KENYATTA UNIVERSITY

UNIVESITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 204 CIRCUIT THEORY II

DATE: **Thursday 12th April 2012** **TIME:** **8.00a.m – 10.00a.m**

INSTRUCTIONS:

*Answer **Question 1** and any other **Two** questions*

Show all working in a neat and legible manner

Question 1 (Compulsory) – 30 marks

a. Given the RC network in figure 1 below, determine

i. An expression for the voltage transfer function of the network [5 marks]

ii. Sketch the magnitude and phase response of the system. How would you characterize the network? [3 marks]

iii. Given that $R = 50\ k\Omega$ and $L = 100\ mH$, determine the cut-off frequency [2 marks]

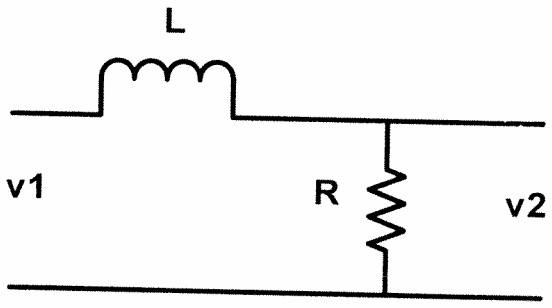

Figure 1

b. A sinusoidal voltage $v(t) = 150\cos(1000t + 10^o)V$ is connected across a passive circuit with an impedance $Z = |Z|\angle\theta$ resulting in a current $i(t) = 5\cos(1000t - 50^o)A$. Provide the complete power information i.e. Power factor, P_{av}, Q and S. [7 marks]

c. A periodic time varying current $i(t)$ passes through a 0.5 μF capacitor. Find and plot:

i. The instantaneous power $p(t)$ entering the capacitor [6 marks]

ii. Energy $w(t)$ stored in the capacitor [3 marks]

Where $i(t)$ is described analytically for one period as

$$i(t) = \begin{cases} 1\ mA & ;0 < t < 1\ mS \\ -1\ mA & ;1 < t < 2\ mS \end{cases}$$

d. When one coil of a magnetically coupled pair has a current of 5 A, the resulting fluxes ϕ_{11} and ϕ_{12} are 0.2 mWb and 0.4 mWb respectively. If the turns are $N_1 = 500$ and $N_2 = 1500$, find L_1, L_2, M and the coefficient of coupling k.

[4 marks]

Question 2 - (20 marks)

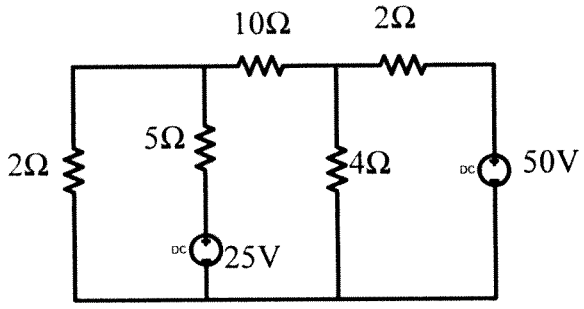

Figure 2

a. For the circuit shown in figure 2,

i. Write the mesh current matrix equation and solve for the three mesh currents [7 marks]

ii. Repeat part (i) above using the node voltage method [7 marks]

b. For the circuit given in figure 1 ($R = 50\ k\Omega$, $L = 100\ mH$), and assuming zero initial conditions, determine the response of the circuit to a unit step input. Clearly indicate the transient and the steady state parts of the response. [6 marks]

Question 3 - (20 marks)

a. Show that for a series resonant circuit, the resonant frequency is given by $\omega_0 = \frac{1}{\sqrt{LC}}$ [5 marks]

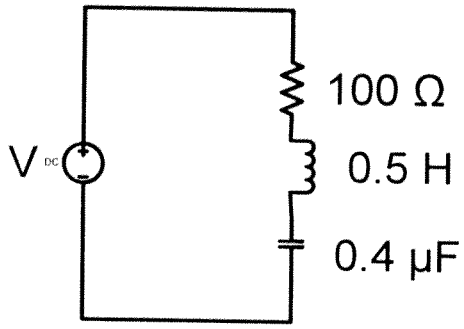

Figure 3

b. For the RLC series circuit shown in figure 3, find

i. The resonant frequency [1 mark]

ii. Upper and lower half power frequencies ω_h and ω_l [6 marks]

iii. Bandwidth of the circuit β [2 marks]

c. Find the resonant frequency of the LC tank circuit of figure 4 if $R = 2000\Omega$, $C = 40\mu F$, $L = 100\ mH$ [6 marks]

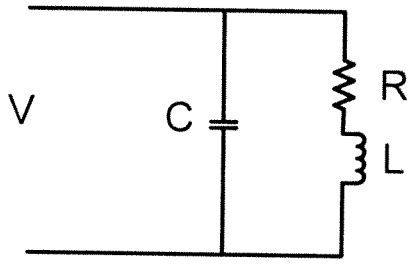

Figure 4

Question 4 - (20 marks)

a. Find average power delivered to an impedance of $Z = 50 + j12\ \Omega$ from a sinusoidal voltage source with $V_{eff} = 330\ V$. Also find the power factor. [6 marks]

b. Determine the total power information for three parallel connected loads specified as follows:

- Load 1 – 250 VA, pf = 0.5 lagging
- Load 2 – 180 W, pf = 0.8 leading
- Load 3 – 300 VA, 100 Var (inductive)

i. Calculate real power (P), reactive power (Q) and apparent power (S) for each load. Draw the power triangles of the three loads [7 marks]

ii. Calculate total P, Q, S and PF for the total load. Draw the combined power triangle [7 marks]

Question 5 - (20 marks)

a. What are the advantages of 3-phase power distribution? [6 marks]

b. A 3-phase, ABC system with effective line voltage $V = 240\ V$ has a Δ connected load of $Z_{AB} = 25\angle 90^0\ \Omega$, $Z_{BC} = 15\angle 30^0\ \Omega$ and $Z_{CA} = 20\angle 0^0\ \Omega$. Obtain the line currents and the total power in the system. Draw the phasor diagram for the system [14 marks]