



STAMFORD COLLEGE

SCHOOL OF ENGINEERING

**FOUNDATION STUDIES IN ENGINEERING
(ELECTRICAL AND ELECTRONIC)**

KE019: Physical Electronics and Fields

Date : 17 September 2007 (Thursday)

Time : 2.00 pm – 4.10 pm

Duration: 2 hours + 10 minutes reading time

Instructions to Candidates

1. **SIX** questions set.
2. Answer any **FOUR** questions.
3. All questions carry equal marks.
4. Maximum marks attainable: 100

Please ensure that this examination paper contains **SIX** questions on **FIVE** printed pages before you start the examination.

Books, papers and other written materials are not allowed to be brought into the examination hall. A candidate who violates the examination rules of Stamford College or commits a malpractice will be disqualified from the examination.

Write your Examination Index Number on each page of your answer booklet.

Answer any **FOUR** questions.

Question 1

(a) Explain Coulomb's law of electrostatics with the aid of diagrams.

(5 marks)

(b) For the series circuit shown in Figure 1(b),

- (i) Find the total resistance.
- (ii) Calculate the source current I_s .
- (iii) Determine the voltages V_1 , V_2 and V_3 .
- (iv) Calculate the power dissipated by R_1 , R_2 and R_3 .
- (v) Determine the power delivered by the source, and compare it to the sum of the power levels of part (iv).

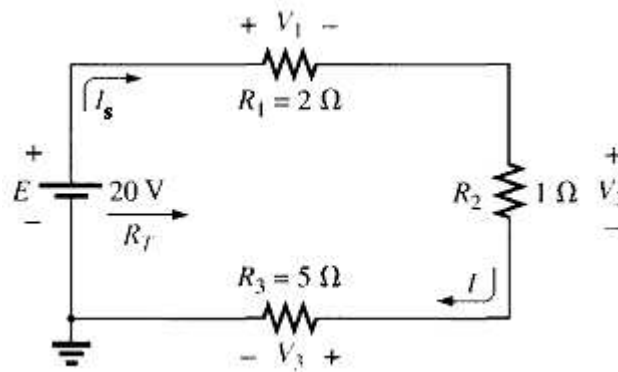


Figure 1 (b)

(10 marks)

(c) Define the following terms:

- (i) Voltage
- (ii) Electrostatics
- (iii) Electric flux density
- (iv) Resistance
- (v) Charge

(10 marks)

(Total = 25marks)

Question 2

- (a) (i) The charge flowing through the imaginary surface as shown in Figure 2(a)(i) is 0.16 C every 64 ms. Determine the current in amperes.

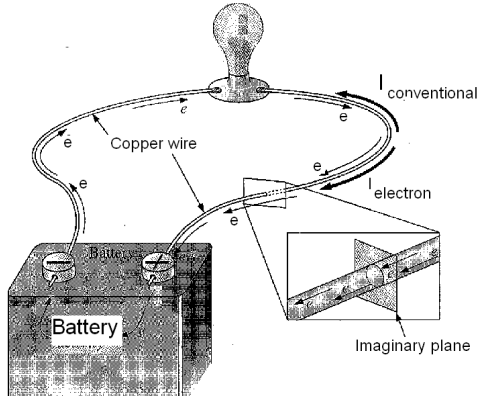


Figure 2(a)(i)

(3 marks)

- (ii) Find the potential difference between two points in an electric system, if 16 Joules of energy are expended by a charge of 20 C between these two points.

(2 marks)

- (b) Explain the following terms:

- (i) Ohm's law
- (ii) Potential gradient
- (iii) Drift velocity
- (iv) Resistivity
- (v) Mobility

(10 marks)

(c) (i) For the circuit shown in the Figure 2(c)(i), $C_1 = 1\mu\text{F}$, $C_2 = 4\mu\text{F}$, $C_3 = 2\mu\text{F}$.

