2016/2017 HARMATTAN SEMESTER EXAMINATIONS

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

GET 201: APPLIED ELECTRICITY I

SATURDAY, DECEMBER 17, 2016

EXAMINATION TIME: 12:00pm – 02:30pm **TIME ALLOWED:** $2\frac{1}{2}$. HOURS

INSTRUCTIONS: Answer question ONE and any other one question in section A, AND question FOUR and any other one question in section B. Each section is to be answered on separate booklets.

(YOU ARE REQUIRED TO FILL IN YOUR PARTICULARS HERE AND ON THE ANSWER BOOKLET)

MATRICULATION NUMBER: ----------

COLLEGE: ----------

DEPARTMENT: ----------

DEGREE PROGRAMME: ----------

PLEASE TURN OVER ONLY WHEN INSTRUCTED TO START BY THE INVIGILATOR

SECTION A

Constant: $\varepsilon_0 = 8.85\times10^{-12}$

QUESTION ONE

(a) Determine the voltage drop and current across the resistor 8Ω in Figure Q2 using

(i) Kirchhoff's Laws (5 marks)
(ii) Superposition's Theorem (5 marks)

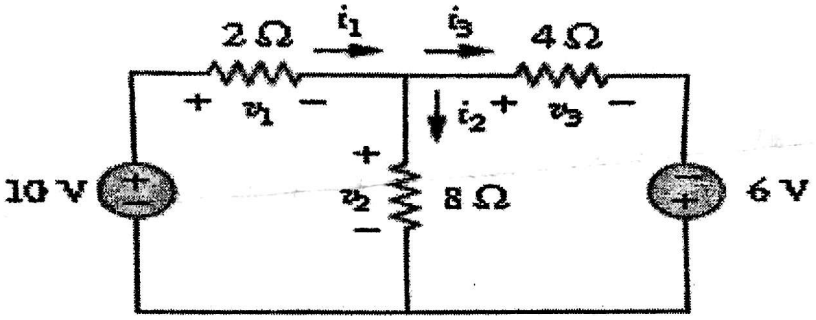


Figure Q2

(b) (i) Replace the 6V source in Figure Q2 with a 1.5Ω load resistor and draw the new figure after the replacement. (2 Marks)
(ii) Having replaced the source with 1.5Ω load, determine the load current through the load resistor using Norton's theorem. (6 Marks)

(c) State the main difference between Thevenin's theorem and Norton's theorem. (2 Marks)

QUESTION TWO

(a) What do you understand by electrical power and potential difference. (4 Marks)

(b) If a 5V e.m.f. source supplies a current of 3A for 10 minutes. Calculate the energy provided in this time? (2 Marks)

(c) An electric heater consumes 1.8MJ when connected to a 200V supply for 30 minutes. Find

(i) the power rating of the heater (2 Marks)
(ii) the current taken from the supply. (2 Marks)

(d) Give Five (5) properties of magnetic flux. (5 Marks)

QUESTION THREE

(a) Explain the terms permittivity of free space and electric flux density. (3 Marks)

(b) A capacitor consists of two metal plates, each 400 × 400 mm, spaced 6mm apart. The space between the metal plates is filled with a glass plate 5mm thick and a layer of paper 1mm thick. The relative permittivities of the glass and paper are 8 and 2 respectively. Calculate

(i) the capacitance neglecting any fringing flux. (3 Marks)
(ii) the electric field strength in each dielectric in kilovolts per millimetre due to a p.d. of 10 kV between the metal plates. (3 Marks)

(c) A coil of 200 turns is wound uniformly over a wooden ring having a mean circumference of 600 mm and a uniform cross-sectional area of 500 mm^2. If the current through the coil is 4.0 A. Calculate

(i) the magnetic field strength. (2 Marks)
(ii) the flux density. (2 Marks)
(iii) the total flux. (2 Marks)

