

## 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  $V_{\text{on}}$ ,  $V_{\text{off}}$ , 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.

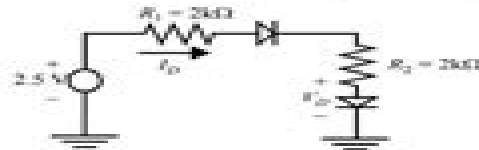


Figure 0.1 Resistor diode circuit.

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:  $V_{\text{ox}} = 2.5$  V,  $V_{\text{os}} = 2.5$  V. PMOS:  $V_{\text{ox}} = -0.5$  V,  $V_{\text{os}} = -1.25$  V.
  - b. NMOS:  $V_{\text{ox}} = 3.3$  V,  $V_{\text{os}} = 2.2$  V. PMOS:  $V_{\text{ox}} = -2.5$  V,  $V_{\text{os}} = -1.8$  V.
  - c. NMOS:  $V_{\text{ox}} = 0.6$  V,  $V_{\text{os}} = 0.1$  V. PMOS:  $V_{\text{ox}} = -2.5$  V,  $V_{\text{os}} = -0.7$  V.
4. [E, SPICE, 3.3.2] Using SPICE plot the  $I$ - $V$  characteristics for the following devices.

# Problem Solution Of Rabaey

**Jin-Ying Zhang**



## **Problem Solution Of Rabaey:**

Artificial Neural Nets. Problem Solving Methods José Mira, José R. Alvarez, 2003-08-03 The two volume set LNCS 2686 and LNCS 2687 constitute the refereed proceedings of the 7th International Work Conference on Artificial and Natural Neural Networks IWANN 2003 held in Ma 3 Menorca Spain in June 2003 The 197 revised papers presented were carefully reviewed and selected for inclusion in the book and address the following topics mathematical and computational methods in neural modelling neurophysiological data analysis and modelling structural and functional models of neurons learning and other plasticity phenomena complex systems dynamics cognitive processes and artificial intelligence methodologies for net design bio inspired systems and engineering and applications in a broad variety of fields nbsp *Enzymes for Solving Humankind's Problems* José J. G. Moura, Isabel Moura, Luisa B. Maia, 2020-12-01 This book presents specific key natural and artificial systems that are promising biocatalysts in the areas of health agriculture environment and energy It provides a comprehensive account of the state of the art of these systems and outlines the significant progress made in the last decade using these systems to develop innovative sustainable and environmentally friendly solutions Chapters from expert contributors explore how natural enzymes and artificial systems tackle specific targets such as climate change carbon footprint and economy and carbon dioxide utilisation nitrogen footprint and fixation and nitrous oxide mitigation hydrogen production fuel cells and energy from bacteria biomass transformation and production of added value compounds as well as biosensors development This book provides an important and inspiring account for the designing of new natural and artificial systems with enhanced properties and it appeals not only to students and researchers working in the fields of energy health food and environment but also to a wider audience of educated readers that are interested in these up to date and exciting subjects Chapter Carbon Dioxide Utilisation The Formate Route is available open access under a Creative Commons Attribution 4 0 International License via link [springer.com](https://www.springer.com) **Proceedings of the International Conference on Soft Computing for Problem Solving (SocProS 2011) December 20-22, 2011** Kusum Deep, Atulya Nagar, Millie Pant, Jagdish Chand Bansal, 2012-04-15 The objective is to provide the latest developments in the area of soft computing These are the cutting edge technologies that have immense application in various fields All the papers will undergo the peer review process to maintain the quality of work *Modern Age Waste Water Problems* Mohammad Oves, Mohammad Omaish Ansari, Mohammad Zain Khan, Mohammad Shahadat, Iqbal M.I. Ismail, 2019-06-12 This book presents a picture of the advances in the research of theoretical and practical frameworks of wastewater problems and solutions The book deals with a basic concept and principles of modern biological chemical and technical approaches to remediate various hazardous pollutants from wastewater The latest empirical research findings in wastewater treatment are comprehensively discussed Examples of low cost technologies are also included The book is written for professionals researchers academics and students wanting to improve their understanding of the strategic role of environmental protection and advanced applied

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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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