



COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

**TRADE DIPLOMA IN ELECTRICAL ENGINEERING (ELECTRICAL & ELECTRONIC
MAJORS)**

EEE 402 - ELECTRICAL PRINCIPLES 2A

FINAL EXAMINATION – SEMESTER 1, 2013

DAY/DATE: As per Timetable.

INSTRUCTIONS TO STUDENTS

1. You are allowed 10 minutes extra reading time during which you are **NOT** to write.
2. **Begin each answer (each Question)** on a fresh page and use both sides of the sheet.
3. Write your candidate number at the top of each answer & attached sheet.
4. Insert all written foolscaps, graph paper etc. in their correct sequence and secure with a string.
5. For all sheets of paper on which rough/craft work has been done, cross it through and you must attach all of them to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. **ANSWER ALL QUESTIONS.**
8. Show all workings where necessary.
9. Attached the multiple choice grid with the Answer Booklet.
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE ROOM!**

SECTION A

MULTIPLE CHOICE

[20 MARKS]

Circle the letter of the best choice in the **Answer Sheet** provided at the back of this question paper. When you are done, remove the answer sheet, insert it in your answer booklet and secure with a string.

1. The combined resistance of two resistors of 20 ohms and 30 ohms connected in parallel is

- A. 600 ohms
- B. 50 ohms
- C. 25 ohms
- D. 12 ohms

2. The unit of electrical power is the

- A. volt
- B. watt
- C. ampere
- D. joule

3. A voltage divider circuit can be made possible by using a

- A. variable capacitor
- B. potentiometer
- C. rheostat
- D. diode

4. The heat dissipated from a resistor of 10 ohms carrying a current 25 amperes is

- A. 6.25 kwatts
- B. 6.50 kwatts
- C. 6.75 kwatts
- D. 7.25 kwatts

5. The insulator between the plates in the capacitor is also known as the

- A. piezoelectric
- B. medium
- C. dielectric
- D. region

6. Which of the following best describes the electric current flowing into the page?



7. The equivalent Capacitance of two Capacitor in parallel is:

- A. $\frac{1}{R_1} + \frac{1}{R_2}$
- B. $C_1 + C_2$
- C. $\frac{C_1 + C_2}{C_1 C_2}$
- D. $\frac{C_1 C_2}{C_1 + C_2}$

8. The unit of mutual inductance is

- A. capacitance
- B. resistance
- C. henry
- D. voltage

9. If a resistor suddenly decreases in value (resistance decreases), what will happen to the current through the resistor?

- A. increases
- B. remains unchanged
- C. decreases
- D. fluctuates

10. When using a standard multimeter to measure AC voltage, what type of measurement will the multimeters indicate?

- A. peak-to-peak
- B. peak
- C. average
- D. rms

11. What happens to current flow in a capacitive circuit when the DC voltage across the capacitor is approximately equal to the source voltage?

- A. Current flow is optimized.
- B. Little current flows.
- C. Current flow is maximum at the source.
- D. Current flow is maximum at the capacitor.

12. In mutual induction, what passes between conductors in order to create voltage?

- A. radiation
- B. magnetic flux
- C. current flow
- D. resistance

13. Which of the following devices can be used to test the windings of an inductor for continuity?

- A. wattmeter
- B. voltmeter
- C. ohmmeter
- D. wheatstone bridge

14. In a parallel circuit operating with a source of 30 VAC, designed to carry a total current of 6 A, what happens to the protection device (fuse) when the resistance suddenly changes to 2 Ω ?

- A. closes
- B. no change
- C. shorts to ground
- D. opens

15. How many watts are in 100 microwatts?

- A. 0.01 milliwatts
- B. 0.1 milliwatts
- C. 1.0 milliwatts
- D. 10 nanowatts

16. Which of the following is an appropriate use for a voltmeter?

- A. To measure difference of potential
- B. To measure current flow
- C. To determine total resistance
- D. To determine power output

17. If the distance between the plates of a capacitor decreases while all other components of the capacitor remains the same, what happens to the capacitance of the device?

- A. increases
- B. remains the same
- C. decreases
- D. varies

18. As temperature increases, what happens to the current-carrying ability of a wire?

- A. There is no change.
- B. The wire can carry more current.
- C. The wire can carry less current.
- D. The wire can carry no current.

19. In a two-branch parallel circuit containing one 30- Ω resistor in each branch and powered from a 10-V source, what is the total current flowing in the circuit?

