EMTR 1030 – Electronics

Assignment 3

Due: 10:00pm, Tuesday, March 10

Problem 4.68

4.68 A half-wave rectifier circuit with a 500-Ω load operates from a 120-V (rms) 60-Hz household supply through a 12-to-1 step-down transformer. It uses a silicon diode that can be modeled to have a 0.7-V drop for any current. What is the peak voltage of the rectified output? For what fraction of the cycle does the diode conduct? What is the average output voltage? What is the average current in the load?

Problem 4.69

4.69 A full-wave rectifier circuit with a 500-Ω load operates from a 120-V (rms) 60-Hz household supply through a 6-to-1 transformer having a center-tapped secondary winding. It uses two silicon diodes that can be modeled to have a 0.7-V drop for all currents. What is the peak voltage of the rectified output? For what fraction of a cycle does each diode conduct? What is the average output voltage? What is the average current in the load?

Problem 4.70

4.70 A full-wave bridge-rectifier circuit with a 500-Ω load operates from a 120-V (rms) 60-Hz household supply through a 6-to-1 step-down transformer having a single secondary winding. It uses four diodes, each of which can be modeled to have a 0.7-V drop for any current. What is the peak value of the rectified voltage across the load? For what fraction of a cycle does each diode conduct? What is the average voltage across the load? What is the average current through the load?

Problem 5.4

5.4 An NMOS transistor that is operated with a small v_{DS} is found to exhibit a resistance r_{DS}. By what factor will r_{DS} change in each of the following situations?

(a) v_{OV} is doubled.

(b) The device is replaced with another fabricated in the same technology but with double the width.

(c) The device is replaced with another fabricated in the same technology but with both the width and length doubled.

(d) The device is replaced with another fabricated in a more advanced technology for which the oxide thickness is halved and similarly for W and L (assume μ_n remains unchanged).

Problem 5.6

5.6 Sketch a set of i_D–v_{DS} characteristic curves for an NMOS transistor operating with a small v_{DS} (in the manner shown in Fig. 5.4). Let the MOSFET have $k_n = 10$ mA/V^2 and $V_{tn} = 0.4$ V. Sketch and clearly label the graphs for $v_{GS} = 0.4$, 0.6, 0.8, 1.0, and 1.2 V. Let v_{DS} be in the range 0 to 50 mV. Give the value of r_{DS} obtained for each of the five values of v_{GS}. Although only a sketch, your diagram should be drawn to scale as much as possible.

Problem 5.9

5.9 An NMOS transistor with $k_n = 5$ mA/V^2 and $V_t = 0.4$ V is operated with $v_{GS} = 0.6$ V. At what value of v_{DS} does the transistor enter the saturation region? What value of i_D is obtained in saturation?