

Chapter 1 Answers

- 1.1. Converting from polar to Cartesian coordinates:

$$\begin{aligned} \frac{1}{\sqrt{2}}e^{j\pi} &= \frac{1}{\sqrt{2}}\cos\pi + j\frac{1}{\sqrt{2}}\sin\pi = -\frac{1}{\sqrt{2}} \\ e^{j\pi/4} &= \cos\left(\frac{\pi}{4}\right) + j\sin\left(\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}} \\ e^{j\pi/2} &= \cos\left(\frac{\pi}{2}\right) + j\sin\left(\frac{\pi}{2}\right) = j \\ e^{j3\pi/4} &= \cos\left(\frac{3\pi}{4}\right) + j\sin\left(\frac{3\pi}{4}\right) = -\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}} \\ e^{j\pi} &= \cos\pi + j\sin\pi = -1 \\ e^{j5\pi/4} &= \cos\left(\frac{5\pi}{4}\right) + j\sin\left(\frac{5\pi}{4}\right) = -\frac{1}{\sqrt{2}} - j\frac{1}{\sqrt{2}} \\ e^{j3\pi/2} &= \cos\left(\frac{3\pi}{2}\right) + j\sin\left(\frac{3\pi}{2}\right) = -j \\ e^{j7\pi/4} &= \cos\left(\frac{7\pi}{4}\right) + j\sin\left(\frac{7\pi}{4}\right) = \frac{1}{\sqrt{2}} - j\frac{1}{\sqrt{2}} \end{aligned}$$

- 1.2. Converting from Cartesian to polar coordinates:

$$\begin{aligned} 1 &= 2e^{j0} & -2 &= 2e^{j\pi} \\ 1 - j &= \sqrt{2}e^{-j\pi/4} & 1 + j &= \sqrt{2}e^{j\pi/4} \\ -1 - j &= \sqrt{2}e^{j3\pi/4} & 1 - j &= \sqrt{2}e^{-j\pi/4} \\ -1 + j &= \sqrt{2}e^{j5\pi/4} & 1 + j &= \sqrt{2}e^{j\pi/4} \end{aligned}$$

- 1.3. (a) $E_{\text{avg}} = \int_{-\infty}^{\infty} e^{-2t} dt = \frac{1}{2}$. $P_{\text{avg}} = 0$, because $E_{\text{avg}} < \infty$.

(b) $x_1(t) = e^{j\pi t} = 1$, $x_2(t) = 1$. Therefore, $E_{\text{avg}} = \int_{-\infty}^{\infty} |x_1(t)|^2 dt = \int_{-\infty}^{\infty} 1 dt = \infty$, $P_{\text{avg}} = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T |x_1(t)|^2 dt = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T 1 dt = \lim_{T \rightarrow \infty} \frac{1}{2T} (2T) = 1$.

(c) $x_3(t) = \cos(2t)$. Therefore, $E_{\text{avg}} = \int_{-\infty}^{\infty} |x_3(t)|^2 dt = \int_{-\infty}^{\infty} \cos^2(2t) dt = \infty$.
 $P_{\text{avg}} = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T \cos^2(2t) dt = \lim_{T \rightarrow \infty} \frac{1}{2T} \int_{-T}^T \left(\frac{1 + \cos(4t)}{2} \right) dt = 1$

(d) $x_4(t) = (1/2)^t e^{j\pi t}$, $|x_4(t)|^2 = (1/2)^{2t}$. Therefore, $E_{\text{avg}} = \sum_{n=-\infty}^{\infty} |x_4(n)|^2 = \sum_{n=-\infty}^{\infty} (1/2)^{2n} = \frac{1}{1 - 1/4} = \frac{4}{3}$.
 $P_{\text{avg}} = 0$, because $E_{\text{avg}} < \infty$.

(e) $x_5(t) = e^{j\pi t} e^{-t} = 1$. Therefore, $E_{\text{avg}} = \sum_{n=-\infty}^{\infty} |x_5(n)|^2 = \infty$.
 $P_{\text{avg}} = \lim_{T \rightarrow \infty} \frac{1}{2T} \sum_{n=-T}^T |x_5(n)|^2 = \lim_{T \rightarrow \infty} \frac{1}{2T} \sum_{n=-T}^T 1 = \lim_{T \rightarrow \infty} \frac{1}{2T} (2T) = 1$.