- A. 0.33 A
- B. 0.67 A
- C. 40 A
- D. 60 A

20. How should a fuse be installed in a circuit to insure proper operation?

- A. parallel to the load
- B. series with the load
- C. in any way possible
- D. at the ground point

SECTION B

SHORT ANSWER QUESTIONS

[20 MARKS]

1. State the following formulae:

- (i) Ohm's Law, (1 mark)
- (ii) Kirchhoff's Voltage Law, (1 mark)
- (iii) Kirchhoff's Current Law, (1 mark)
- (iv) The Current Divider Rule. (1 mark)

2. Sketch the following standard electrical Symbol:

- i) Variable Resistor (1 mark)
- ii) Variable Capacitor (1 mark)
- iii) Diode (1 mark)
- iv) Fuse (1 mark)
- v) Ammeter (1 mark)

3. List the first four steps you will take if you come across someone who gets electrocuted in electrical workshop. (2 marks)

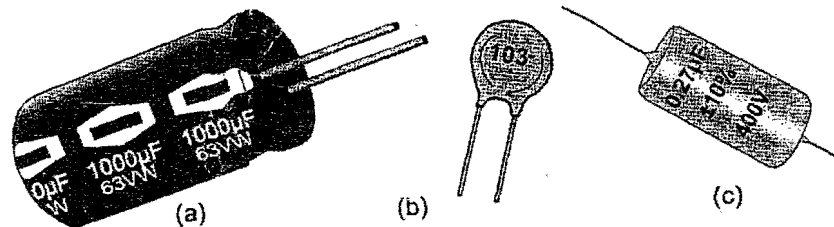
4. a) Determine the values and tolerance range of the given resistors:

- i). Brown, Yellow, Brown, Silver
- ii). Red, Red, Red, Gold
- iii) Blue, Green, Red, No band (3 marks)

b) What is the colour code of a 470 ohms resistor with a tolerance of 5%? (1mark).

5. List (Four) 4 factors that affect the resistance of a conductor. (2 marks)

6. i). Identify the types of capacitors shown below: (1.5 marks)



ii). What are the three things that determine the capacitance of capacitor? (1.5 marks)

SECTION C

[60 MARKS]

Attempt all questions in this section. Show all necessary working.

Question 1

(20 marks)

1. Determine the current flow in each of the five resistors in **Figure 1**.

(5 marks)

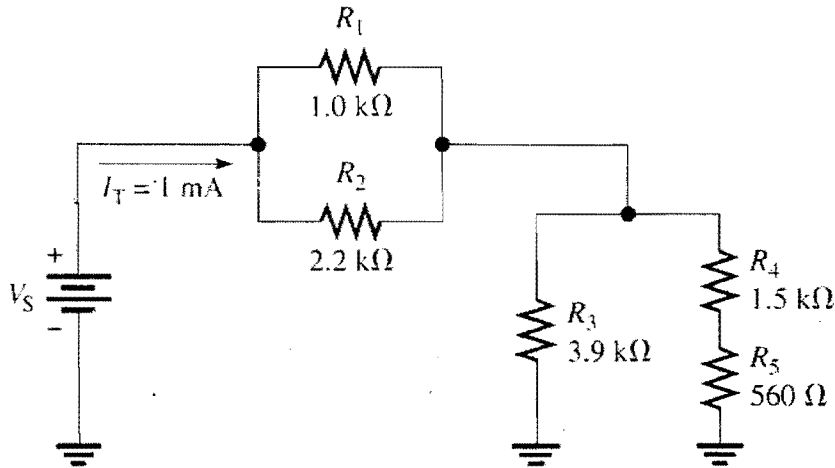


Figure 1: Circuit with combination of series and parallel resistances

2. Calculate the voltage across each resistor in the circuit of **Figure 2**, as well as the total resistance, total current and total power consumed by the circuit.

(5 marks)

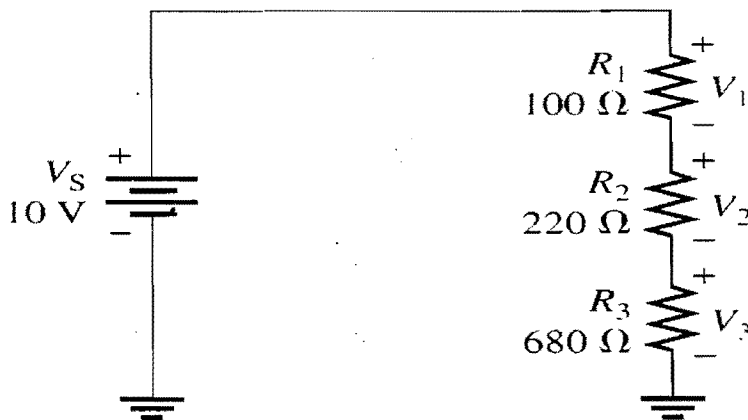


Figure 2: Series circuit

3. For the circuit shown in Figure 3, with $V_S = 5\text{ V}$, calculate the total resistance for the circuit, the total current flowing out of the voltage source, and the individual currents flowing through R_1 , R_2 and R_3 .

