

Ministry of Higher Education and Scientific research



Department of Physics

College of Education - Shaqlawa

University of Salahaddin

Subject: Electromagnetic Theory-second semester

Course Book – (4th Year)

Lecturer's name: Dr. Dilshad Salih Ismael

Academic Year: 2022/2023

Course Book

1. Course name	Electromagnetic Theory
2. Lecturer in charge	<i>Dr. Dilshad Salih Ismael</i>
3. Department/ College	Physics/ Science
4. Contact	dilshad.ismael@su.edu.krd
5. Time (in hours) per week	Theory: 3 Practical: 0
6. Office hours	4
7. Course code	
8. Teacher's academic profile	<p>I have more than 16 year experience teaching of different subjects such as: Classical Mechanics, Calculus, Electrical measurements, Electromagnetic Theory , Solid State Physics Lab., Electronics Lab. and General Physics Lab also I have four(2) papers are published in different foreign journals.</p> <p>B.Sc. of Physics from 2001 M.Sc. of Plasma Physics from 2005 Ph.D. of medical physics from 2015</p> <p>Assist Lecturer Oct 2005 – Feb 2015 Instructor Feb 2015 – up to date Assist Prof.</p>
9. Keywords	Electromagnetic Theory, Vector Analysis, charge, Maxwell equations, Electromagnetic Waves.
10. Course overview:	<p>This lecture notes covers the principal elements of classical electromagnetic theory.</p> <p>At the beginning of the semester, I will give them some subjects as a back ground for remembering the principle and the requirement as a gate for our major subjects including(Vectors analysis, Coordinate System, Divergence, Divergence Theorem, curl, Stokes's Theorem, Electrostatic field, Coulomb's Force, Electric Field Intensity, Charge Distribution, The Electric Potential, Electric Flux, Gauss's Law).</p> <p>After the students get ready, I will start to give them the new subjects including (Maxwell's Eq., Poisson's and Laplace Eq. in different coordinate, Electrostatic Dipole, Conductor, semiconductor, Dielectric & Capacitance, Boundary Condition between media, The Steady Magnetic Field, The Biot-Savart Law, Time Varying Fields and Maxwell's Eq., Faraday Law, Propagation of Electromagnetic Wave and (Electric & Magnetic Energy Density)) which employ the requirement for this stage.</p> <p>validity of the postulates upon which the theory is built.</p>

11. Course objective:

Electricity and Magnetism is an essential subject in physics. It deals with the fields that come from an intrinsic property of matter which is charge and its movement. These fields have different applications in our daily life concerning transferring of information and energy from a place to another place where they are needed. Understanding the emission of these fields and their interaction with the material is the main objective of this course.

12. Student's obligation

The students are required to take two or three exams during the period of the course. 35 marks will be assigned to these exams. 5 marks will be assigned to the assignments given at the end of each chapter(including quizzes) and activities in the class room. There will be a final exam on sixty marks.

لیره ماموستا بهر پرسیاریتی قوتابی خویندکار رووندەکاتەوه سەبارەت بە کۆرسەکه بۆ نمونە ئامادەبوونی قوتابیان لێ وانهکاندا، لێ تاقیکردنەوهکاندا، راپۆرت و ووتار نووسین... هتد.

13. Forms of teaching

Our lecture is depend directly on showing the strong point in the lecture via data show depending on the power point program... and solve problem on the white board with the students.

لیره ماموستا رێگهی وانه ووتنەوه دەنووسیت، بۆ نمونە: داتاشۆ و پاوەرپۆینت، سەر تەختەپرەش، تەختەهی سپی، سمارتپۆرد یان مەلزمە... هتد

14. Assessment scheme

The students are required to take two or three exams during the period of the course. 35 marks will be assigned to these exams. 5 marks will be assigned to the assignments given at the end of each chapter(including quizzes) and activities in the class room. There will be a final exam on sixty marks.

لیره ماموستا جۆری هەلسەنگاندن (تاقیکردنەوهکان یان ئەزمونەکان) دەنووسیت بۆ نمونە تاقیکردنەوهی مانگانە، کویزەکان، بیرکردنەوهی رەخنەگرانە (پریزەنتەیشن)، راپۆرت نووسین، ووتار نووسین یان ئامادەبوونی خویندکار لێ پۆلدا... هتد. ئامانە چەند نمرە لێ سەردەبیت و ماموستا چۆن نمرەکان دابەشەکات؟

15. Student learning outcome:

Electromagnetic theory plays a very important role in the Physics field, during the years I teaching Electromagnetic theory, I have notices that students generally find it easier to learn its underlying ideas than to handle the practical aspects of the formalism. What is true is that the students at the Physics department who were all selected after a stiff entrance examination, and whose ambitions in life were diverse – in science, in industry, in business, in high public office – all had to follow this

introductory physics course. As a consequence, the challenge was to try to get them interested in the field whatever their future goals were. Of course, Electromagnetic theory is an ideal subject because one can be interested in it for a variety of reasons, such as the physics itself, the mathematical structure of the theory, its technological spinoffs, as well as its philosophical or cultural aspects. So the task was basically to think about the pedagogical aspects, in order to satisfy audiences that went up to many students during the last 10 years.

پرکردنەوی ئەم خانەییە زۆر گەرنەگە، مامۆستا دەرئەنجامەکانی فیزیوون دەنوو سێت. بۆ نمونە: پرونی ئامانجە سەرەکیەکانی کۆرسەکە (بابەتەکە) بۆ خوێندکار گونجاندنی ناوەڕۆکی کۆرسەکە بە پێویستی دەرەو و بازاری کار قوتابی چی نوێ فێردەبێت لە ڕێگەی پێدانی ئەم کۆرسەو؟

This should not be less than 100 words

16. Course Reading List and References:

- 1- Engineering Electromagnetics, Sixth Edition, William H. Hayt, Jr. John A. Buck.
- 2- Introduction to Electrodynamics. David J. Griffiths
- 3- Electromagnetic Fields and Waves, Second Edition, Paul Lorrain and Dale Corson.
- 4- Foundation of Electromagnetic Theory, 2nd Edition, John R. Reitz and Frederick J. Milford.
- 5- Sehoum's out Line Series Theory and Problems of "Electromagnetic", By Joseph. A. Adminster.

- Key references:
- Useful references:
- Magazines and review (internet):

17. The Topics:

Lecturer's name

Subject	Lecturer's name
The Steady Magnetic Field, The Biot-Savart Law	Dr. Dilshad Salih Ismael ex: (3 hrs)
Magnetic Intensity, Ampere's Law, Magnetic(Flux & Flux Density)	
Time Varying Field, The Scalar and Vector Magnetic Field	
Time Varying Fields and Maxwell's Eq. , Faraday Law (part1)	
Time Varying Fields and Maxwell's Eq. , Faraday Law (part2)	
Non Homogenous Wave Eq. For E & D, Plane Electromagnetic Wave in Infinite Media, Propagation of Electromagnetic Wave in Different Media	
Pointing Vector (E×H), Propagation of Electromagnetic Wave in Non Conductor, Propagation in Lousy Dielectric "Conductors"	
Propagation of Plane Wave in Conductor Media "Lousy Conductors"	
Propagation of Long Plane Electromagnetic Wave in Good Conductor	
Propagation of Electromagnetic Wave in Low Pressure Ionized Gas	
The conductivity of An Ionized Gas	

18. Practical Topics (If there is any)

In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture

Lecturer's name
ex: (3-4 hrs)

19. Examinations:

Q/ Write the Maxwell's Equations in time varying field.

Answer:

$$\nabla \cdot D = \rho$$

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

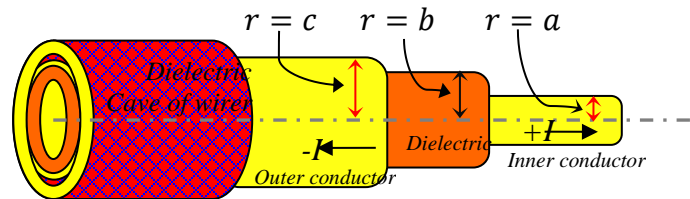
$$\nabla \times H = J + \frac{\partial D}{\partial t}$$

$$\nabla \cdot B = 0$$

Q Consider an infinite along coaxial cable carrying a uniformly total current in the center conductor of (+I) and (-I) in the outer conductor. Find H at:

$$1 - a < r < b$$

$$2 - r > c$$



Infinite coaxial cable

Answer:

$$1 - At \ a < r < b$$

The current enclosed I_{enc}

$$I_{enc} = +I$$

$$\oint H \cdot dl = I_{enc}$$

$$\oint H \cdot dl = \int_0^{2\pi} H \cdot r d\varphi a_\varphi = +I$$

$$H = \frac{I}{2\pi r} a_\phi$$

$$2 - At r > c$$

$$I_{enc} = (+I) + (-I) = 0 \quad \oint H \cdot dl = 0 \quad \therefore H = 0$$

Q/ show that $k_r = k_i = \sqrt{\left(\frac{w\mu\sigma}{2}\right)}$ for Propagation of Plane Electromagnetic Wave in Good Conductors.

