Course Specifications

Program(s) on which the course is given : P., P.&las.
Major or minor element of program : major - minor
Department offering the program : P., P.
Department offering the course : Physics
Academic year / Level: 4
Date of specification approval: 2012

A- Basic Information

Title: Electrodynamics Code: P474

Credit Hours: 3 Lecture: 3h
Tutorial: 0 Practical: 0
Total: 3h

B- Professional Information

1 – Overall aims of course

The course aims to give the undergraduate student a theoretical treatise of the problem of the time-varying fields. The treaties are based on Maxwell's equations, which involves fields, sources and response parameters of the media. The detailed function forms of charges and currents distributions as well as the response parameters of media give the student Varity of applications

2 – Intended learning outcomes of course (ILOs)

a Knowledge and understanding:

The course aims to give the undergraduate student:

a1- ability to use some abstract concepts in pure mathematics in order to formulate and inspect some practical aspects in physics

a2- deep insight about the mechanism by which electromagnetic radiation is generated and propagated through different media. Some phenomena like reflection, transmission, resonant absorption and anomalous dispersion in dielectric media are taken as example

a3- theoretical basis to study more advanced topics for

instance ; plasma physics, astrophysics, scattering theory in nuclear physics

b Intellectual skills

The scientific material of the course encourage the student to :

b1- think in more reasonable ways which take into account the fundamental theories in the given area of scientific interest

b2- solve some problems connected with the polarization and magnetization of polar material at high frequencies

b3- establish some relation from which energy and momentum carried out by electromagnetic wave could by calculated .

c Professional and practical skills

The electromagnetic theory has many applications in practical life. For instance, it may help the graduate to employ his knowledge in :

c1- industrial field where the electromagnetic radiations are used in inspecting the crakes and dislocations in solids .

c2- in medicine where the effect of radiations on the cell of the human body play the major role in radio therapy

c3- in communications and radio-TV broadcasting

d General and transferable skills

The course help the student

d1- understand the theory of electromagnetic radiations and its applications .

d2- establish a link between theory and experiment

3- Contents

Topic	No. of hrs	Lecture	Tutorial / practical
Electromotive force (Ohm's law-	**3**	**1**	

motional emf) Faraday's law (electromagnetic induction inductance – Newman formula for mutual inductance – energy in magnetic fields) Solved problems			
Maxwell equations (electrodynamics before Maxwell's –Maxwell's correction to Ampere's law- about the existence of magnetic charge – Maxwell's equation inside matter – boundary conditions)- potential formulation of electrodynamics – Gauge transformations (Lorentz and Coulomb gauges)- lorentz force in potential form (potential energy and canonical momentum)	**3**	**1**	
Energy and momentum (Newton's third law in electrodynamics – conservation of energy (poyntings theorem for : system of charged particles, harmonic fields , field definition of impedance an admittance)- conservation of linear momentum(Maxwell's stress tensor)- solved problems	**6**	**2**	
Transformation properties of electromagnetic field (fields and sources under rotations, spatial reflections, and time reversal) – discussions of Dirac quantization condition – the wave equation (one, tow, and three dimensional)-	**6**	**2**	

Green functions for the wave equation)- solved problems			
Electromagnetic plane waves in(vacuum – Non-conducting media – linear and circular polarization- Stokes parameters – energy and momentum of electromagnetic waves – reflection and transmission of electromagnetic waves at the interface between dielectrics (normal and Olblique incidence) – solved problems	**6**	**2**	
Polarization by reflection and total internal reflection (determination of Brewster angle)- frequency dispersion characteristics of dielectircs, conductors, and plasmas (simple models for ε(ω)- anomalous dispersion and resonate absorption – reflection and absorption coefficient of water as functions of frequency)	**3**	**1**	
Simplified model of propagation in the ionosphere and magnetosphere – wave in a conducting or dissipative medium – superposition of waves in one dimension (group velocity)- spreeding of pulse during propagation in dispersive medium	**3**	**1**	
Causality in connection between D and E (Kramer's – Kronig	**6**	**2**	

relations) – arrival of signal after propagation through dispersive medium (general properties of : A(ω) , n (ω) in the complex(ω) plane – method station phase) – discussion			

4– Teaching and learning methods

4.1- lecture

4.2- open discussion about the subject of the lecture and some of its applications

4.3- solving some problems to make the idea clear

5- Student assessment methods

5.1 written exam to assess understanding and memorizing skills

5.2 Oral Exam to assess overall performance

Assessment schedule

Assessment 1 : mid-term and semester work 7, 9, 11th week

Assessment 2 : Final term 14th week

Weighting of assessments

Mid-Term Examination	**20 %**
Final-term Examination	**60 %**
Oral Examination.	**10 %**
Semester Work	**10 %**
Total	**100%**

Any formative only assessments

N/A

6- List of references

6.1- Course notes

6.2- Essential books (text books)

Jackson, J.D., classical Electrodynamics, John Wiley & sons, New York (1975)

Griffths, D. J., Introduction to Electrodynamics, Prentice-Hall Inc., Englewood Cliffs 07632 (1981).

6.3- Recommended books

6.4- Periodicals, Web sites, … etc

7- Facilities required ml for teaching and learning

Graphical and data processing facilities are recommended.

Course coordinator: Dr. Mohamed A. Abd El- Hakeem

Head of Department: Prof.Dr. Sana Maize

Date: / /