Determine:

(I) The total capacitance

(II) The charge on each capacitor C_1 and C_2

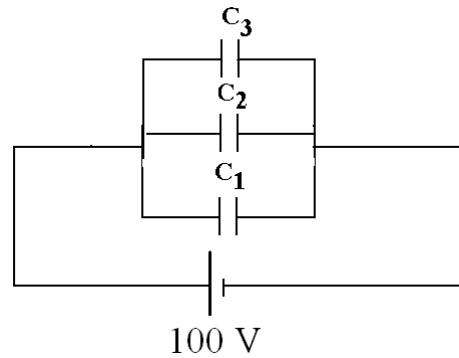


Figure 2(c)(i)

(4 marks)

(ii) Two plates each $10\text{ cm} \times 10\text{ cm}$, are separated by 3 mm of mica which has a dielectric constant of 4. Determine the capacitance.

(2 marks)

(iii) (I) Explain the construction of capacitor with the aid of diagram.

(2 marks)

(II) Define capacitance of a capacitor.

(2 marks)

(Total = 25 marks)

Question 3

(a) The magnetic circuit of the electromagnet is 10 cm long. The flux density in an electro-magnetic core is 1.2 T. The area of the core is 2 cm^2 . If the coil has 50 turns with current 2 A flowing through it, find:

- (i) The magnetic flux.
- (ii) The m.m.f.
- (iii) The magnetic field strength.

(9 marks)

(b) Explain the following with the aid of diagrams:

- (i) Properties of magnet (2 marks)
- (ii) Force between two parallel conductors (4 marks)

(c) Define the following terms:

- (i) Ampere's law
- (ii) Magnetomotive force (m.m.f.)
- (iii) Reluctance

(6 marks)

(d) Derive an expression for magnetic flux density \mathbf{B} , along the axis of a solenoid of length λ meters having N number of turns that carries a current I amperes.

(4 marks)

(Total = 25 marks)

Question 4

- (a) List five applications of a diode. (5 marks)
- (b) Explain the operation of silicon diode under forward biased and reverse biased condition. Draw the typical voltage-current characteristic for the diode. (10 marks)
- (c) With the aid of suitable diagrams, explain the operation of a single phase full wave rectifier. (10 marks)
- (Total = 25 marks)

Question 5

- (a) With the aid of diagrams, describe the two types of extrinsic semiconductor and give two examples for each. (10 marks)
- (b) With the aid of diagrams, describe the process of forming a semiconductor diode by joining p-type and n-type materials. (5 marks)
- (c) Define the following terms:
- (i) Drift
 - (ii) Breakdown voltage
 - (iii) Rectification
- (6 marks)
- (d) Distinguish between insulator, semiconductor and conductor. (4 marks)
- (Total = 25 marks)

Question 6

(a) Calculate the following for the circuit shown in Figure 6 (a), given that $\beta_{dc} = 100$.

- (i) Base current (I_B)
- (ii) Collector current (I_C)
- (iii) Emitter current (I_E)
- (iv) Voltage between collector and emitter (V_{CE}).
- (v) Voltage between collector and base (V_{CB}).

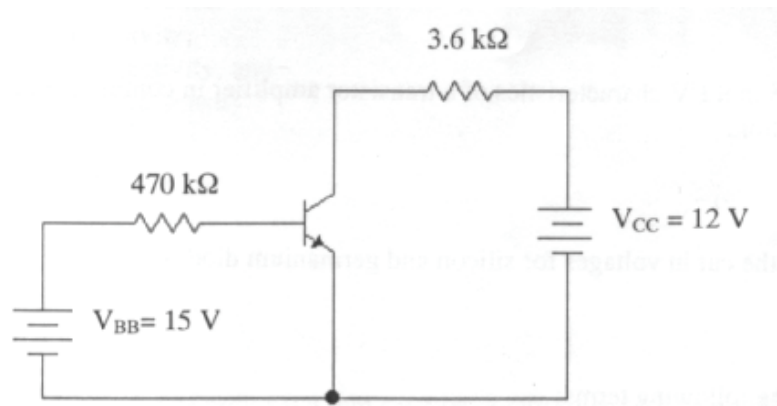


Figure 6 (a)

(10 marks)

(b) For a transistor circuit having $V_{CC} = 10\text{ V}$, $R_C = 2\text{ k}\Omega$, $I_B = 50\text{ }\mu\text{A}$, $V_{BE} = 0.7\text{ V}$ and $\beta = 100$, find the values of V_{CE} and I_C .

(5 marks)

(c) Explain the input and output characteristics of a transistor.

(10 marks)

(Total = 25 marks)

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