31. Course Specification of Electromagnetic Field Theory II

I. Course Identification and General Information:

1.	Course Title:	Electromagnetic Field Theory II				
2.	Course Code & Number:	CNE212				
3.	Credit hours:	C.H.				Total C.H.
		Th.	Tu.	Pr.	Tr.	
		2	2	-	-	3
4.	Study level/ semester at which this course is offered:	3rd Level/ 2nd Semester				
5.	Pre –requisite (if any):	Engineering Mathematics (BR223) Engineering Physics (FR002) EM I, Electrical Circuits (PME110)				
6.	Co –requisite (if any):	None				
7.	Program (s) in which the course is offered:	Communication Engineering and Networks				
8.	Language of teaching the course:	English + Arabic				
9.	Location of teaching the course:	Faculty of Engineering, Sana'a University				
10.	Prepared By:	Assoc. Prof. Dr. Mohammed A. Saeed Al-Mekhlafi				
11.	Date of Approval	2020				

II. Course Description:

This course introduces the fundamentals of electromagnetics in both theory and application. Topics include: Waves and Applications; Faraday's law, transformer and motional electromotive forces, displacement current, Maxwell's equations in point and integral forms, time-harmonic fields, Electromagnetic Wave Propagation; plane wave propagation in lossless and loss dielectrics, plane wave propagation in free space and in good conductors, skin effect, wave polarization, power and Poynting's theorem, plane wave reflection at normal & oblique incidences. Transmission Lines (TLs); TL parameters, TL equations, input impedance, standing wave ratio, Smith chart applications, some applications of TLs, transients on TLs, Waveguides; rectangular waveguides, transverse magnetic TM and transverse electric (TE) modes, wave propagation in the guide, power transmission and

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attenuation, waveguide current and mode excitation, waveguide resonators. Basics of Antennas; Hertzian dipole, half-wave dipole, quarter-wave monopole, small-loop, antenna characteristics, antenna arrays.

III. Course Intended learning outcomes (CILOs) of the course		**Referenced PILOs**
a1	Explain the concepts of induced electromotive force, induced electric field, self-induction, mutual induction, magnetic energy, displacement current, and describe them mathematically.	A1
a2	Identify the characteristics and parameters of different antennas	A1
b1	Solve problems on transmission lines, simple antennas structures and their radiation, rectangular waveguides and their applications.	B1
b2	Analyze transmission line parameters, attenuation and phase constants, characteristic impedance reflections, and power transfer from generator to load.	B2
c1	Use Faraday's law, Maxwell`s equations in integral and point forms to solve various electromagnetic engineering problems.	C1
c2	Analyze electromagnetic waves propagation in different media and at the boundary surfaces, wave polarization, wave reflections and refractions, antenna radiation, wave scattering.	C3
d1	Acquire and apply new knowledge as needed, using appropriate learning strategies.	D2

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1 – Explain the concepts of induced electromotive force, induced electric field, self-induction, mutual induction, magnetic energy,	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving	▪ Assignments ▪ Quizzes ▪ Midterm Exam ▪ Final Exam

displacement current, and describe them mathematically.		
a2 – Identify the characteristics and parameters of different antennas	▪ Interactive Lectures ▪ Demonstrations ▪ Independent readings	▪ Assignments ▪ Midterm Exam ▪ Final Exam

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1 – Demonstrate ability to solve problems on transmission lines, simple antennas structures and their radiation, rectangular waveguides and their applications.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving	▪ Assignments ▪ Quizzes ▪ Final Exam
b2 – Analyze and formulate transmission line parameters, attenuation and phase constants, characteristic impedance reflections, and power transfer from generator to load.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving	▪ Assignments ▪ Quizzes ▪ Final Exam

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1 – Use Faraday's law, Maxwell`s equations in integral and point forms to solve various electromagnetic engineering problems.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving	▪ Assignments ▪ Quizzes ▪ Midterm Exam ▪ Final Exam
c2 - Analyze electromagnetic waves propagation in different media and	▪ Interactive Lectures ▪ Demonstrations	▪ Assignments ▪ Quizzes

at the boundary surfaces, wave polarization, wave reflections and refractions, antenna radiation, wave scattering.	▪ Problem Solving	▪ Midterm Exam ▪ Final Exam

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1 – Acquire and apply new knowledge as needed, using appropriate learning strategies.	▪ Discussions ▪ Web-based Investigations ▪ Projects	▪ Written Reports ▪ Presentations

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IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Maxwell's Equations	a1, c1	- Review (Electrostatic and Magnetostatic Fields, Time-Invariant Maxwell's Equations). - Faraday's Law, - Transformer and Motional Electromotive Forces, - Displacement Current, - Maxwell's Equations in Point Form and Integral Form, - Time-Harmonic Fields	3	6
2.	Electromagnetic Wave Propagation	a1, c2	- Waves in General, - Wave Propagation in Lossy Dielectrics, - Plane Waves in Lossless Dielectrics, - Plane Waves in Free Space, - Plane Waves in Good Conductors, - Wave Polarization, -Power and the Poynting Vector, - Reflection of a Plane Wave at Normal Incidence	3	6
3.	Transmission Lines-A	b1, b2	- Transmission Line Parameters - Transmission Line Equations	1	2
4.	Transmission Lines-B	b1, b2	- Input Impedance,	2	4

			- Standing Wave Ratio, and Power, - The Smith Chart, - Some Applications of Transmission Lines		
5.	Waveguides	b1, b2	- Rectangular Waveguides, - Transverse Magnetic (TM) Modes, - Transverse Electric (TE) Modes, - Wave Propagation in the Guide, - Power Transmission and Attenuation, - Waveguide Resonators	3	6
6.	Electromagnetic Radiation and Antennas	a2, b1, c2	- Radiation from Infinitesimal Current Elements, - Hertzian Dipole, - Half-Wave Dipole Antenna, - Quarter-Wave Monopole Antenna, - Small-Loop Antenna, - Antenna Characteristics, - Antenna Arrays	2	4
Number of Weeks /and Units Per Semester				**14**	**28**

B - Tutorial Aspect:

Order	Tutorial Skills List	Number of Weeks	C.H.	CILOs
1.	Faraday's Law and Electromotive Forces • Review (Electrostatic and Magnetostatic Fields, Time -Invariant Maxwell's Equations) • Faraday's Law • Transformer and Motional Electromotive Forces	1	2	a1, c1
2.	Displacement Current and Maxwell's Equations • Displacement Current • Maxwell's Equations in Point Form and Integral Form • Time-Harmonic Fields	1	2	a1, c1
3.	Electromagnetic Wave Propagation - 1 • Waves in General • Wave Propagation in Lossy Dielectrics	1	2	a2, c2
4.	Electromagnetic Wave Propagation - 2 • Plane Waves in Lossless Dielectrics • Plane Waves in Free Space • Plane Waves in Good Conductors	1	2	a2, c2
5.	Electromagnetic Wave Propagation - 3 • Wave Polarization • Power and the Pointing Vector • Reflection of a Plane Wave at Normal Incidence	1	2	a2, c2
6.	Transmission Lines-A • Transmission Line Parameters • Transmission Line Equations	1	2	b1, b2
7.	Transmission Lines-B • Input Impedance, • