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**Instructor's Solutions Manual for
Elements of Electromagnetics**

International Fifth Edition

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Prairie View A&M University

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2011

SEVENTH
EDITION

**ELEMENTS OF
ELECTROMAGNETICS**

MATTHEW N. O. SADIKU

OXFORD
UNIVERSITY PRESS

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$$\begin{aligned}
 F &= eE \\
 \rho_v &= \frac{e}{4\pi} \left(\frac{1}{r^2} + \frac{3e}{4\pi R^3} \right) \\
 \rho_v &= \begin{cases} \frac{e}{4\pi} \left(\frac{1}{r^2} + \frac{3e}{4\pi R^3} \right) & 0 < r < R \\ 0 & \text{elsewhere} \end{cases} \\
 \oint \mathbf{D} \cdot d\mathbf{S} &= Q_{en} = \int_V \rho_v dV = \frac{1}{4\pi} \left(\frac{4\pi R^3}{3} \right) \cdot D_r(4\pi r^2) \\
 E_r &= \frac{3er}{12\pi\epsilon_0 R^3} \\
 F = eE &= \frac{e^2 r}{4\pi\epsilon_0 R^3}
 \end{aligned}$$

Prob 4.22

(a)

$$\begin{aligned}
 v &= Q_{en} \\
 \text{For } r &= 1.5\text{m}, \\
 Q_{en} &= \int_V \rho_v dV = \int_0^{1.5} \rho_v(4\pi r^2) \\
 &= 2(10^7)\pi(1.5^3) + 8\pi(10^6) \\
 v &= Q_{en} = 2.23 \mu\text{C} \\
 \text{For } r &= 2.5\text{m}, \\
 Q_{en} &= \rho_v(4\pi R^3) + \rho_v(4\pi R^2) \\
 &= 8\pi(10^7) + (-0.10^6)(4\pi 2^2) \\
 &= (8\pi - 64\pi)10^6 \\
 v &= Q_{en} = -17.91 \mu\text{C}
 \end{aligned}$$

(b)

$$\begin{aligned}
 v &= Q_{en} = \int_V \rho_v dV = Q_{en} \\
 D_r(4\pi r^2) &= Q_{en} \\
 D_r &= \frac{Q_{en}}{4\pi r^2}
 \end{aligned}$$

Prob. 10.1
(a) Wave propagates along +z.

(b)

$$f = \frac{2\pi}{\omega} = \frac{2\pi}{2\pi \times 10^6} = 1 \mu\text{s}$$
$$\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{6} = 1.047 \text{ m}$$
$$u = \frac{\omega}{\beta} = \frac{2\pi \times 10^6}{6} = 1.047 \times 10^6 \text{ m/s}$$

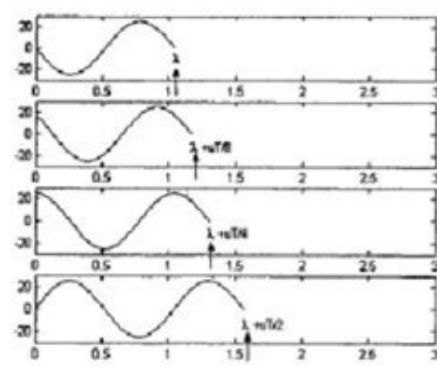
(c) At $t=0$, $E_z = 25 \sin(-6x) = -25 \sin 6x$

At $t=7/8$, $E_z = 25 \sin\left(\frac{2\pi T}{8} - 6x\right) = 25 \sin\left(\frac{\pi}{4} - 6x\right)$

At $t=7/4$, $E_z = 25 \sin\left(\frac{2\pi T}{4} - 6x\right) = 25 \sin(-6x + 90^\circ) = 25 \cos 6x$

At $t=7/2$, $E_z = 25 \sin\left(\frac{2\pi T}{2} - 6x\right) = 25 \sin(-6x + \pi) = -25 \sin 6x$

These are sketched below.



