



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

ECV 211: ELECTROMECHANICAL ENGINEERING

DATE: 15/12/2020

TIME: 2:00 – 4:00 PM

INSTRUCTIONS

- There are **Five** questions.
- Question No.1 is **Compulsory** and carries **30 Marks**.
- Select any **other Two** questions, each of which carries 20 Marks.
- Define all symbols used .
- Marks will be awarded for procedure, methodologies used and not necessarily on the final answer.

QUESTION ONE (30 MARKS)

- Explain the difference between zero input response and zero state response for a $R - C$ electrical circuit. (4 marks)
 - Draw phasor diagrams for resistive, inductive and capacitive loads. (6 marks)
- Define Resistance. (2 marks)
 - State Joule's Law. (2 marks)
 - Show what Mutual Inductance is. (6 marks)
- Given the circuit in FigQ1, the switch S is closed at time $t = 0$. Assuming that the capacitor C contains no charge:-
 - Obtain the expression for the current $i(t)$. (7 marks)
 - Sketch the curve of current against time. (3 marks)

QUESTION TWO (20 MARKS)

- a) Give the circumstances under which an escalator may be incorporated in a building project, and its minimum standard dimensions. (4 marks)
- b) Using relevant examples, distinguish between:-
- i. *Natural*, and *ventilation* systems. (3 marks)
 - ii. *Passive Stack Ventilation* (PSV), and *Passive Draught Evaporation Cooling* (PDEC). (5 marks)
 - iii. State the circumstances under which, *PSV* and *PDEC* are applied in building projects. (3 marks)
- c) Write an essay on the required fire resistance for any element or component for use in any building. (5 marks)

QUESTION THREE (20 MARKS)

- a) With the aid of a phasor diagram, show that for both star and delta connected balanced loads, the total active power is given by $\sqrt{3} v(t)i(t)\cos \phi$ where v and i are line values of voltage and current respectively and ϕ is the angle between phase values of current and voltage. (10 marks)
- b) In Fig.Q3, the switch is opened at $t=0$ having been closed long enough for the circuit to attain a steady state. Find $v(t)$ for $t > 0$. (10 marks)

QUESTION FOUR (20 MARKS)

Given the circuit in Fig Q4:-

- a) Find the voltage across each impedance. (4 marks)
- b) Determine the current flowing through each loop. (8 marks)
- c) Apply the superposition principle to determine the current flowing in the $(1+j2)$ impedance. (8 marks)

QUESTION FIVE (20 MARKS)

- a) (Show that the energy flow through a capacitor is generally given by:-

$$W_c = \int_{t_0}^{t_1} \frac{1}{C(t)} q(t) dq(t), C(t) \neq 0. \quad (10 \text{ marks})$$

- b) A capacitor is specified by $C(t) = 1 - 2t$, and the charge contained in it is specified by $q(t) = t - t^2$. Find the energy flow through the capacitor in the interval $0 \leq t \leq 1$.

(10 marks)

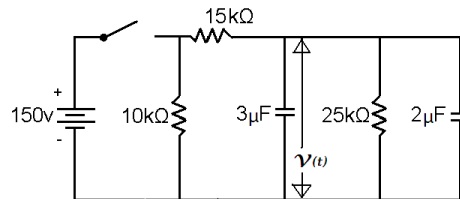


Fig Q3

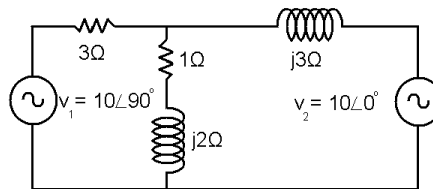
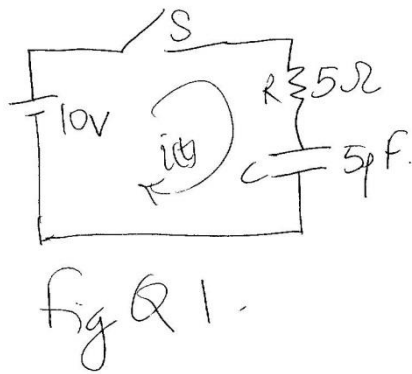


Fig Q4