

Following Exercise questions are **IMPORTANT!**

2.4, 2.5, 2.13, 2.14, 2.16, 2.17, 2.18, 2.19, 2.22, 2.23, 2.27, 2.28, 2.29, 2.30, 2.31

D2.1 (a). $Q_A = -20\mu C$ located at A(-6,4,7) , $Q_B = 50\mu C$ located at B(5,8,-2)
Find $\vec{R}_{AB}$

$$\vec{R}_{AB} = (5 - (-6))\hat{a}_x + (8 - 4)\hat{a}_y + (-2 - 7)\hat{a}_z = 11\hat{a}_x + 4\hat{a}_y - 9\hat{a}_z$$

(b). $|\vec{R}_{AB}| = \sqrt{(11)^2 + 4^2 + (-9)^2} = 14.76m$

(c). $\vec{F}_{AB} = Q_A Q_B \vec{R}_{AB} / 4\pi\epsilon_0 |\vec{R}_{AB}|^3 = (-20 \times 10^{-6} \times 50 \times 10^{-6} (11\hat{a}_x + 4\hat{a}_y - 9\hat{a}_z)) / (4\pi \times (10^{-9}/36\pi) |14.76|^3)$
 $\Rightarrow \vec{F}_{AB} = 30.76\hat{a}_x + 11.184\hat{a}_y - 25.16\hat{a}_z mN$

(d). $\vec{F}_{AB} = Q_A Q_B \vec{R}_{AB} / 4\pi\epsilon_0 |\vec{R}_{AB}|^3 = (-20 \times 10^{-6} \times 50 \times 10^{-6} (11\hat{a}_x + 4\hat{a}_y - 9\hat{a}_z)) / (4\pi \times 8.85 \times 10^{-12} |14.76|^3)$
 $\Rightarrow \vec{F}_{AB} = 30.72\hat{a}_x + 11.169\hat{a}_y - 25.13\hat{a}_z mN$

D2.2(a). $Q_A = -0.3\mu C$ located at A(25,-30,15) in cm , $Q_B = 0.5\mu C$ located at B(-10,8,12)

Find $\vec{E}$ at the origin O(0,0,0).

Let $\vec{E}$ at the origin is denoted by $\vec{E}_o$ and it will be the sum of $\vec{E}_A$ ($\vec{E}$ due to Q_A located at point A) and $\vec{E}_B$ ($\vec{E}$ due to Q_B located at point B)

$$\vec{E}_A = Q_A \vec{R}_{OA} / 4\pi\epsilon_0 |\vec{R}_{OA}|^3$$

$$\vec{R}_{OA} = (0 - 25)\hat{a}_x + (0 - (-30))\hat{a}_y + (0 - 15)\hat{a}_z = (-25\hat{a}_x + 30\hat{a}_y - 15\hat{a}_z)cm$$

$$|\vec{R}_{OA}| = \sqrt{(-25)^2 + (30)^2 + (-15)^2} = 41.83cm$$

$$\vec{E}_A = (-0.3 \times 10^{-6}) \times (-25\hat{a}_x + 30\hat{a}_y - 15\hat{a}_z) \times 10^{-2} / 4\pi \times 8.85 \times 10^{-12} \times |41.83 \times 10^{-2}|^3 = -368.55(-25\hat{a}_x + 30\hat{a}_y - 15\hat{a}_z)$$

$$\vec{E}_B = Q_B \vec{R}_{OB} / 4\pi\epsilon_0 |\vec{R}_{OB}|^3$$

$$\vec{R}_{OB} = (0 - (-10))\hat{a}_x + (0 - 8)\hat{a}_y + (0 - 12)\hat{a}_z = (10\hat{a}_x - 8\hat{a}_y - 12\hat{a}_z)cm$$

$$|\vec{R}_{OB}| = \sqrt{(10)^2 + (-8)^2 + (-12)^2} = 17.55cm$$

$$\vec{E}_B = (0.5 \times 10^{-6}) \times (10\hat{a}_x - 8\hat{a}_y - 12\hat{a}_z) \times 10^{-2} / 4\pi \times 8.85 \times 10^{-12} \times |17.55 \times 10^{-2}|^3 = 8317.36(10\hat{a}_x - 8\hat{a}_y - 12\hat{a}_z)$$

$$\vec{E}_o = \vec{E}_A + \vec{E}_B = (-368.55(-25\hat{a}_x + 30\hat{a}_y - 15\hat{a}_z)) + 8317.36(10\hat{a}_x - 8\hat{a}_y - 12\hat{a}_z) = (92.3\hat{a}_x - 77.6\hat{a}_y - 94.2\hat{a}_z)KV/m$$

(b). Find $\vec{E}$ at the point P(15,20,50).

