INFORMATION TECHNOLOGY UNIVERSITY, LAHORE, PAKISTAN

Electrical Network Analysis (EE-241)

Assignment # 6, Spring 2021

Submission Deadline:**Thursday** July 15, 2021 Maximum Marks: 100

- Submit at the start of the class on Thursday (15th July 2021).
- Write down your roll number on each page at the top right corner and stapple properly.
- Use pencils to draw the circuit diagrams.

1. (a) Let $h(t) = 2e^{-3t}u(t)$ and $x(t) = u(t) - \delta(t)$. Find $y(t) = h(t) \star x(t)$ by [4]
   i. using convolution in the time domain
   ii. finding $H(s)$ and $X(s)$ and then obtaining inverse Laplace Transform of $H(s).X(s)$

   (b) If a network is found to have the transfer function $H(s) = \frac{s}{s^2+8s+7}$, determine the s-domain output voltage for v_{in}(t) equal to [8]
   i. $3u(t)\,\mathrm{V}$
   ii. $25e^{-2t}u(t)\,\mathrm{V}$
   iii. $4u(t+1)\,\mathrm{V}$
   iv. $2 \sin\ 5t\,\mathrm{V}$

   (c) A particular network is known to be characterized by the transfer function $H(s) = \frac{s+1}{s^2+23s+60}$. Determine the critical frequencies of the output if the input is [8]
   i. $2u(t) + 4\delta(t)$
   ii. $-5e^{-t}u(t)$
   iii. $4te^{-2t}u(t)$
   iv. $5\sqrt{2}e^{-10t}cos\ 5t\ u(t)$

2. (a) For each of the two networks shown in Figure 1, write the **Transfer Functions** H(s) and determine their **poles** and **zeros**. [4]

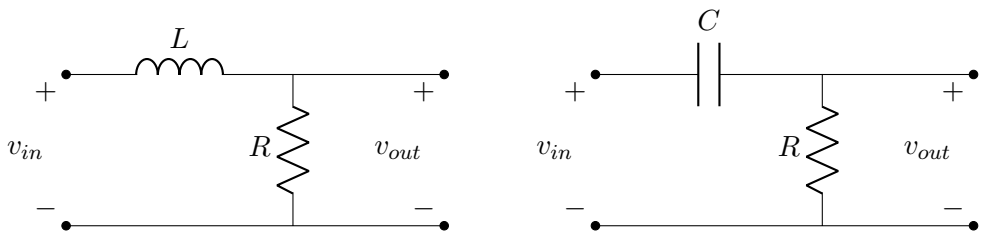


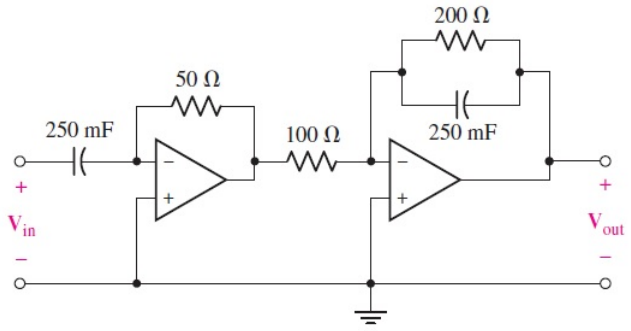
Figure 1: Circuit diagrams for problem 2a

   (b) The **Transfer Function** of a circuit is H(s) $= \frac{-5s}{s^2+15s+50}$. Determine the impulse response and step response of this circuit. [8]

   (c) Design a circuit which produces the transfer function $H(s) = \frac{V_{out}}{V_{in}}$ equal to [8]
   i. $5(s+1)$
   ii. $\frac{5}{s+1}$
   iii. $5\frac{s+1}{s+2}$
   iv. $3\frac{s+50}{(s+75)^2}$

3. For the following functions, sketch the Bode magnitude plots: [20]
   (a) $\frac{1}{3+4s}$
   (b) $(1+\frac{s}{3})(5+s)$
   (c) $\frac{0.1}{(1+5s)(2+s)}$
   (d) $3\frac{s}{s^2+7s+10}$
   (e) $\frac{s^2+9s+20}{s^2(s+1)^3}$

4. For the circuit shown in Figure, derive an expression for the transfer function $\mathbf{H(s)} = \frac{V_{out}}{V_{in}}$. Sketch the corresponding Bode magnitude and phase plots. [20]



5. (a) Design a low-pass filter circuit with a gain of 30 dB and a cutoff frequency of 10 kHz. [5]

   (b) Design a bandpass filter having a low-frequency cutoff of 500 Hz and a high frequency cutoff of 1580 Hz. [5]

   (c) Design a low-pass filter characterized by a voltage gain of 40 dB and a corner frequency of 1000 rad/s. [5]

   (d) Design a high-pass filter characterized by a voltage gain of 25 dB and a corner frequency of 500 rad/s. [5]