

Ministry of Higher Education and Scientific research



Department of Physics

College of Education - Shaqlawa

University of Salahaddin

Subject: Electromagnetic Theory-First 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 نامادەبوونی قوتابیان لە وانەکاندا، لە 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 وانە ووتنەوه دەنووسیت، بۆ نمونە: داتاشۆ و پاوەرپۆینت، سەر تەختەپرەش، تەختەهی سپی، سمارتبۆرد 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 نامادەبوونی خویندکار لە پۆلدا... هتد. نامانە چەند نمرە لەسەر دەبیت و ماموستا چۆن نمرەکان دا بەشدهکات؟

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 دەنووسیت. بۆ نمونە: پرونی ئامانجە سەرەکیەکانی کۆرسەکە (بابەتەکە) بۆ خوێندکار گونجاندنی ناوەڕۆکی کۆرسەکە بە پێویستی دەرەو و بازاری کار قوتابی چی نوێ فێردەبیت لە رێگەی 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
Scalars and Vectors, Vector Algebra, Coordinate System, Operation on Vector	Dr. Dilshad Salih Ismael ex: (3 hrs)
Divergence & Divergence Theorem, Curl & Stokes's Theorem	
Laplace Equation, Problems, Electrostatic field, Coulomb's Force, Electric Field Intensity	
Charge Distribution, Standard Charge Distribution, The Electric Potential	
The Electric Potential, Electric Flux, Gauss's Law	
Maxwell's First Eq. , Energy Distribution in Electrostatic Field	
Example, Poisson's and Laplace Eq.	
Poisson's and Laplace Eq. in (Cartesian & Cylindrical) coordinate	
Example, Poisson's and Laplace Eq. in spherical coordinate	
Examples, Electrostatic Dipole	
(Conductor, Dielectric & Capacitance), (Current & Current Density)	
Continuity of Current, Conductor Property & Boundary Eq.	
Conductor-Free Space Boundaries, Dielectric Materials	

Example, Boundary Condition For Perfect Dielectric	
Interface Between Dielectric & Conductor	
Capacitor(Parallel Plates , Multiple Dielectric Capacitor)	
Example, Capacitor of tow Coaxial Cylinder, Capacitor of two Parallel Wires	
Examples	

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/

Find the voltage drop across each dielectric in the figure below, where ($\epsilon_{r1} = 2, \epsilon_{r2} = 5$) the inner conductor is at ($r=2\text{cm}$) and the outer at ($r=2.5\text{ cm}$) with dielectric interface at half way between them.

Answer:

The capacitance of two coaxial cylindrical

$$C = \frac{2\pi\epsilon l}{\ln \frac{r_2}{r_1}}$$

The capacitance of each segment

$$C_s = \frac{\alpha}{2\pi} \cdot \frac{2\pi\epsilon l_r}{\ln \frac{r_2}{r_1}}$$

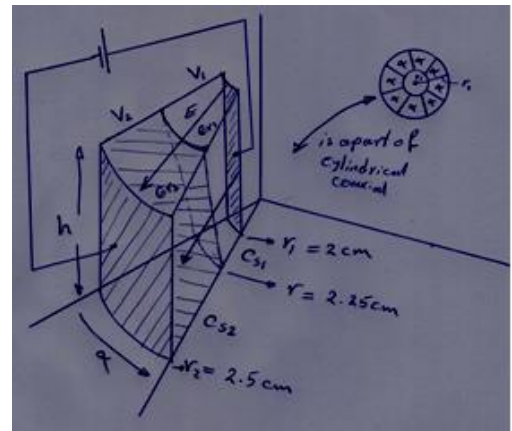
$$C_{s1} = \frac{\alpha\epsilon_0 \times 2 \times h}{\ln \frac{2.25\text{cm}}{2\text{cm}}}$$

$$C_{s2} = \frac{\alpha\epsilon_0 \times 5 \times h}{\ln \frac{2.5\text{cm}}{2.25\text{cm}}}$$

$$Q = Q_1 = Q_2, \quad C_1V_1 = C_2V_2 \rightarrow V_1 = \frac{C_2V_2}{C_1} = \frac{C_2}{C_1}(V - V_1)$$

$$V_1 + \frac{C_2V_1}{C_1} = \frac{C_2}{C_1}V, \quad V_1 = V \left(\frac{C_2}{C_1 + C_2} \right)$$

$$\therefore V_1 = V \left(\frac{C_{s2}}{C_{s1} + C_{s2}} \right) = 74 \text{ volt} \quad V_2 = V \left(\frac{C_{s1}}{C_{s1} + C_{s2}} \right) = 26 \text{ volt}$$



