

4. Plot the phasor diagrams of voltage and current in: **[3 Pts]**

a) Resistors **b)** Capacitors **c)** Inductors

PART III. Workout the following questions by showing all the necessary steps **[24 Pts]**

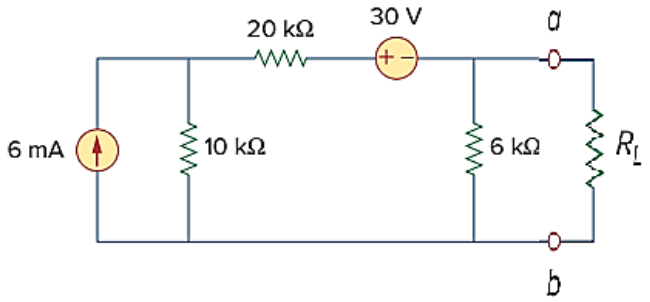
1. For the following linear circuit below. **[6 Pts]**



a. Calculate the current $\mathbf{i_o}$?

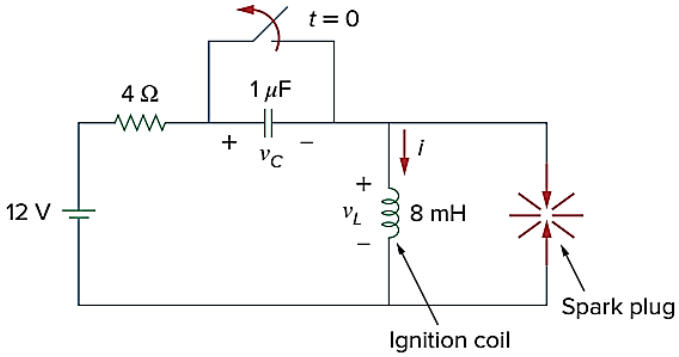
b. What value of input voltage is necessary to make $\mathbf{i_o = 5A}$?

2. For the circuit shown below: **[6 Pts]**



a. Find the **Thevenin equivalent** circuit with respect to terminals **a-b?**
b. Find the **Norton equivalent** circuit using **Source transformation**?
c. If $\mathbf{R_L = 6\Omega}$ then find the voltage drop across $\mathbf{R_L}$?
d. Find the value of $\mathbf{R_L}$ for maximum power transfer?
e. Find the **maximum power** transferred?

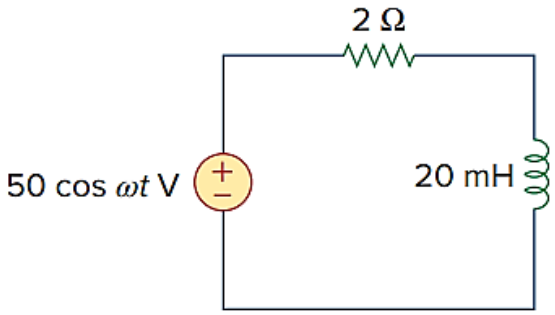
3. From an Automobile Ignition System, we consider the voltage generating system. The system is modeled by the circuit shown in the figure below. The **12-V** source is due to the battery and alternator. The **4-Ω** resistor represents the resistance of the wiring. The ignition coil is modeled by the 8-mH inductor. The 1-μF capacitor (known as the condenser to auto-mechanics) is in parallel with the switch (known as the breaking points or electronic ignition which **opens at t=0s**). **[6 Pts]**



Thus,

a) Determine the voltage drop $\boldsymbol{V_L(t)}$ across the Ignition coil to create spark.
b) Determine the voltage drop across the Capacitor $\boldsymbol{V_C(t)}$ and Resistor model $\boldsymbol{V_R(t)}$

4. For the RL circuit given below: **[6 Pts]**



a. Find the Total impedance ($\mathbf{Z_T}$) of the circuit?
b. Find the Total Current ($\mathbf{I_T}$) of the circuit?
c. Find the voltage drop across the **Inductor** $\boldsymbol{V_L(t)}$ and **Resistor** $\boldsymbol{V_R(t)}$?
d. Plot the Impedance phasor diagram ($\mathbf{Z_T}$, $\mathbf{Z_R}$ and $\mathbf{Z_C}$)
e. Plot the Phasor diagram for Supply voltage ($\mathbf{V_S}$), and the Total current ($\mathbf{I_T}$)