(f) $x_6(t) = \cos(t)$. Therefore, $E_{\text{avg}} = \sum_{n=-\infty}^{\infty} |x_6(n)|^2 = \sum_{n=-\infty}^{\infty} \cos^2(n) = \infty$.
 $P_{\text{avg}} = \lim_{T \rightarrow \infty} \frac{1}{2T} \sum_{n=-T}^T \cos^2(n) = \lim_{T \rightarrow \infty} \frac{1}{2T} \sum_{n=-T}^T \left(\frac{1 + \cos(2n)}{2} \right) = \frac{1}{2}$

- 1.4. (a) The signal $x(t)$ is shifted by 3 to the right. The shifted signal will be zero for $t < 1$ and $t \geq 7$.
 (b) The signal $x(t)$ is shifted by 4 to the left. The shifted signal will be zero for $t < -4$ and $t > 8$.

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- 1.5. (a) $\Re\{x_1(t)\} = -2 + 2e^{j\pi t} \cos(2t) + e^{j\pi t}$
 (b) $\Re\{x_2(t)\} = \sqrt{2} \cos(t) \cos(2t + 2\pi) = \cos(2t) = e^{j2\pi t} \cos(2t + \pi)$
 (c) $\Re\{x_3(t)\} = e^{-t} \sin(2t + \pi) = -e^{-t} \sin(2t) = \frac{1}{2}j(e^{j2\pi t} - e^{-j2\pi t})$
 (d) $\Re\{x_4(t)\} = -e^{j2\pi t} \sin(100t) = e^{j2\pi t} \sin(100t + \pi) = e^{j2\pi t} \cos(100t + \frac{\pi}{2})$

- 1.6. (a) $x_1(t)$ is a periodic complex exponential.

$$x_1(t) = je^{j2\pi t} + je^{j4\pi t} + 1$$

The fundamental period of $x_1(t)$ is $\frac{1}{2} = \frac{1}{N}$.

- (b) $x_2(t)$ is a complex exponential multiplied by a decaying exponential. Therefore, $x_2(t)$ is not periodic.

- (c) $x_3(t)$ is a periodic signal.

$$x_3(t) = e^{j\pi t} + e^{j2\pi t}$$

$x_3(t)$ is a complex exponential with a fundamental period of $\frac{1}{2} = \frac{1}{N}$.

- (d) $x_4(t)$ is a periodic signal. The fundamental period is given by $N = \text{m.c.}(\frac{1}{2N_1}) = \text{m.c.}(\frac{1}{2})$. By choosing $m = 2$, we obtain the fundamental period to be 1.

- (e) $x_5(t)$ is not periodic. $x_5(t)$ is a complex exponential with $\omega_0 = 1/5$. We cannot find any integer m such that $m(\frac{1}{5})$ is also an integer. Therefore, $x_5(t)$ is not periodic.

- 1.7.

$$x(t) = 2\cos(20t + 1) - \sin(40t - 3)$$

Period of first term in RHS = $\frac{2\pi}{20} = \frac{1}{5}$

Period of second term in RHS = $\frac{2\pi}{40} = \frac{1}{10}$

Therefore, the overall signal is periodic with a period which is the least common multiple of the periods of the first and second terms. This is equal to 1.

- 1.8.

$$x(t) = 1 + e^{j\pi t} - e^{j2\pi t}$$

Period of the first term in the RHS = 1

Period of the second term in the RHS = $\text{m.c.}(\frac{1}{2N_1}) = 1$ (when $m = 2$)

Period of the third term in the RHS = $\text{m.c.}(\frac{1}{2N_2}) = 1$ (when $m = 1$)

Therefore, the overall signal $x(t)$ is periodic with a period which is the least common multiple of the periods of the three terms in $x(t)$. This is equal to 1.

- 1.9.

- (a) The signal $x(t)$ is as shown in Figure S1.12. $x(t)$ can be obtained by flipping $x_1(t)$ and then shifting the flipped signal by 3 to the right. Therefore, $x(t) = x_1(t-3)$. This implies that $M = -1$ and $n_0 = -3$.

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- (c) The signal $x(t)$ is flipped. The flipped signal will be zero for $t < -4$ and $t > 2$.
 (d) The signal $x(t)$ is flipped and the flipped signal is shifted by 2 to the right. This new signal will be zero for $t < -2$ and $t > 4$.
 (e) The signal $x(t)$ is flipped and the flipped signal is shifted by 2 to the left. This new signal will be zero for $t < -6$ and $t > 6$.