Answer:

In conductors (Lossy dielectrics)

$$k_r = w \sqrt{\left(\frac{\mu\epsilon}{2}\right)} \sqrt{\left(\sqrt{1 + \frac{1}{\phi^2}} + 1\right)}$$

$$k_i = w \sqrt{\left(\frac{\mu\epsilon}{2}\right)} \sqrt{\left(\sqrt{1 + \frac{1}{\phi^2}} - 1\right)}$$

$$\phi = \frac{w\epsilon}{\sigma} \leq \frac{1}{50}$$

$$\phi = \frac{w\epsilon}{\sigma} \ll \frac{1}{50}$$

in Good conductors

$$\therefore w \sqrt{\left(\frac{\mu\epsilon}{2}\right)} \sqrt{\left(\sqrt{1 + \frac{1}{\phi^2}} + 1\right)} \cong \sqrt{\frac{1}{\phi}}$$

$$\text{Then } k_r = k_i = w \sqrt{\left(\frac{\mu\epsilon}{2}\right)} \cdot \sqrt{\frac{1}{\phi}} = w \sqrt{\left(\frac{\mu\epsilon}{2}\right)} \cdot \sqrt{\frac{\sigma}{w\epsilon}} = \sqrt{\left(\frac{w\mu\sigma}{2}\right)} \text{ in Good conductors}$$

Q/ Drive the equation of *Electric and Magnetic Energy densities* in Free Space.

Answer:

$$\begin{aligned}
 S_{av} &= E_{rms} \times H_{rms} \\
 S_{av} &= E_{rms} H_{rms} \\
 S_{av} &= \left(\frac{E_0}{\sqrt{2}}\right) \left(\frac{H_0}{\sqrt{2}}\right) \\
 S_{av} &= \frac{1}{2} E_0 H_0 \\
 S_{av} &= \frac{1}{2} E_0 \sqrt{\frac{\epsilon_0}{\mu_0}} E_0 \quad \frac{E}{H} = \sqrt{\frac{\epsilon_0}{\mu_0}} \\
 S_{av} &= \frac{1}{2} \epsilon_0 \frac{1}{\sqrt{\mu_0 \epsilon_0}} E_0^2 \\
 S_{av} &= c \left(\frac{1}{2} \epsilon_0 E_0^2\right)
 \end{aligned}$$

Q/ At 1km from an antenna radiating 50kwatt of power is tropically at frequency of 1μHz.

$$\text{Sol/ } \frac{1}{c} \left(\frac{dz}{dt}\right)_{Max.} = 1.63 \times 10^6 \frac{S_{av}}{f^2} = 1.63 \times 10^6 \frac{50 \times 10^3}{10^{12}} = 10^{-8}$$

Q/ A laser beam can carry power density of the order of $\left(10^{16} \frac{w}{m^2} \text{ at } f \cong 10^{15} \text{ Hz}\right)$ (visible light).

$$\text{Sol/ } \frac{1}{c} \left(\frac{dz}{dt}\right)_{Max.} = 1.63 \times 10^6 \frac{S_{av}}{f^2} = 1.63 \times 10^6 \frac{10^{16}}{(10^{15})^2} \cong 1.63 \times 10^{-8}$$

20. Extra notes:

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

21. Peer review

پیداچونہوہی ھاوہل

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.

(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).

ئەم كۆرسىۋوكە دەبىت لەلايەن ھاوئەلىكى ئەكادېمىيە سەير بىكرىت و ناوەرۆكى بابەتەكانى كۆرسەكە پەسەند بىكات و جەند ووشەيەك بنووسىت لەسەر شىاوى ناوەرۆكى كۆرسەكە و واژووى لەسەر بىكات. ھاوئەل ئەو كەسەيە كە زانىارى ھەبىت لەسەر كۆرسەكە و دەبىت پلەى زانستى لە مامۇستا كەمتر نەبىت.