Index Number: UE 20016516 Programme: BSc. Comp. ENG.

UNIVERSITY OF ENERGY AND NATURAL RESOURCES, SUNYANI, GHANA
SCHOOL OF ENGINEERING
DEPARTMENT OF COMPUTER AND ELECTRICAL ENGINEERING
LEVEL 200 - END OF FIRST SEMESTER EXAMINATION, 2017/2018
Bachelor of Science (Electrical and Electronics Engineering)
Bachelor of Science (Computer Engineering)
Bachelor of Science (Renewable Energy Engineering)

CENG 201: ELECTRIC CIRCUIT DESIGN

December, 2017 **Time Duration: 2 Hrs: 30 mins**

Material required: *Non-programmable calculator, pencil, pen, eraser, and ruler*

Instructions: ***The paper consist of FIVE questions, answer ANY THREE questions out of the five. Each question carries 20 marks.***

QUESTION ONE

A. The sinusoidal voltage source in the circuit in Fig. 1 is developing a voltage equal to $50\sin 400t$ V.

i. Find the Thévenin's voltage with respect to the terminals *a-b*.

ii. Find the Thévenin's impedance with respect to the terminals *a-b*.

iii. Draw the Thévenin's equivalent circuit.

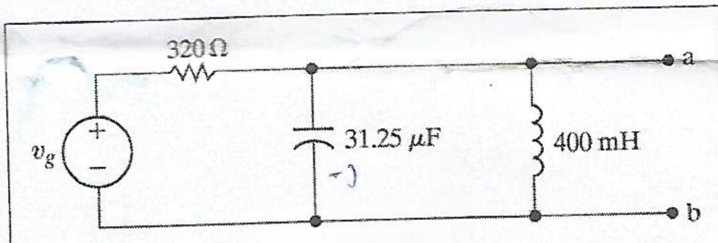

Fig. 1

B. The op-amp in the Fig. 2 is ideal.

i. Find v_o if $v_a = 3\text{V}$, $v_b = 9\text{V}$, $v_c = 5\text{V}$, and $v_d = 6\text{V}$

ii. Assume v_a, v_b, and v_d retain their values as given in (i). Specify range of v_c such that the op-amp operates within its linear region

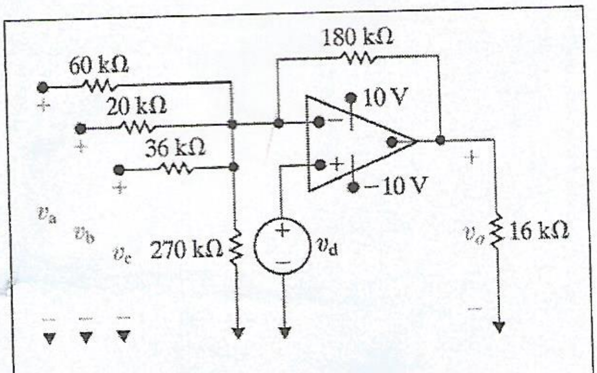

Fig. 2

S. T. Koduah
S. Osei Fobi

Index Number: ______________________ **Programme:** ______________________

QUESTION TWO

A. Z-parameters of the two-port network N in Fig. 3 are $Z_{11} = 4s$, $Z_{12} = Z_{21} = 3s$, and $Z_{22} = 9s$, find input current i_1 for $v_s = \cos 1000t$ V.

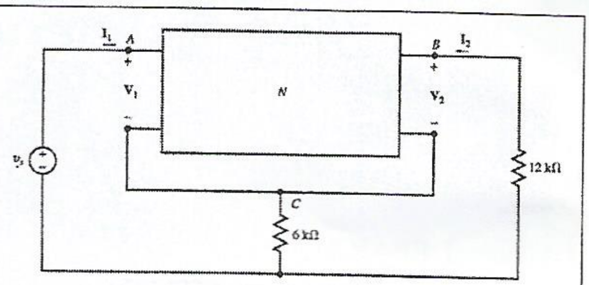

Fig. 3

B. The circuit in Fig. 4 has resistor R_l, connected in series with the inductor to form a filter.

i. What type of filter is this?

ii. Derive the transfer expression of the circuit

iii. At what frequency will the magnitude of the transfer function be maximum?

iv. What is the maximum value of the magnitude of the transfer function?

High pass.

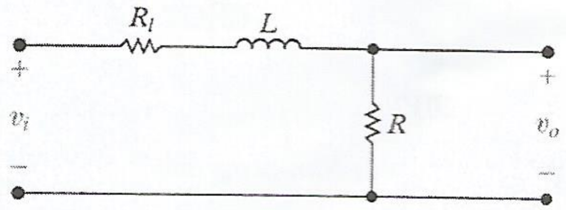

Fig. 4

QUESTION THREE

A. In Fig. 5, find:

(a) The Z-parameters of the circuit.

