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MAIN EXAMINATION

SEPTEMBER –DECEMBER 2021

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

REGULAR PROGRAMME

PHY 312: AC CIRCUIT THEORY

Date: DECEMBER 2021	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any TWO Questions	

Q1.

a) Giving mathematical expressions define Kirchhoff's laws ; **(3 marks)**

b) An alternating voltage is given by $v = 282.8\cos 314t$ volts. Find;

i). the rms voltage, **(4 marks)**

ii). the frequency and **(3 marks)**

iii). the instantaneous value of voltage when t =4 ms. **(3 marks)**

c) A circuit consist of an inductor of 65mH and a capacitor of 20μF. Given that the circuit is at resonance, find the resonance frequency(f_0). **(4 marks)**

d)

i) What do you understand by the term resonance frequency in an R-LC circuit **(1 mark)**

ii) Show that the resonance frequency is given by $\omega_0 = \frac{1}{\sqrt{LC}}$. **(4 marks)**

e) A 22Ω resistor is connected to a battery of emf 3 V and an internal resistor of 1Ω. Find;

i) Total current in the circuit

ii) the terminal voltage of the battery

iii) the power delivered by the source voltage

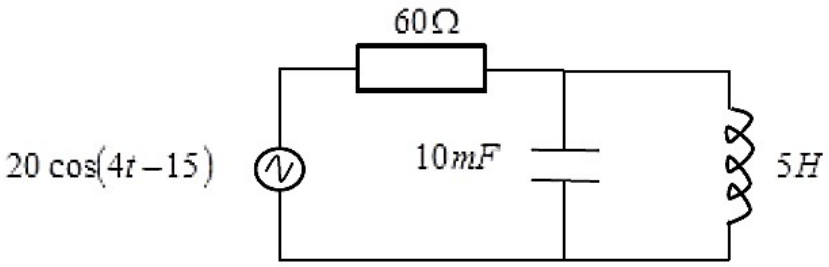
iv) the power delivered to the external resistor **(8 marks)**

Q2.

a) An ac voltage is given by the equation $V(t) = 36\sin 3\pi$¿. Determine;
   i). Phase constant **(6 Marks)**
   ii). Frequency of the ac voltage **(4 marks)**

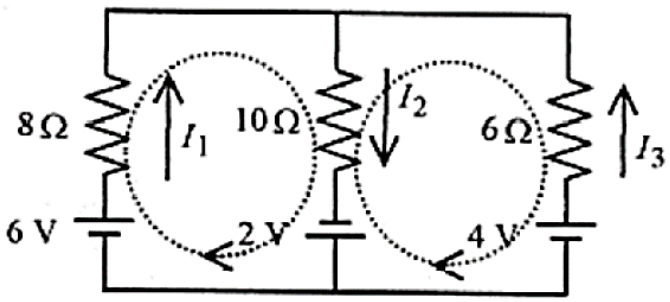
b)

c) By expressing the source voltage in the circuit below in phasor form, determine the voltage across the 10*mF*capacitor. **(10marks)**



Q3.

a) The circuit below represent a network of resistors with current I_1, I_2 and I_3 flowing through the circuit as indicated. Taking advantage of the indicated loops. Solve for current I_1, I_2 and I_3 using mesh current method. **(8 marks)**



b) 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)

c) 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)**

Q4.

a) What do you understand by the terms; **(2 marks)**
   i). Mutual inductance

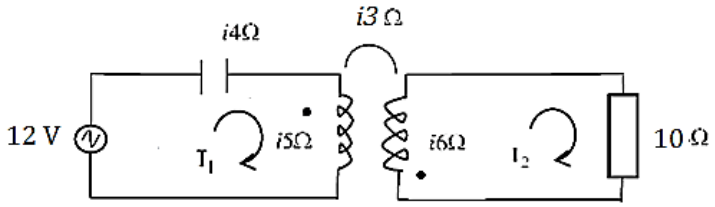
ii). Magnetically coupled circuits

b)

i). Differentiate between instantaneous and average power giving mathematical expression in each case **(4 marks)**

ii). State the dot convention principle in the two forms **(2 marks)**

c) Calculate the phasor currents $\mathbf{I}_1$and $\mathbf{I}_2$ in the circuit shown below **(6 marks)**



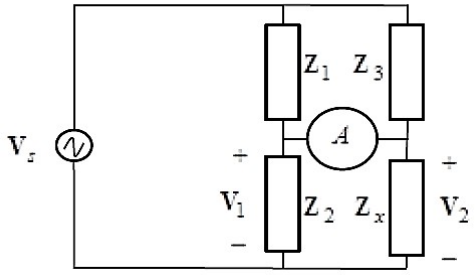
d) Determine the capacitive reactance of a capacitor of 10μF when connected to a circuit of frequency **(6 marks)**

i). 50 Hz

ii). 20 kHz.

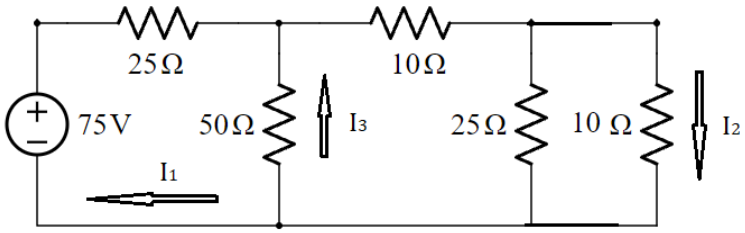
Q5.

a) The ac bridge circuit in the figure below balances when Z_1 is a 1kΩ resistor, Z_2 is a 4.2kΩ resistor,Z_3 is a parallel combination of a 1.5MΩ resistor and a 12pF capacitor, and f = 2 kHz. Find the series components that make-up Z_x. (8 marks)



b) Considering that instantaneous power is given as $P(t)=V(t)I(t)$. Show that the time independent component of the instantaneous power is given as $\frac{1}{2}V_0 I_0 \cos(\Phi_v - \Phi_i)$. **(6marks)**

c) Using node voltage method determine the current in the following circuit with reference to the indicated direction **(6 marks)**



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