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Message of President TPC 7 7. Plenary Talks 8 8. Invited Talks. 13 9. Tutorials 14 10. Program Programming ... 15 11. Details 24 12. Reviewers List. 44 13. Volunteer List 45 2 | A E M C 2 0 1 5 , I T G U W A H A T I ORGANIZING COMMITE PATRON: Director, Indian Institute of Technology Guwahati Advisory Honotra Ajoy Chakraborty Professor, the Eletra'nica e engenharia de Comunicacã@trica Institute tecnologia da ãndia kandia kanpur cadeiras de finanãsas s. fo local): Chitralekha Mahanta Iit Guwahati 3 | A e c 2 0 1 5 , i t g a m a m a t i organizing committee reception & registration prof. Rohit. Sinha iit guwahati Dr. PRAVEEN IT IIT GUWAHATI ALOMATE E HOSPITAL DR. A. Rajesh Iit Guwahati Dr. Prithwijiit Guha Iit Guwahati Dr. Smarajit das iit iit guwahati code e refreshment Dr. A. 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With the advent of high speed computational platforms, the research in the area of applied electromagnetics gathered tremendous momentum and today we live in an era of computational electromagnetics. Applied Electromagnetics Conference (AEMC), a biennial event of AP-MTT Chapter of IEEE Kolkata section, provides a major platform to the researchers working in the field of electromagnetics for knowledge sharing and exhibition of theoretical and technological development in the general areas of applied electromagnetics. I am happy that the fifth edition of AEMC is being organized at IIT Guwahati by the Department of Electronics and Electrical Engineering in association with the AP-MTT Chapter of IEEE Kolkata section. We have taken every care to ensure that high quality of academic standard is maintained in order to make the participation in AEMC 2015, an enriching experience. I extend my hearty welcome to the experts and delegates of AEMC 2015 and hope that they will enjoy their stay in our beautiful campus. I congratulate the Organizing for their endeavor in conducting this event and wish them a grand success of the event. Professor Gautam Biswas FNA, FASC, FNAE, FNASc, F-ASME, FIE Director, IIT Guwahati and J. C. Bose National Fellow 6 | A E M C 2 0 1 5 , I I T G u w a h a t i Message From the General Chairs It gives us great pleasure to invite you all to the 5th edition of Applied Electromagnetic Conference, AEMC 2015, being held at the beautiful campus of IIT Guwahati during 18-21 December 2015. AEMC started its journey from the city of Sir J. C. Bose in the year 2007 and over the years this conference has evolved into a major platform in India for the research community working in the different aspects of Applied Electromagnetics. Papers selected for this impactful conference represent the hard work of many outstanding researchers. We have taken every care to ensure that very high level of academic standards is maintained in the conference and participants of AEMC 2015 have very enriching experience. We are fortunate to have several leading researchers and experts in this field agreeing to deliver lectures in the conference and share their knowledge with the participants. We take this opportunity to express our heartfelt gratitude to all who have contributed directly or indirectly in making AEMC 2015 a successful event. We are thankful to the advisory committee members for their valued advice. We are particularly indebted to different chairs and co-chairs who have worked relentlessly for making this event successful. We also take this opportunity to place on record our sincere thankfulness to the Director, IIT Guwahati for agreeing to be the patron for the event, IIT Guwahati Administration and Department of EEE for allowing us to use all the resources whenever needed. At the background of all the activities, a group of budding Engineers and Research Scholars are working silently and tirelessly and we expect that their efforts will be evident AEMC 2015. We expect that your stay at the banks of mighty Brahmaputra during AEMC 2015 will be an unforgettable experience and the conference will provide a platform for a very high level of academic deliberations. With Best Wishes, Prof. Ratnajit Bhattacharjee Indian Institute of Technology Guwahati, India Prof. Gautam Chattopadhyaya Jet Propulsion Laboratory, Pasadena, CA, USA 7 | A E M C 2 0 1 5 , I I T G u w a h a t i Message From the TPC Chairs On behalf of the Technical Program Committee, we welcome you to Guwahati, Assam, India and the 2015 IEEE Applied Electromagnetics Conference 2015. We have planned the Technical Program carefully with interesting Plenary and Invited Talks, Oral and Poster presentations. It is important to mention that, we have included total 170 technical papers in 20 Oral Sessions and three Poster Sessions. Each submitted paper received two independent reviews, before the Technical Program Committee members reviewed it again and finalized for the acceptance/rejection. The paper acceptance rate is around 66%. Papers were also checked for the Plagiarism and the IEEE Prohibited Authors List. The conference starts with Pre-Conference Tutorials on December 18, 2015. Followed by that, Welcome Plenary Talk by Professor Raj Mittra and Professor Guo is included in the evening followed by a cultural program and dinner. The actual Technical Sessions of the Conference starts from December 19, 2015. We start the morning with Plenary Talk by Dr. Dev Giri. Followed by that, we have three half-parallel Oral Sessions with interesting papers. In afternoon session, we start with two Invited Talks by Professors Janaswamy and Selvan. We have plannedPage 3 3

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