

Chapter 3 PROBLEMS

For all problems, use the device parameters provided in Chapter 3 (Tables 3.2 and 3.5) and the inside back book cover, unless otherwise mentioned. Also assume $T = 300$ K by default.

1. [E, SPICE, 3.2.2]
 - a. Consider the circuit of Figure 0.1. Using the simple model, with $V_{\text{on}} = 0.7$ V, solve for I_D .
 - b. Find I_D and V_D using the ideal diode equation. Use $I_s = 10^{-14}$ A and $T = 300$ K.
 - c. Solve for V_{on} , V_{off} , and I_D using SPICE.
 - d. Repeat parts b and c using $I_s = 10^{-16}$ A, $T = 300$ K, and $I_s = 10^{-14}$ A, $T = 350$ K.

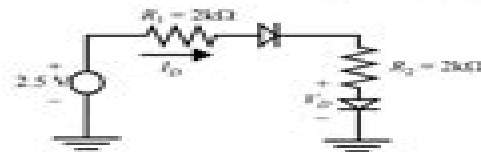


Figure 0.1 Resistor diode circuit.

2. [M, None, 3.2.3] For the circuit in Figure 0.2, $V_s = 3.3$ V. Assume $A_{\text{ox}} = 12 \mu\text{m}^2$, $\phi_0 = 0.65$ V, and $m = 0.5$. $N_A = 2.5 \text{ E}16$ and $N_D = 5 \text{ E}15$.
 - a. Find I_D and V_D .
 - b. Is the diode forward- or reverse-biased?
 - c. Find the depletion region width, W_p , of the diode.
 - d. Use the parallel-plate model to find the junction capacitance, C_j .
 - e. Set $V_s = 1.5$ V. Again using the parallel-plate model, explain qualitatively why C_j increases.



Figure 0.2 Series diode circuit.

3. [E, None, 3.3.2] Figure 0.3 shows NMOS and PMOS devices with drains, source, and gate ports annotated. Determine the mode of operation (saturation, linear, or cutoff) and drain current I_D for each of the biasing configurations given below. Verify with SPICE. Use the following transistor data: NMOS: $k_n' = 115 \mu\text{A/V}^2$, $V_{\text{th}} = 0.43$ V, $\lambda = 0.06 \text{ V}^{-1}$, PMOS: $k_p' = 30 \mu\text{A/V}^2$, $V_{\text{th}} = -0.4$ V, $\lambda = -0.1 \text{ V}^{-1}$. Assume $(W/L) = 1$.
 - a. NMOS: $V_{\text{gs}} = 2.5$ V, $V_{\text{ds}} = 2.5$ V. PMOS: $V_{\text{gs}} = -0.5$ V, $V_{\text{ds}} = -1.25$ V.
 - b. NMOS: $V_{\text{gs}} = 3.3$ V, $V_{\text{ds}} = 2.2$ V. PMOS: $V_{\text{gs}} = -2.5$ V, $V_{\text{ds}} = -1.8$ V.
 - c. NMOS: $V_{\text{gs}} = 0.6$ V, $V_{\text{ds}} = 0.1$ V. PMOS: $V_{\text{gs}} = -2.5$ V, $V_{\text{ds}} = -0.7$ V.
4. [E, SPICE, 3.3.2] Using SPICE plot the I - V characteristics for the following devices.

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A Gutmann



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book presents the state of the art in the area of water remediation It covers topics such as decentralized ecological wastewater treatment applications of remote sensing and geographic information systems GIS in water quality monitoring and remediation water remediation through nanotechnology and processes used in water purification The contents of this volume will prove useful to researchers students and policy makers alike *Intelligent CAD Systems I* Paul J.W. ten Hagen,Tetsuo Tomiyama,2012-12-06 CAD Computer Aided Design technology is now crucial for every division of modern industry from a viewpoint of higher productivity and better products As technologies advance the amount of information and knowledge that engineers have to deal with is constantly increasing This results in seeking more advanced computer technology to achieve higher functionalities flexibility and efficient performance of the CAD systems Knowledge engineering or more broadly artificial intelligence is considered a primary candidate technology to build a new generation of CAD systems Since design is a very intellectual human activity this approach seems to make sense The ideas of intelligent CAD systems ICAD are now increasingly discussed everywhere We can observe many conferences and workshops reporting a number of research efforts on this particular subject Researchers are coming from computer science artificial intelligence mechanical engineering electronic engineering civil engineering architectural science control engineering etc But still we cannot see the direction of this concept or at least there is no widely accepted concept of ICAD What can designers expect from these future generation CAD systems In which direction must developers proceed The situation is somewhat confusing **Handbook of Research on Wireless Multimedia: Quality of Service and Solutions** Cranley, Nicola,Murphy, Liam,2008-07-31 This book highlights and discusses the underlying QoS issues that arise in the delivery of real time multimedia services over wireless networks Provided by publisher **Semantic Web Technologies and E-Business: Toward the Integrated Virtual Organization and Business Process Automation** Salam, A.F.,Stevens, Jason,2006-12-31 This book presents research related to the application of semantic Web technologies including semantic service oriented architecture semantic content management and semantic knowledge sharing in e business processes It compiles research from experts around the globe to bring to the forefront the many issues surrounding the application of semantic Web technologies in e business Provided by publisher A Practical Introduction to Hardware/Software Codesign Patrick R. Schaumont,2012-11-27 This textbook serves as an introduction to the subject of embedded systems design with emphasis on integration of custom hardware components with software The key problem addressed in the book is the following how can an embedded systems designer strike a balance between flexibility and efficiency The book describes how combining hardware design with software design leads to a solution to this important computer engineering problem The book covers four topics in hardware software codesign fundamentals the design space of custom architectures the hardware software interface and application examples The book comes with an associated design environment that helps the reader to perform experiments in hardware software codesign Each chapter also includes exercises and further reading suggestions Improvements in this second edition

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