It is the same as part(a) but this time we have to calculate $\vec{R}_{PA}$ and $\vec{R}_{PB}$ and the rest of the problem is similar to part(a)

D2.3 (a).

$$\Sigma_0^5 ((1 + (-1)^m) / (m^2 + 1)) = (1 + (-1)^0) / (0^2 + 1) + (1 + (-1)^1) / (1^2 + 1) + (1 + (-1)^2) / (2^2 + 1) + (1 + (-1)^3) / (3^2 + 1) + (1 + (-1)^4) / (4^2 + 1) + (1 + (-1)^5) / (5^2 + 1) = 2 + 0 + 2/5 + 0 + 2/17 + 0 = 2.52$$

(b). Similar to the part(a)

D2.4 (a). $0.1 \leq (|x|, |y|, |z|) \leq 0.2$, given ranges of x,y and z co-ordinates doesnot constitute a cubical volume so $dv = 0 \Rightarrow Q = \int_{vol} \rho_v dv = 0$

(b). Differential volume in cylindrical co-ordinates is given by $dv = \rho d\rho d\phi dz$, we have $Q = \int_{vol} \rho_v dv$

$$\Rightarrow Q = \int_{vol} (\rho^2 z^2 \sin(0.6)\phi) \rho d\rho d\phi dz = \int_0^{0.1} \int_0^{0.2} \int_0^{2\pi} (\rho^2 z^2 \sin(0.6)\phi) \rho d\rho d\phi dz = \int_0^{0.1} \rho^2 d\rho \int_0^{2\pi} (\sin(0.6)\phi) d\phi \int_0^{0.2} z^2 dz$$

$$\Rightarrow Q = [\rho^3/4]_0^{0.1} \times [(-\cos(0.6\phi))/0.6]_0^{2\pi} \times [z^3/3]_0^{0.2} = [(0.1)^3/4] \times [(-\cos(108^\circ) - (-\cos(0)))/0.6] \times [(64 - 8)/3]$$

$$\Rightarrow Q = [(0.1)^3/4] \times [(1.31)/0.6] \times [56/3] = 1.018mC$$

¹This document is prepared in L^AT_EX. (Email: ahmadsajjad01@cit.net.pk)

Engineering Electromagnetics 7th Edition Chapter Problems Solutions

Albert Ruehli, Giulio Antonini, Lijun Jiang



Engineering Electromagnetics 7th Edition Chapter Problems Solutions:

Balanis' Advanced Engineering Electromagnetics Constantine A. Balanis, 2024-01-31 Balanis Advanced Engineering Electromagnetics The latest edition of the foundational guide to advanced electromagnetics Balanis third edition of Advanced Engineering Electromagnetics a global best seller for over 30 years covers the advanced knowledge engineers involved in electromagnetics need to know particularly as the topic relates to the fast moving continuously evolving and rapidly expanding field of wireless communications The immense interest in wireless communications and the expected increase in wireless communications systems projects antennas microwaves and wireless communications points to an increase in the number of engineers needed to specialize in this field Highlights of the 3rd Edition include A new chapter on Artificial Impedance Surfaces AIS contains material on current and advanced EM technologies including the exciting and fascinating topic of metasurfaces for Control and broadband RCS reduction using checkerboard designs Optimization of antenna fundamental parameters such as input impedance directivity realized gain amplitude radiation pattern Leaky wave antennas using 1 D and 2 D polarization diverse holographic high impedance metasurfaces for antenna radiation control and optimization Associated MATLAB programs for the design of checkerboard metasurfaces for RCS reduction and metasurface printed antennas and holographic L WA for radiation control and optimization Throughout the book there are Additional examples numerous end of chapter problems and PPT notes Fifty three MATLAB computer programs for computations graphical visualizations and animations Nearly 4 500 multicolor PowerPoint slides are available for self study or lecture use

Engineering Electromagnetics William Hart Hayt, John A. Buck, 2006 Now in its Seventh Edition Bill Hayt and John Buck s Engineering Electromagnetics is a classic book that has been updated for electromagnetics today This widely respected book stresses fundamentals and problem solving and discusses the material in an understandable readable way Numerous illustrations and analogies are provided to aid the reader in grasping difficult concepts In addition independent learning is facilitated by the presence of many examples and problems Jacket *Introduction to Engineering Electromagnetics* Yeon Ho Lee, 2024-07-08 This book provides junior and sophomore college and university students with a thorough understanding of electromagnetic fundamentals through rigorous mathematical procedures and logical reasoning Electromagnetics is one of the most difficult courses in engineering because mathematical theorems cannot completely convey the physical concepts underlying electromagnetic principles This book fills this gap with logical reasoning such as symmetry considerations and the uniqueness theorem and clearly distinguishes between mathematical procedures and expressions for physical events The sign convention is carefully set to distinguish static phasor and time varying quantities and to be consistent with double indexed symbols This book begins with a coverage of vector fields coordinate systems and vector calculus which are customized for the study of electromagnetics Subsequently static electric and magnetic fields are discussed Before discussing time varying fields and their applications in transmission lines waveguides and antennas the