(5 marks)

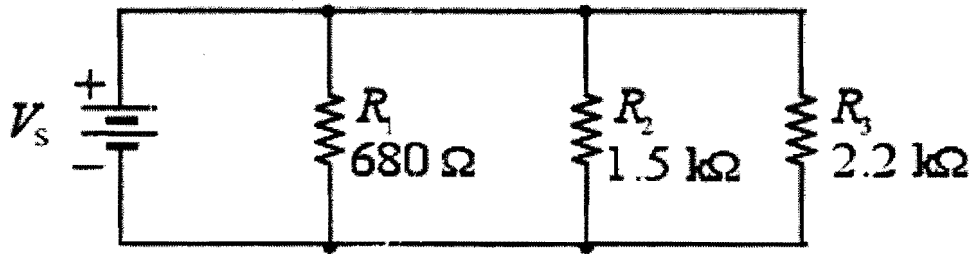


Figure 3: Parallel resistor circuit

4. For the circuit shown in Figure 4, Use KCL to solve for I_{R1}

(3 marks)

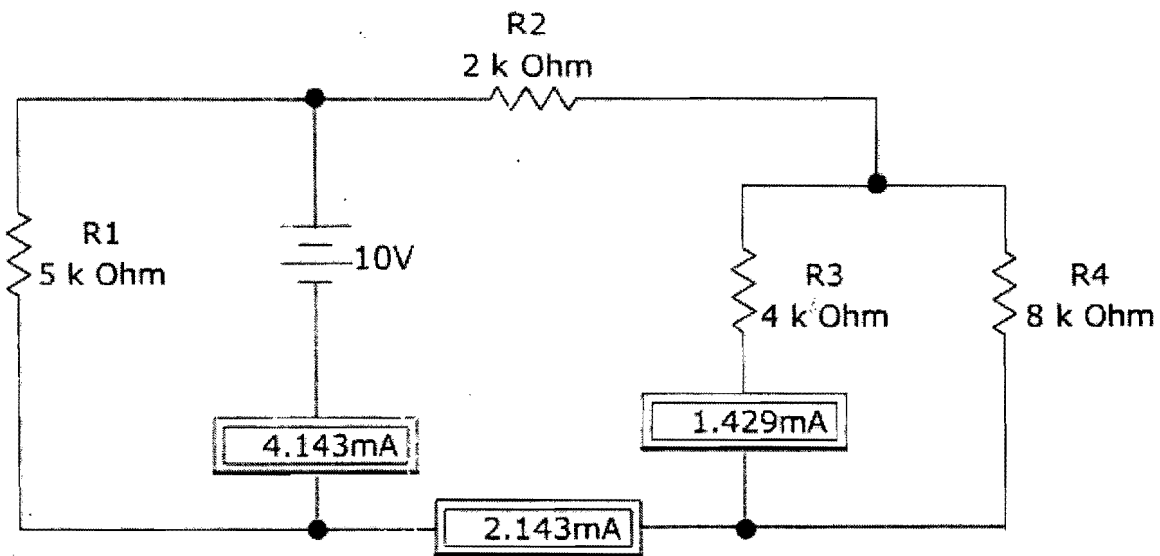


Figure 4: Combination circuit

5. What value of current can a 6Ah battery supply for 10 hours, if this rating is for a $C/10$ discharge current?

(2 marks)

Question 2

(20 marks)

1. An ac load takes 2.5 kW of power from a supply 110V at 60 Hz. The current is 30 A. Determine the power factor and the size of a capacitor needed in series to correct it. (2 marks)

2. A resistor of value 470 Ω is connected in series with a capacitor of 22 μF and an inductor of 50 mH and a voltage is applied across it. A current of 100 mA (rms) is produced. Determine the impedance, the phase angle between the voltage and current and the applied voltage when the frequency is 50 Hz. (3 marks)

3. A series circuit comprises of a resistance of 5 Ω , a capacitor of 2 nF and an inductor of 5 μH . Calculate the resonant frequency and the current at resonance when 1 V rms is applied and the Q factor at resonance. (3marks)

4. A capacitor stores 0.05 Coulombs when the terminal voltage is 160V. What is the capacitance? (2 marks)

5. A variable capacitor when fully closed has a total plate area of 50 000 mm². The plates are spaced 0.5 mm apart and the space is filled with air. Calculate the capacitance when fully closed. (2 marks)

6. A capacitor has a value of 800 μF and it is charged until the terminal voltage is 15V. Calculate the energy stored. (2 marks)