Q/The cylindrical surface ($r = 8\text{cm}$, $1\text{cm} < z < 5\text{cm}$, $30^\circ < \varphi < 90^\circ$) contains the surface charge density ($\rho_s = 5e^{-20z} \frac{\text{nC}}{\text{m}^2}$). How much flux (*total flux*) leaves this surface?

Answer:

The cylindrical surface ($r = 8\text{cm}$, $1\text{cm} < z < 5\text{cm}$, $30^\circ < \varphi < 90^\circ$) contains the surface charge density, ($\rho_s = 5e^{-20z} \frac{\text{nC}}{\text{m}^2}$). How much flux (*total flux*) leaves this surface?

We just integrate the charge density on that surface to find the flux that leaves it.

$$\Phi = Q' = \int_{.01}^{.05} \int_{30^\circ}^{90^\circ} 5e^{-20z} (.08) d\varphi dz \text{ nC} = \left(\frac{90 - 30}{360} \right) 2\pi (5) (.08) \left(\frac{-1}{20} \right) e^{-20z} \Big|_{.01}^{.05}$$

$$= 9.45 \times 10^{-3} \text{ nC} = \underline{9.45 \text{ pC}}$$

Q/ In cylindrical coordinate there are two plane charged ($\varphi = \text{constant}$), then planes are insulated along z-axis. Find the expression for D between the planes where:

$$V = 100\text{v} \quad \text{at} \quad \varphi = \alpha \quad \text{and} \quad V = 0 \quad \text{at} \quad \varphi = 0$$

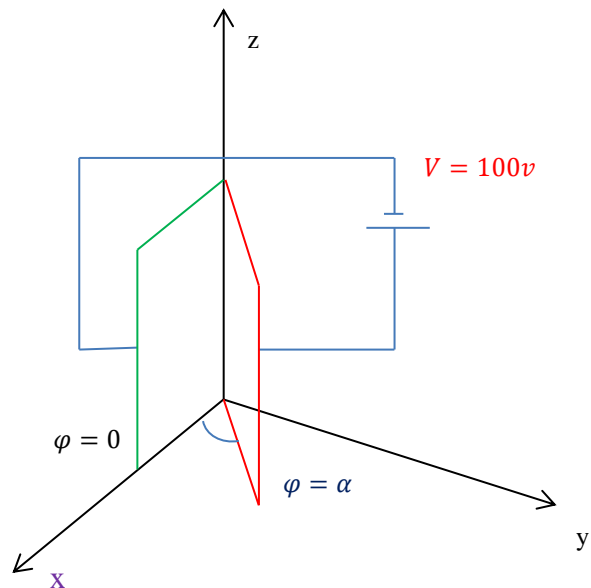
Sol/ $V = A\varphi + B$

$$\left. \begin{array}{l} 100 = A\alpha + B \\ 0 = 0 + B \end{array} \right\} \therefore \begin{array}{l} B = 0 \\ A = \frac{100}{\alpha} \end{array}$$

$$V = \frac{100\varphi}{\alpha}$$

$$E = -\nabla V = -\frac{1}{r} \frac{dV}{d\varphi} a_\varphi = \frac{-100}{r\alpha} a_\varphi$$

$$D = \frac{-100\epsilon_0}{r\alpha} a_\varphi$$



The equipotential surfaces are semicircular radial planes, $V = V(\varphi)$

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

پیداچونہودی 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 كۆرسبووكە دەبىت لەلایەن ھاوھلێكى ئەكادىمىيەو سەير بگرىت و ناوھروكى بابەتھكانى كۆرسەكە پەسەند بكات و جەند ووشەپەك بنوسىت لەسەر شىاوى ناوھروكى كۆرسەكە و واژووى لەسەر بكات.
ھاوھل ئەو كەسەيە كە زانىارى ھەبىت لەسەر كۆرسەكە و دەبىت پلەى زانستى لە مامۇستا كەمتر نەبىت.