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Applied Electromagnetics Stuart M. Wentworth,2025-09-09 A timely and authoritative update to a leading text on the applied electromagnetics of transmission lines In the newly revised second edition of Applied Electromagnetics Early Transmission Lines Approach experienced engineer and professor Stuart Wentworth delivers an up to date and authoritative discussion of the electromagnetic foundations of signal transmission The book explains practical applications for wireless systems transmission lines waveguides including optical fiber and antennas Wentworth provides a detailed theoretical grounding of the subject and combines it with hands on MATLAB simulations available on the web that help students understand critical concepts Brand new end of chapter problems at a broad range of difficulty levels Many more drill and example problems Worked solutions provided on the companion website Extensively updated material as well as entirely new material on metamaterials and patch antennas Perfect for undergraduate students of electrical engineering Applied Electromagnetics Early Transmission Lines Approach will also benefit researchers and educators in electrical engineering

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Antenna Theory Constantine A. Balanis, 2016-02-01 Updated with color and gray scale illustrations a companion website housing supplementary material and new sections covering recent developments in antenna analysis and design. This book introduces the fundamental principles of antenna theory and explains how to apply them to the analysis design and measurements of antennas. Due to the variety of methods of analysis and design and the different antenna structures available the applications covered in this book are made to some of the most basic and practical antenna configurations. Among these antenna configurations are linear dipoles loops arrays broadband antennas aperture antennas horns microstrip antennas and reflector antennas. The text contains sufficient mathematical detail to enable undergraduate and beginning graduate students in electrical engineering and physics to follow the flow of analysis and design. Readers should have a basic knowledge of undergraduate electromagnetic theory including Maxwell's equations and the wave equation introductory physics and differential and integral calculus. Presents new sections on flexible and conformal bowtie Vivaldi antenna antenna miniaturization antennas for mobile communications dielectric resonator antennas and scale modeling. Provides color and gray scale figures and illustrations to better depict antenna radiation characteristics. Includes access to a companion website housing MATLAB programs Java based applets and animations Power Point notes Java based interactive questionnaires and a solutions manual for instructors. Introduces over 100 additional end of chapter problems.

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Electromagnetics Edward J. Rothwell, Michael J. Cloud, 2018-10-03 Providing an ideal transition from introductory to advanced concepts. Electromagnetics Second Edition builds a foundation that allows electrical engineers to confidently proceed with the development of advanced EM studies research and applications. This second edition of a popular text continues to offer coverage that spans the entire field from electrostatics to the integral solutions of Maxwell's equations. The book provides a firm grounding in the fundamental concepts of electromagnetics and bolsters understanding through the

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Table of Contents Engineering Electromagnetics 7th Edition Chapter Problems Solutions

1. Understanding the eBook Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - The Rise of Digital Reading Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Advantages of eBooks Over Traditional Books
2. Identifying Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - User-Friendly Interface
4. Exploring eBook Recommendations from Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Personalized Recommendations
 - Engineering Electromagnetics 7th Edition Chapter Problems Solutions User Reviews and Ratings
 - Engineering Electromagnetics 7th Edition Chapter Problems Solutions and Bestseller Lists
5. Accessing Engineering Electromagnetics 7th Edition Chapter Problems Solutions Free and Paid eBooks
 - Engineering Electromagnetics 7th Edition Chapter Problems Solutions Public Domain eBooks
 - Engineering Electromagnetics 7th Edition Chapter Problems Solutions eBook Subscription Services
 - Engineering Electromagnetics 7th Edition Chapter Problems Solutions Budget-Friendly Options

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 - ePub, PDF, MOBI, and More
 - Engineering Electromagnetics 7th Edition Chapter Problems Solutions Compatibility with Devices
 - Engineering Electromagnetics 7th Edition Chapter Problems Solutions Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Highlighting and Note-Taking Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Interactive Elements Engineering Electromagnetics 7th Edition Chapter Problems Solutions
8. Staying Engaged with Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Engineering Electromagnetics 7th Edition Chapter Problems Solutions
9. Balancing eBooks and Physical Books Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Engineering Electromagnetics 7th Edition Chapter Problems Solutions
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Setting Reading Goals Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Fact-Checking eBook Content of Engineering Electromagnetics 7th Edition Chapter Problems Solutions
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

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