7. For the Figure 5 shown below, calculate the following:
 - a). total capacitance of the circuit (2 marks)
 - b). the total charge of the circuit (2 marks)
 - c). voltage across C₄ (2 marks)

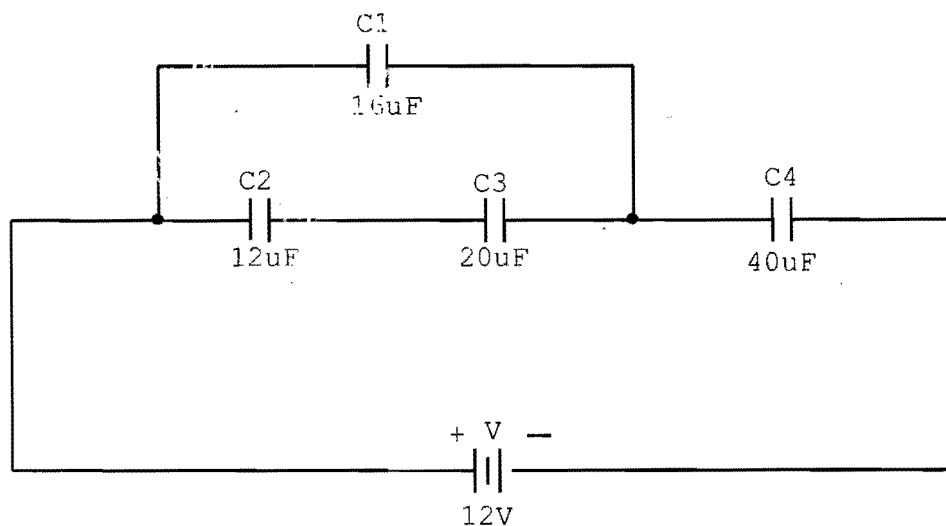


Figure 5: Combination Circuit

Question 3

(20marks)

- 1. A coil of 2000 turns wound on an iron core that's 85mm long has a current of 0.3A passing through the coil. What's the magnetizing force in the core? (2 marks)
- 2. Figure 6 shows two charged spheres a & b. Assume that spheres are in free space, draw the electric field around the sphere? (3marks)

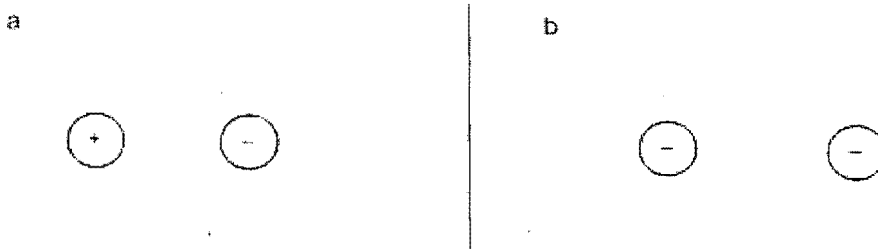


Figure 6: Two charged spheres

- 3. Determine the force on a 40cm long conductor which is carrying a current of 20A and is situated at right angles to the magnetic field with a flux density of 0.7T. If the force on a conductor is to be increased to 28N, determine the new current level required. (3 marks)
- 4. a). Define the term magnetomotive force? (2marks)
- b). Find the force that should be exerted on a 6m length of a conductor, carrying a current of 800mA situated at right angles in a magnetic field with a flux of 5 Tesla. (2marks)
- c). Sketch the magnetic fields for the magnetic arrangement in figure 7 as shown below.

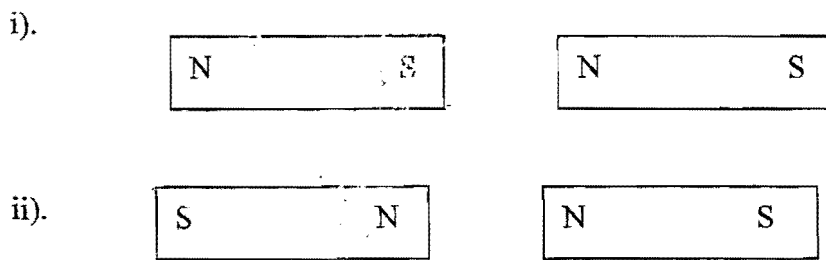


Figure 7: Magnets

- 5. A 5/1 step down transformer has a full load secondary current of 20 A 500V. The primary winding has 800 Turns. Assuming ideal conditions determine the following. (1 mark)
 - a) (i) The number of turns on the secondary coil. (1 mark)
 - (ii) The voltage and current in the primary winding. (2 marks)
- b) If the transformer has losses due to a secondary resistance of 0.3 Ω and no other losses, determine the efficiency of the transformer. (2 marks)

THE END