UNIVERSITY OF GHANA

BACHELOR OF SCIENCE IN ENGINEERING
SECOND SEMESTER EXAMINATIONS: 2014/2015
CPEN 206: LINEAR CIRCUITS

INSTRUCTIONS: ATTEMPT ALL QUESTIONS.
TIME ALLOWED: *THREE HOURS*

Q1(a) Briefly explain why in solving problems in linear circuits Star(T) network is a times converted into the equivalent of Delta($\prod$) and vise verse. **[2marks]**
(b) A star network has Z_1=20Ω, Z_2=(10+j10) and Z_3=(20-j5). Calculate the values of the components of the equivalent delta curcuit. **[6marks]**
(c) State the Superposition theorem. **[2marks]**
(d)A voltage generator whose internal resistance is 500Ω and voltage source of 15V is connected in parallel to another generator whose internal resistance is 40Ω and voltage is 24V. If the two generators are producing currents which are out of phase, calculate the total current that will flow through a 600Ω connected across the two voltage generators, using the superposition theorem. **[6marks]**
(e) Repeat Q1(d) using mesh analysis. **[4marks]**

Q2 (a) Give two uses of electric Resonance **[2marks]**
(b) State three conditions of Resonance **[3marks]**
(c) A series-resonant circuit is connected across a 10V, 2MHz supply having an internal impedance of 5Ω.Calculate the values of inductance and capacitance required to give a capacitor voltage of 250V at the resonant frequency. **[8marks]**
(d) Define Quality or Q-factor of a series-tuned circuit **[2marks]**
(e) A 4μFcapacitor is connected in series with 500kΩ resistor and a 120V d.c supply. Calculate the rate at which energy is being stored in the capacitor when its terminal voltage is 50V. **[5marks]**

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Examiner: Mr. Agyare Debra

Q3 (a) Briefly explain why the Maximum Power Transfer theorem is particularly useful for analysing communication networks but not power transmission and distribution networks **[2marks]**

(b) State the Maximum Power Transfer theorem. **[2marks]**

(c) Draw a circuit consisting of a generator having a e.m.f of E(volts) and internal resistance (R_S) which is connected in series to a load resistor (R_L) and use it to proof the maximum power transfer theorem **[4marks]**

(d) A source of impedance (6000-j125)Ω at a frequency of $1000/2\pi$ Hz is to be connected to a resistive load of 6000Ω. Calculate the value of the component that should be connected in series with the load in order for the load to dissipate maximum power. **[6marks]**

(e) The Thevenin's equivalent circuit of a network is calculated to consist of a voltage source of $15.4/60^{\circ}$ volts in series with a resistor of 1kΩ, a capacitor of reactance –j100Ω and a load impedance Z_L. What should be the value of Z_L for it to dissipate the maximum possible power. **[6marks]**

Q4 (a) Give two advantages of Active Filters over Passive Filters. **[2marks]**

(b) Using the Voltage divider theorem, show how a Passive Low Pass Filter (LPF) can easily be made by connecting together a single resistor and a capacitor across an a.c voltage source **[4marks]**

(c) A Low Pass Filter consists of a resistor of 50kΩ in series with a capacitor of 70nF and input voltage of 20V. Calculate the output voltage (V_o) at frequencies of 200Hz and 20kHz. **[7marks]**

(d) Use the result obtained in *Q4(c)* to plot the output voltage against the different values of the input frequency and explain by the curve how the network acts as a Low Pass Filter. **[7marks]**

Q5 (a) State the Thevenin's theorem. **[2marks]**

(b) A linear network consisting of a 6Vvoltage source whose internal resistance is 120Ω is connected in parallel to 5000Ω resistor. The parallel circuit is joined to a series circuit which is made up of 300Ω resistor and inductor whose inductive reactance is j400Ω. Use Thevenin's theorem to determine the current that will flow in an impedance of (350-j600)Ω if it is connected to the output of the linear network. **[10marks]**

(c) Verify your answer by Norton's Theorem [8marks]