KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SPH 304: AC CIRCUIT THEORY

DATE: Monday, 5th December 2011 **TIME:** 8.00 a.m. – 10.00 a.m.

INSTRUCTIONS:

Answer question one and any other two.

Q1 (a) What do you understand by alternating current theory? (2 marks)

(b) Name and explain **four** basic properties or characteristics associated with AC waveforms. (4 marks)

(c) Write equations for the root mean square current and root mean square Voltage. (3 marks)

(d) An IIΩ resistor is connected to a battery of emf 6V and an internal resistor of IΩ. Find;

(i) the current

(ii) the terminal voltage of the battery

(iii) the power delivered by the emf

(iv) the power delivered to the external resistor (8 marks)

(e) A 20 μf capacitor is connected across the terminals of a generator that has a maximum Emf of 100V. Find the capacitive reactance and the maximum current if the generator has a frequency of 60Hz. (4 marks)

(f) Name and describe the three main sections of a power supply. (6 marks)

(h) Draw diagrams of circuits that are capable of providing half wave and full wave Rectification. (3 marks)

Q2. (a) A resistor R is connected across the terminals of an AC generator (in series). Derive an expression for the power dissipated across the resistor in terms of the peak current and resistor R. (8 marks)

(b) A capacitor is connected to an AC source of emf v. Obtain an expression for the reactive Capacitor X_C. (4 marks)

(c) An inductor L is connected across the terminals of the AC power source. The self induced emf across the inductor is $L\frac{dL}{dt}$. Applying the Kirchoff's rule, or otherwise show that the Power dissipated through an inductor is zero. (8 marks)

Q3. (a) An AC voltage source with amplitude 15V and frequency 60Hz is applied across a 30mH inductor. Find the actual expression for the resulting AC current. (6 marks)

(b) An RLC circuit all connected in series with an emf source V. if the current flowing in the circuit is I, derive an expression for the total impedance Z of the circuit. (6 marks)

(c) A circuithas an AC source, a resistor R and an inductor L all connected in series. The frequency of the generator is 1MHz. If L = 150μH, C = 220pf and voltage source is $10V_{rms}$, calculate:

(i) The impedance Z

(ii) The current I in the circuit

(iii) The voltage across capacitor and inductor (8 marks)

Q4. (a) Two circuits are such that both have a resistor R and a capacitor C. If the power input in the circuit is an AC voltage source V_{in} draw the two circuit stating the integrator circuit and the differentiator circuit. Derive an expression for the gain of each circuit. (10 marks)

(b) Derive an equation for each showing the integrator and differentiator circuit. (10 marks)

Q5. (a) Consider a series RLC circuit. If the driving voltage is V and using complex notation, derive the expression for the impedance Z of the circuit and the phase angle ϕ. (6 marks)

(b) Derive the expression for the quality factor Q (6 marks)

(c) In the same circuit energy is stored in two forms namely magnetic energy U_m and in electrical form U_e. If the charge in the circuit at any time t is $Q = Q_O \cos \omega t$ where Q_o is the maximum charge, obtain an expression for the total energy in terms of Q_o and Capacitance C. (8 marks)

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