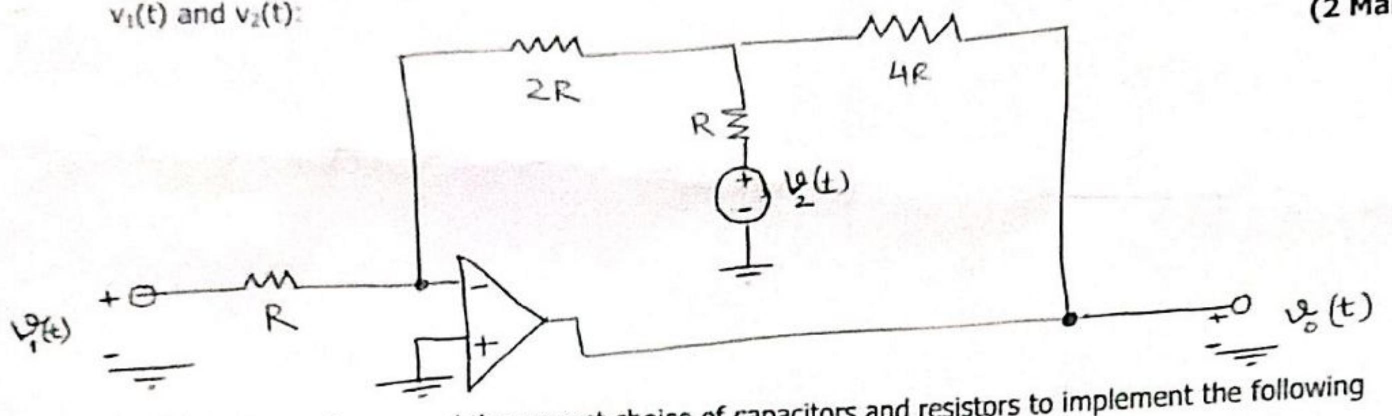
ELL100 Minor Exam 2
March 19, 2015

Total Marks: **20**

Q1. Design a series RLC circuit to select a 100 kHZ frequency of AM radio. This circuit has a bandwidth of 5 kHZ and draws 11 W from a 220 V (rms) source. **(3 Marks)**

Q2(a). For the ideal Op-Amp circuit shown in Figure 1, find the output $v_o(t)$ as a function of the inputs $v_1(t)$ and $v_2(t)$: **(2 Marks)**

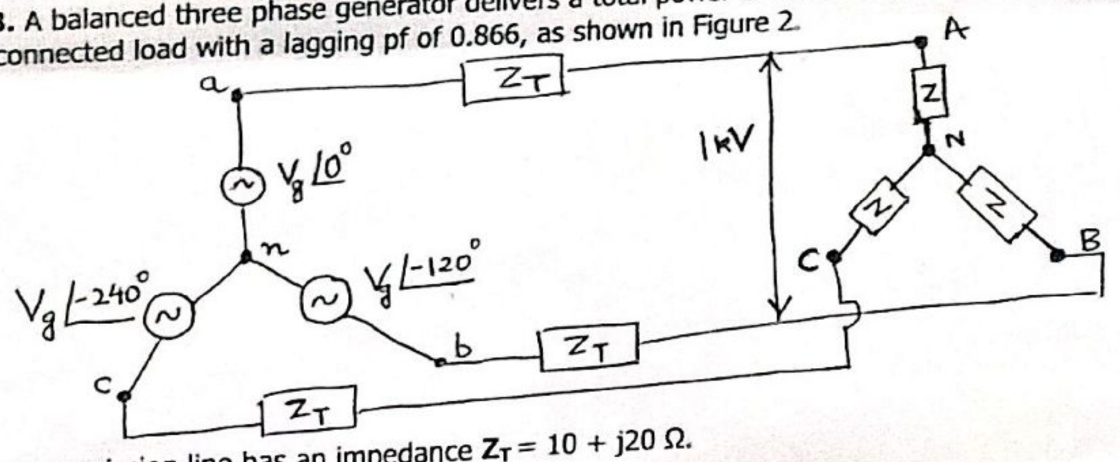


Q2(b). Use Op-Amps, and the correct choice of capacitors and resistors to implement the following function y(t), where $y_1(t)$ is an input signal:

$$y(t) = \frac{d^2 y_1}{dt^2} - 5\frac{dy_1}{dt}$$

(3 Marks)

Q3. A balanced three phase generator delivers a total power of 10 kW at 1 kV to a balanced three phase Y-connected load with a lagging pf of 0.866, as shown in Figure 2.



The transmission line has an impedance $Z_T = 10 + j20\ \Omega$.

(a) Determine the load impedance $Z\angle\theta$. **(2 Marks)**

(b) Determine the total average power supplied by the generator. **(3 Marks)**

Q4. Implement a Digital to Analog Convertor (DAC), using Op-Amps and the correct choice of capacitors and/or resistors, for a 4-bit digital input $v_3v_2v_1v_0$ where v_3, v_2, v_1, and v_0 are input voltage signals that can have values either '0' V or '1' V. Note a digital signal $v_3v_2v_1v_0$ has an analog value $2^0\times v_0 + 2^1\times v_1 + 2^2\times v_2 + 2^3\times v_3$. For example, the digital signal 1011 has an analog value $2^0\times 1 + 2^1\times 1 + 2^2\times 0 + 2^3\times 1 = 11$. **(3 Marks)**

Q5. In a power plant, the power is supplied to the plant at 6000V for a 50 Hz operation. The load of the power plant consists of heating (50 kW) and induction motors (200 kVA) that are operating at a lagging power factor of 0.5.

(a) Calculate the plant power factor **(1.5 Marks)**

(b) Calculate the reactive power **(1 Marks)**

(c) What reactive load has to be added to correct the power factor of the plant to 0.95? **(1.5 Marks)**