- 1.10.

- (a) $x(t) = 1$ is obtained by flipping $x_1(t)$ and shifting the flipped signal by 1 to the right. Therefore, $x(t) = 1$ will be zero for $t > 2$.
 (b) From (a), we know that $x(t) = 1$ is zero for $t > 2$. Similarly, $x(t) = 1$ is zero for $t < -1$. Therefore, $x(t) = 1$ will be zero for $t > -3$.
 (c) $x(t)$ is obtained by linearly compressing $x_1(t)$ by a factor of 3. Therefore, $x(t)$ will be zero for $t < 1$.
 (d) $x(t)$ is obtained by linearly stretching $x_1(t)$ by a factor of 3. Therefore, $x(t)$ will be zero for $t < 9$.

- 1.11.

- (a) $x_1(t)$ is not periodic because it is zero for $t < 0$.
 (b) $x_2(t) = 1$ for all t . Therefore, it is periodic with a fundamental period of 1.
 (c) $x_3(t)$ is as shown in the Figure S1.14.



Figure S1.14

Therefore, it is periodic with a fundamental period of 4.

- 1.12. (a)

$$f(x_1(t)) = \frac{1}{2}(\cos(t) + \cos(-t)) = \frac{1}{2}(\cos(t) + \cos(t)) = \cos(t)$$

Therefore, $f(x_1(t))$ is zero for $|t| > \pi$.

- (b) Since $x_2(t)$ is an odd signal, $f(x_2(t))$ is zero for all values of t .

- (c)

$$f(x_3(t)) = \frac{1}{2}(\cos(t) + \cos(-t)) = \frac{1}{2}(\cos(t) + \cos(t)) = \cos(t)$$

Therefore, $f(x_3(t))$ is zero when $|t| > \pi$ and when $|t| \rightarrow \infty$.

- (d)

$$f(x_4(t)) = \frac{1}{2}(\cos(t) + \cos(-t)) = \frac{1}{2}(\cos(t) + \cos(t)) = \cos(t)$$

Therefore, $f(x_4(t))$ is zero only when $|t| \rightarrow \infty$.

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Signals And Systems 2nd Edition Solutions Manual

**M. Ghavami, Lachlan Michael, Ryuji
Kohno**



Signals And Systems 2nd Edition Solutions Manual:

Solutions Manual Naveed Akhtar Malik, Syed Hamid Nawab, 1983 **A Practical Approach to Signals and Systems**

D. Sundararajan, 2009-03-04 Concisely covers all the important concepts in an easy to understand way Gaining a strong sense of signals and systems fundamentals is key for general proficiency in any electronic engineering discipline and critical for specialists in signal processing communication and control At the same time there is a pressing need to gain mastery of these concepts quickly and in a manner that will be immediately applicable in the real world Simultaneous study of both continuous and discrete signals and systems presents a much easy path to understanding signals and systems analysis In A Practical Approach to Signals and Systems Sundararajan details the discrete version first followed by the corresponding continuous version for each topic as discrete signals and systems are more often used in practice and their concepts are relatively easier to understand In addition to examples of typical applications of analysis methods the author gives comprehensive coverage of transform methods emphasizing practical methods of analysis and physical interpretations of concepts Gives equal emphasis to theory and practice Presents methods that can be immediately applied Complete treatment of transform methods Expanded coverage of Fourier analysis Self contained starts from the basics and discusses applications Visual aids and examples makes the subject easier to understand End of chapter exercises with a extensive solutions manual for instructors MATLAB software for readers to download and practice on their own Presentation slides with book figures and slides with lecture notes A Practical Approach to Signals and Systems is an excellent resource for the electrical engineering student or professional to quickly gain an understanding of signal analysis concepts concepts which all electrical engineers will eventually encounter no matter what their specialization For aspiring engineers in signal processing communication and control the topics presented will form a sound foundation to their future study while allowing them to quickly move on to more advanced topics in the area Scientists in chemical mechanical and biomedical areas will also benefit from this book as increasing overlap with electrical engineering solutions and applications will require a working understanding of signals Compact and self contained A Practical Approach to Signals and Systems be used for courses or self study or as a reference book

