**EEE 148 Buck Converter in Simulink**

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| **Submitted by**: | **Student Number**: | **Section**: |
| **Collaborated with:** | | |

**GENERAL INSTRUCTIONS:** Provide the required information in the spaces provided. If you run out of room for your answer, feel free to adjust the template as necessary.

**Learning Activity: Open-Loop Buck Converter**

1. **Open-loop Buck Converter.** Implement the open-loop buck converter in Figures 4 and 5.

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| 1. waveform. at steady-state = \_\_\_\_\_\_\_\_\_\_ 2. waveform. |

1. **Buck Converter with Resistances.** Modify the buck converter in Fig. 4 using the following values: L = 5µH, RL = 80mΩ, C = 390µF, Resr = 2mΩ.

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| 1. Block Diagram of the buck converter itself (similar to Fig 4; not the overall diagram). |

1. **PWM.** Set d=0.4

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| 1. waveform. at steady-state = \_\_\_\_\_\_\_\_\_\_ 2. waveform. at steady-state = \_\_\_\_\_\_\_\_\_\_ |

1. **Varying the duty cycle.**  Change the duty cycle iteratively to get the desired output of .

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| 1. What is the duty cycle needed to get ? \_\_\_\_\_\_\_\_\_\_ 2. waveform. at steady-state = \_\_\_\_\_\_\_\_\_\_ 3. waveform. 4. What is your process for varying the duty cycle? How does the output of the buck converter affect your decision whether to increase or decrease the duty cycle? |

1. **Changing the load resistance**

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| 1. Show the new block diagram of the open-loop system. 2. What is the value of and at steady state? \_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_ 3. How does the load affect and ? Explain. 4. How can you get back a desired value for when using a different load? |

**Learning Activity: Closed-Loop Buck Converter**

1. **Closed-loop Buck Converter.** Implement the open-loop buck converter in Figures 7.

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| 1. waveform. at steady-state = \_\_\_\_\_\_\_\_\_\_ 2. waveform. |

1. **Changing the output .** Modify the closed-loop buck converter such that

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| 1. Block Diagram of the closed-loop buck converter 2. What variable must be changed? What should be its value? \_\_\_\_\_\_\_ = \_\_\_\_\_\_\_ 3. Explain how this works. Include both equations and explanations. 4. Probe the value of the duty cycle . What is the value at steady-state? \_\_\_\_\_\_\_\_\_\_\_\_   Compare this with the duty cycle value that you got in the open-loop exercise to also get . Explain. |

1. How can you implement without using another voltage source? Note that we only have a single input  
   voltage source available to us.

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1. **Changing the load resistance.** Replace the load with

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| 1. Show the new block diagram of the closed-loop system. 2. Show the waveforms. What is the value of and at steady state?   \_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_   1. How does the load affect and ? Explain. 2. Probe the value of the duty cycle d. What is the value at steady-state? Did the value change compared to when ? Why or why not? |

1. Explain how an open-loop system would get a desired , and how it differs from a closed-loop system.

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1. Explain the advantages and disadvantages of using an open-loop vs. using a closed-loop system.

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