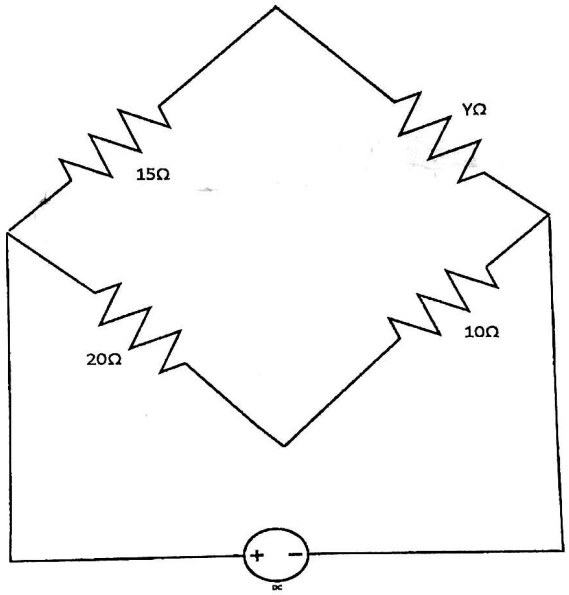
SECTION B

QUESTON FOUR

(a) Describe briefly with the aid of a diagram the experimental procedure for the measurement of an unknown resistance value of a resistor using Wheatstone bridge. (6 marks)

(b) Derive a formula to obtain the value of an unknown resistance in a Wheatstone bridge. (5 marks)

(c) Find the unknown resistance (YΩ) of the resistor shown in the diagram below. (3 marks)



(d) Consider a conductor of cross sectional area $0.2mm^2$ and length of 0.9m, having a resistance YΩ obtained above

i. Calculate the resistivity of the conductor (3 marks)

ii. Calculate the conductivity of the conductor (3 marks)

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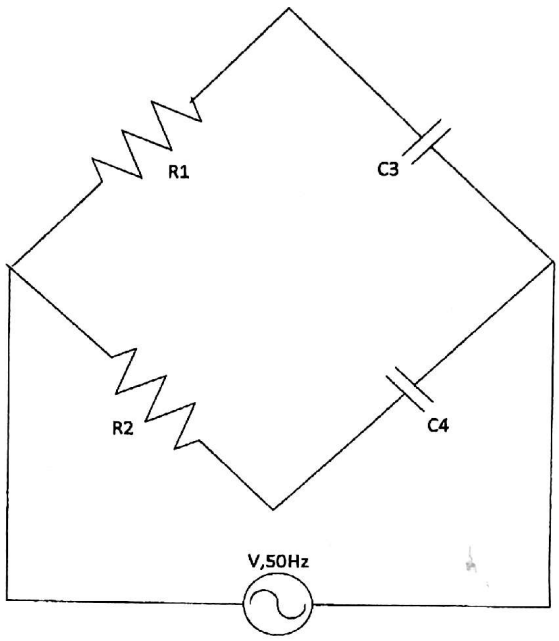
QUESTION FIVE

(a) Give two examples each of capacitance and inductance measuring bridges. *(4 marks)*

(b) Derive a formula to measure capacitance (C3) in the bridge shown below; (5 marks)



(c) From the diagram in [illegible]ove, if R1 = R2 = 3Ω, and C4 = 0.5μF, Calculate

i. The capacitive reactance for C4. (1 mark)
ii. Describe the bridge depicted in the diagram (1 mark)
iii. The capacitance of C3. (2 marks)
iv. If C3 and C4 are connected in series, calculate the resultant capacitance of the two capacitors. (2 marks)

QUESTION SIX

(a) A coil of inductance 600mH and negligible resistance is connected in series with a 200Ω resistor to a 240V, 50Hz supply. Calculate; (5 marks)

i. the inductive reactance of the coil,
ii. the impedance of the circuit,
iii. the current in the circuit,
iv. the potential difference across each component, and
v. the circuit phase angle.

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(b) A capacitor C is connected in series with a 20Ω resistor across a supply of frequency 60 Hz. A current of 3 A flows and the circuit impedance is 40Ω. Draw the phasor diagram of the circuit and calculate; (6 marks)

i. the value of capacitance, C,
ii. the supply voltage,
iii. the phase angle between the supply voltage and current,
iv. the potential difference across the resistor
v. the potential difference across the capacitor.

(c) From (b), if the resistance and the capacitive reactance of the circuit is given in the form $R + jXc$, re-write the expression in the following vector notation; (4marks)

i. Trigonometric Form,
ii. Exponential Form,
iii. Polar Form and
iv. Rectangular form