Continuous-Time Signals and Systems Oktay Alkin, 2025-03-24 Drawing on author's 30 years of teaching experience Continuous Time Signals and Systems A MATLAB Integrated Approach represents a novel and comprehensive approach to understanding signals and systems theory Many textbooks use MATLAB as a computational tool but Alkin's text employs MATLAB both computationally and pedagogically to provide interactive visual reinforcement of fundamental concepts important in the study of continuous time signals and systems In addition to 210 traditional end of chapter problems and 168 solved examples the book includes hands on MATLAB modules consisting of 77 MATLAB based homework problems and projects coordinated with the traditional end of chapter problems 106 live scripts and GUI based interactive apps that animate key figures and bring core concepts to life Downloadable MATLAB code for most of the solved examples 64 fully

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Chaparro,2010-11-10 This new textbook in signals and systems provides a pedagogically rich approach to what can commonly be a mathematically dry subject With features like historical notes highlighted common mistakes and applications in controls communications and signal processing Chaparro helps students appreciate the usefulness of the techniques described in the book Each chapter contains a section with MatLab applications Pedagogically rich introduction to signals and systems using historical notes pointing out common mistakes and relating concepts to realistic examples throughout to motivate learning the material Introduces both continuous and discrete systems early then studies each separately in more depth later Extensive set of worked examples and homework assignments with applications to controls communications and signal processing throughout Provides review of all the background math necessary to study the subject MatLab applications in every chapter **Ultra Wideband Signals and Systems in Communication Engineering** M. Ghavami,Lachlan

Michael,Ryuji Kohno,2007-02-06 The thoroughly revised and updated second edition of Ultra Wideband Signals and Systems in Communication Engineering features new standards developments and applications It addresses not only recent developments in UWB communication systems but also related IEEE standards such as IEEE 802 15 wireless personal area network WPAN Examples and problems are included in each chapter to aid understanding Enhanced with new chapters and several sections including Standardization advanced topics in UWB Communications and more applications this book is essential reading for senior undergraduates and postgraduate students interested in studying UWB The emphasis on UWB development for commercial consumer communications products means that any communication engineer or manager cannot afford to be without it New material included in the second edition Two new chapters covering new regulatory issues for UWB systems and new systems such as ad hoc and sensor networks MAC protocols and space time coding for UWB systems IEEE proposals for channel models and their specifications Interference and coexistence of UWB with other systems UWB antennas and arrays and new types of antennas for UWB systems such as printed bow tie antennas Coverage of new companies working on UWB such as Artimi and UBISense UWB potential for use in medicine including cardiology respiratory

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Micromechatronics Victor Giurgiutiu, Sergey Edward Lyshevski, 2016-04-19 Focusing on recent developments in engineering science enabling hardware advanced technologies and software Micromechatronics Modeling Analysis and Design with MATLAB Second Edition provides clear comprehensive coverage of mechatronic and electromechanical systems It applies cornerstone fundamentals to the design of electromechanical syst

Real-time Digital Signal Processing Sen-Maw Kuo, 2003

Noise and Vibration Analysis Anders Brandt, 2023-10-02 Complete guide to signal processing and modal analysis theory with coverage of practical applications and a plethora of learning tools Features numerous line diagrams and illustrations the newly revised and updated Second Edition of Noise and Vibration Analysis is a comprehensive and practical guide that combines both signal processing and modal analysis theory with their practical application in noise and vibration analysis This new edition has been updated with three new chapters covering experimental modal analysis operational modal analysis and practical vibration measurements Taking a practical learning approach the text includes exercises that allow the content to be developed in an academic course framework or as supplementary material for private and further study including multiple choice questions at the end of each chapter An accompanying website hosts a MATLAB toolbox additional problems and examples and videos Written by a highly qualified author with significant experience in the field Noise and Vibration Analysis covers sample topics such as Dynamic signals and systems covering periodic random and transient signals RMS value and power and the Continuous Fourier Transform Time data analysis covering the sampling theorem analog digital smoothing and acoustic octave filters time data differentiation and FFT based processing Statistics and random processes covering expected value errors in estimates and probability distribution in random theory and tests of normality and stationarity Fundamental mechanics covering Newton s laws alternative quantities for describing motion frequency response plot formats

