EECE418 Power Electronics
Dr. Charles Kim

Assignment 1: Ch2 – Power Computations

A. Instruction:
Solve the following **Chapter 2** problems. Use of Smath Studio is encouraged in the calculations.

Academic Honesty: If any two or more submitted works are (almost) identical, all such works will be considered as cheated ones, and are subject to 0 point first and then to possible additional disciplinary action from the university.

B. Score Distribution and Rubric:

Prob #	**Description**	**Point Distribution (by the quality of the answer)**
Each problem (of All other problems)	Show all the calculation process	10
	Calculation process is limited	5
	Does not show calculation process	0
LTSpice Problems	Schematic	10 5 0
	Source	10 5 0
	Obtaining the calculation results	10 5 0

C. Submission: Submit either (a) hand-written and sketched works or (b)typed report with computer generated sketch in the following file name: **YourLastName_Assignment1.xxx**

D. Submission due: Check the webpage

E. Late submission Point Deduction (**Maximum score by submission date**)

Submission Time/Date	Maximum score
By 8:00pm submission date (W)	100
By 5:00pm submission date + 1 (R)	70
By 5:00pm submission date + 2 (F)	50
After the above	0

F. Problems

2-4. The voltage and current for a device (using the passive sign convention) are periodic functions with $T = 100$ ms described by

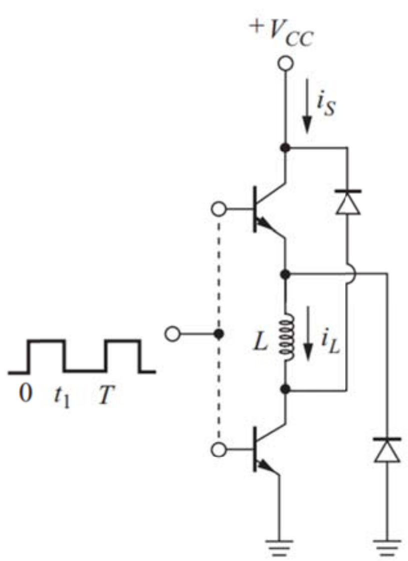
$$v(t) = \begin{cases} 10\text{ V} & 0 < t < 70\text{ ms} \\ 0 & 70\text{ ms} < t < 100\text{ ms} \end{cases}$$

$$i(t) = \begin{cases} 0 & 0 < t < 50\text{ ms} \\ 4\text{ A} & 50\text{ ms} < t < 100\text{ ms} \end{cases}$$

Determine (*a*) the instantaneous power, (*b*) the average power, and (*c*) the energy absorbed by the device in each period.

2-9. An electric resistance space heater rated at 1500 W for a voltage source of $v(t) = 120\sqrt{2}\sin(2\pi 60t)$ V has a thermostatically controlled switch. The heater periodically switches on for 5 min and off for 7 min. Determine (*a*) the maximum in stantaneous power, (*b*) the average power over the 12-min cycle, and (*c*) the electric energy converted to heat in each 12-min cycle.

2-12. An inductor is energized as in the circuit of Fig. 2-5*a*. The circuit has $L = 50$ mH, $V_{CC} = 90$ V, $t_1 = 4$ ms, and $T = 50$ ms. (*a*) Determine the peak energy stored in the inductor. (*b*) Graph the inductor current, source current, inductor instantaneous power, and source instantaneous power versus time. Assume the transistors are ideal.



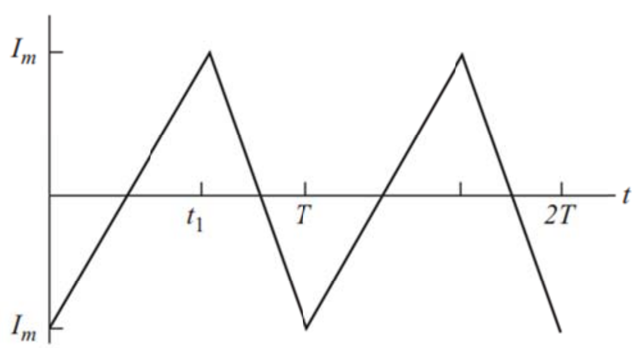
(*a*)

2-19. The voltage and current for a circuit element are $v(t) = 2 + 5\cos(2\pi 60t) - 3\cos(4\pi 60t + 45°)$ V and $i(t) = 1.5 + 2\cos(2\pi 60t + 20°) + 1.1\cos(4\pi 60t - 20°)$ A. (*a*) Determine the rms values of voltage and current. (*b*) Determine the power absorbed by the element.

2-27. A sinusoidal voltage source of $v(t) = 170\cos(2\pi 60t)$ V is applied to a nonlinear load, resulting in a nonsinusoidal current that is expressed in Fourier series form as $i(t) = 10\cos(2\pi 60t + 30°) + 6\cos(4\pi 60t + 45°) + 3\cos(8\pi 60t + 20°)$ A. Determine (*a*) the power absorbed by the load, (*b*) the power factor of the load, (*c*) the distortion factor, and (*d*) the total harmonic distortion of the load current.

2-29. A sinusoidal voltage source of $v(t) = 240\sqrt{2}\sin(2\pi 60t)$ V is applied to a nonlinear load, resulting in a current $i(t) = 8\sin(2\pi 60t) + 4\sin(4\pi 60t)$ A. Determine (*a*) the power absorbed by the load, (*b*) the power factor of the load, (*c*) the THD of the load current, (*d*) the distortion factor of the load current, and (*e*) the crest factor of the load current.

2-41. (LTSpice Simulation) For a triangular waveform like that of Fig. 2-9a, (a) demonstrate that its rms value is $V_m/\sqrt{3}$, and (b) derive Fourier series coefficients up to the 7th harmonic. T= 10 ms, t_1= 6 ms, and I_m = 10.



(*a*)