MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic 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

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

QUESTION ONE (30 MARKS)

a) i Explain the difference between zero input response and zero state response for a $R-C$ electrical circuit. (4 marks)

ii Draw phasor diagrams for resistive, inductive and capacitive loads. (6 marks)

b) i Define Resistance. (2 marks)

ii State Joule's Law. . (2 marks)

iii Show what Mutual Inductance is. (6 marks)

c) Given the circuit in FigQ1, the switch *S* is closed at time $t = 0$. Assuming that the capacitor *C* contains no charge:-

i. Obtain the expression for the current *i(t).* (7 marks)

ii. 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 Downdraught 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 $\sqrt{3}\, v(t)i(t)Cos\, \varphi$ 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:-

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

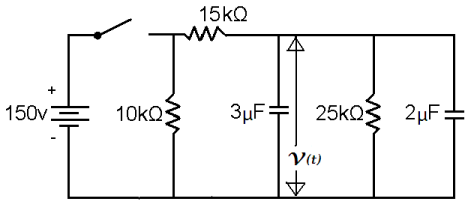

Fig Q3

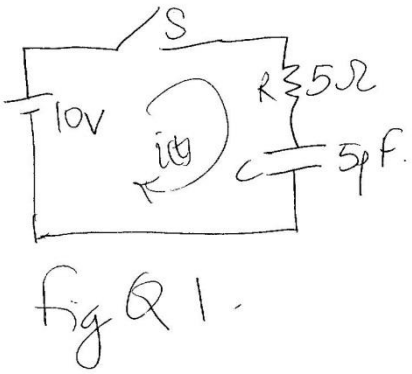

fig Q1.

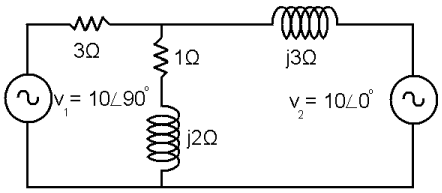

Fig Q4