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Matrix And Linear Algebra, Edition 2 Datta, Kanti Bhushan, 2008-07-30 The present book renamed Matrix and Linear Algebra Aided with MATLAB is a completely re organized thoroughly revised and fully updated version of the author s earlier book Matrix and Linear Algebra This second edition of the well received textbook propelled by the motivation of introducing MATLAB for the study of the numerical aspect of matrix theory has been developed after taking into account the recent changes in university syllabi additional pedagogic features needed as well as the latest developments in the subject areas of Matrix Algebra and Linear Algebra The use of MATLAB macros throughout the book is the most interesting feature of this edition Besides the second edition significantly improves the coverage of all major topics in the two allied subject areas such as the topics on matrices determinants vector spaces bilinear transformations and numerical techniques that were presented in the first edition New to the Second Edition Sections on MATLAB operations at the end of most chapters Square root sine cosine and logarithm of a matrix Solution of vector matrix differential equations Extensively revised presentation of a section on decomposition of root subspaces Enhanced discussion of many existing topics Increased numbers of chapter end problems and worked out examples Many redrawn figures for greater clarity An exhaustive Solutions Manual for instructors teaching this subject The book is highly suitable for undergraduate and postgraduate students of Mathematics Statistics and all engineering disciplines It will also be a useful reference for researchers and professionals in these fields

Sensors and Actuators Clarence W. de Silva, 2015-07-30 This introductory textbook on engineering system instrumentation emphasizes sensors transducers actuators and devices for component interconnection The book deals with instrumenting an engineering system through the incorporation of suitable sensors actuators and associated interface hardware including filters amplifiers and other signal modifiers In view of the practical considerations design issues and industrial techniques that are presented throughout the book and in view of the simplified and snap shot style presentation of more advanced theory and concepts it also serves as a useful reference for engineers technicians project managers and other practicing professionals in industry and in research laboratories

Applied Digital Signal Processing Dimitris G. Manolakis, Vinay K. Ingle, 2011-11-21 Master the basic concepts and methodologies of digital signal processing with this systematic introduction without the need for an extensive mathematical background The authors lead the reader through the fundamental mathematical principles underlying the operation of key signal processing techniques providing simple arguments and cases rather than detailed general proofs Coverage of practical implementation discussion of the limitations of particular methods and plentiful MATLAB illustrations allow readers to better connect theory and practice A focus on algorithms that are of theoretical importance or useful in real world applications ensures that students cover material

relevant to engineering practice and equips students and practitioners alike with the basic principles necessary to apply DSP techniques to a variety of applications Chapters include worked examples problems and computer experiments helping students to absorb the material they have just read Lecture slides for all figures and solutions to the numerous problems are available to instructors

Theory of Vibration Protection Igor A. Karnovsky, Evgeniy Lebed, 2016-05-09 This text is an advancement of the theory of vibration protection of mechanical systems with lumped and distributed parameters The book offers various concepts and methods of solving vibration protection problems discusses the advantages and disadvantages of different methods and the fields of their effective applications Fundamental approaches of vibration protection which are considered in this book are the passive parametric and optimal active vibration protection The passive vibration protection is based on vibration isolation vibration damping and dynamic absorbers Parametric vibration protection theory is based on the Shchipanov Luzin invariance principle Optimal active vibration protection theory is based on the Pontryagin principle and the Krein moment method The book also contains special topics such as suppression of vibrations at the source of their occurrence and the harmful influence of vibrations on humans p Numerous examples which illustrate the theoretical ideas of each chapter are included This book is intended for graduate students and engineers It is assumed that a reader has working knowledge of theory of vibrations differential equations and complex analysis About the Authors Igor A Karnovsky Ph D Dr Sci is a specialist in structural analysis theory of vibration and optimal control of vibration He has 40 years of experience in research teaching and consulting in this field and is the author of more than 70 published scientific papers including two books in Structural Analysis published with Springer in 2010 2012 and three handbooks in Structural Dynamics published with McGraw Hill in 2001 2004 He also holds a number of vibration control related patents Evgeniy Lebed Ph D is a specialist in applied mathematics and engineering He has 10 years of experience in research teaching and consulting in this field The main sphere of his research interests are qualitative theory of differential equations integral transforms and frequency domain analysis with application to image and signal processing He is the author of 15 published scientific papers and a US patent 2015

Solutions Manual to Accompany Physical Chemistry for the Life Sciences C. A. Trapp, M. P. Cady, 2011 This solutions manual contains fully worked solutions to all end of chapter discussion questions and exercises featured in Physical Chemistry for the Life Sciences

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