(b) an equivalent model which uses three positive-valued resistors and one dependent voltage source.

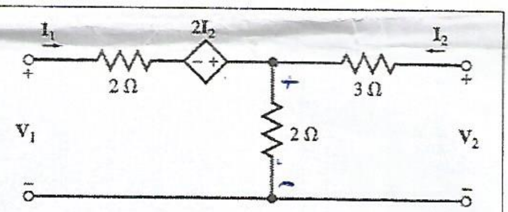

Fig. 5

B. Use node voltage method to find the steady-state expression for i_o, in the circuit seen in Fig. 6 if

$i_g = 5\cos 2500t$ A and $v_g = 20\cos\left(2500t + 90^\circ\right)$ V.

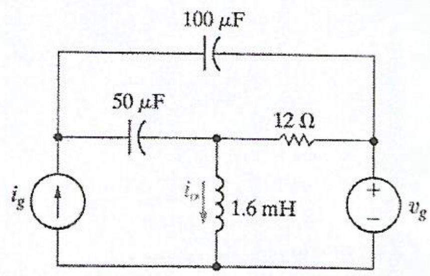

Fig. 6

S. T. Koduah
S. Osei Fobi

Index Number: ______________________ **Programme:** ______________________

QUESTION FOUR

A. The circuit shown in Fig. 7a can be reduced to the circuit shown in Fig. 7b, using source transformations and equivalent resistances. Determine the values of the source current i_{sc} and the resistance R.

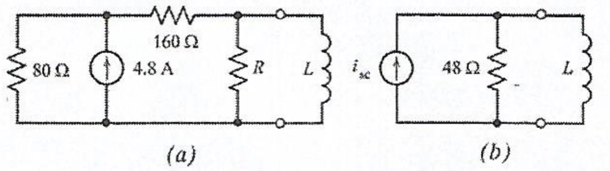

Fig. 7

354

B. Using the circuit in Fig. 8
   i. Express the voltage $V(s)$ of the circuit in Fig in the s-domain if $v(0^+) = 0$ V.
   ii. From the results obtained in (i), find the voltage $v(t)$ of the circuit.

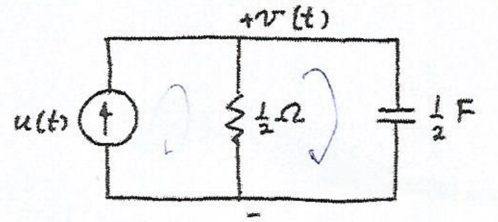

Fig. 8

QUESTION FIVE

A. For the circuit in Fig. 9, find and using nodal analysis. find V_1 V_2 V_o

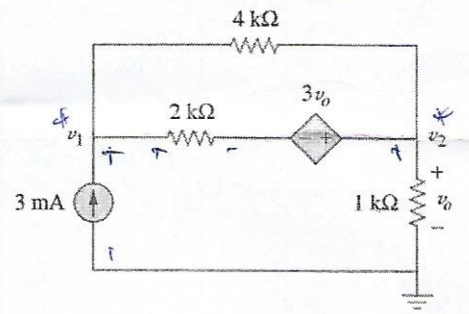

Fig. 9

B. In the circuit shown in Fig. 10, the initial currents in inductors L_1 and L_2 have been established by sources not shown. The switch is opened at $t = 0$.
   i. Find i_1, i_2, and i_3 for $t \geq 0$.
   ii. Calculate the initial energy stored in the parallel inductors.
   iii. Determine how much energy is stored in the inductors as $t \to \infty$.
   iv. Show that the total energy delivered to the resistive network equals the difference between the results obtained in (ii) and (iii).

$2i_2$

$i_2 - 2i = 0$

$= 0$

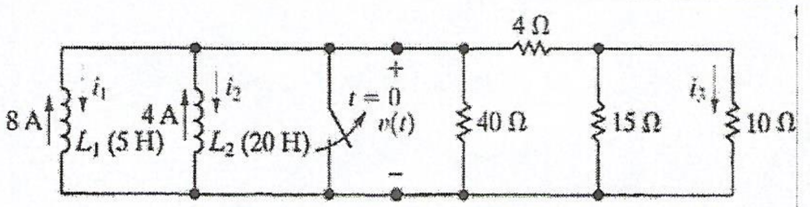

Fig. 10

$1 \pm \sqrt{2}$ $\quad 1 - \sqrt{2}$

$$\frac{2s + 1 - s^2}{2s^2 + s}$$

S. T. Koduah
S. Osei Fobi