UNIVERSITY OF GHANA
SECOND SEMESTER EXAMINATIONS, 2013/2014
LEVEL 200: BACHELOR OF SCIENCE IN ENGINEERING
CPEN 206: LINEAR CIRCUITS

INSTRUCTIONS: Answer **ALL five (5)** questions.

Time Allowed: ***THREE (3)*** *hours*

Q1. (a) State the **Maximum Power Transfer** theorem. *[2marks]*

(b) If a voltage source of e.m.f, $\mathbf{E_S}$ with internal impedance of $\mathbf{R_S + jX_S}$ is connected to a load of impedance $\mathbf{R_L + jX_L}$, prove that the maximum possible transfer of power from the source to the load will occur when the source and the load impedances are of the same magnitude. *[8marks]*

(c) For the circuit shown in ***figure 1*** below, calculate the value of the load resistor, $\mathbf{R_L}$ for which the power dissipated in it would be **maximum** and find the power. *[10marks]*

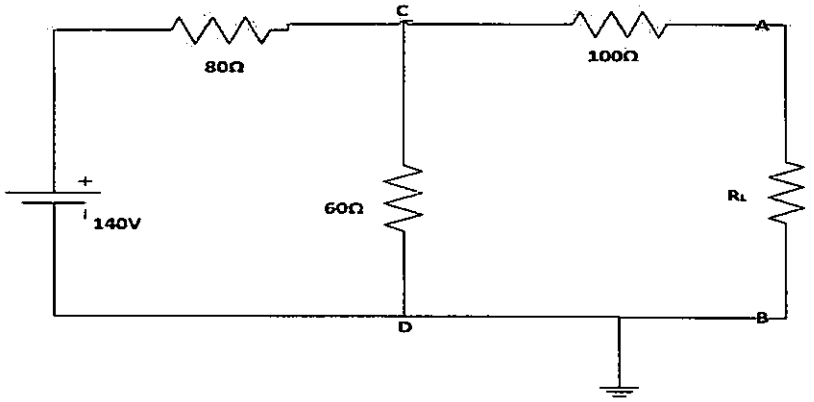

Figure 1.

Q2. (a) State **Norton's** theorem. *[2marks]*

(b) Using **Norton's** theorem, calculate current flowing in a **200Ω** resistor connected across terminals **AB** of the circuit shown in ***figure 2*** below. *[10marks]*

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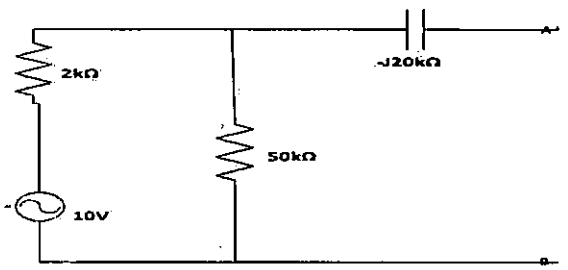

Figure 2.

(c) Verify your answer by using **Thevenin's** theorem. *[8marks]*

Q3. (a) Draw a block diagram of an Operational amplifier. *[3marks]*

(b) Give **four (4)** special characteristics (parameters) that an Operational amplifier should have. *[4marks]*

(c) Define an **operational amplifier bandwidth** and draw the Voltage gain (**dB**) / Frequency (**Hz**) response curve. *[4marks]*

(d) A non – inverting operational amplifier has input resistance $\mathbf{R_i = 40k\Omega}$, feedback resistance, $\mathbf{R_f = 200k\Omega}$ and load resistance, $\mathbf{R_L = 10k\Omega}$. If a voltage of **6V** is applied to the input, calculate:

(i) The output voltage (V_O). *[3marks]*

(ii) The voltage gain (A_V). *[3marks]*

(e) Draw an integrator circuit using an operational amplifier. *[3marks]*

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

(b) Using the **Voltage Potential Divider** theory, show how a Passive Low Pass Filter (**LPF**) can easily be made by connecting together in series a single resistor with a single capacitor. *[6marks]*

(c) A low pass filter circuit consists of a resistor of **100kΩ** in series with a capacitor of **70nF** and input voltage (V_{in}) of **10V**. Calculate the output voltage (V_O) at frequency of **400Hz** and again at frequency of **50kHz**. *[6marks]*

(d) Use the result obtained in **Q4 (c)** to plot the output voltage against different values of the input frequency, frequency response curve and explain by the curve how the network acts as a Low Pass Filter. *[6marks]*

Q5. (a) A current of **500mA** flows in an inductor of **60mH**, and **10Ω** resistance. Calculate the voltage across the inductor at a frequency of **1000Hz**. *[6marks]*

(b) A 10uF capacitor is charged from a 24 V d.c supply and is then disconnected from the supply. Calculate the energy stored in the capacitor. **[7marks]**

(c) A capacitor which is formed by nine (9) metal plates and have air as its dielectric. The area of the plate is $0.05cm^2$ and the distance between the plates is 0.06cm. Calculate the value of the capacitor given permittivity of free space (ε_o) = 8.85×10^{-12} F/m. **[7marks]**

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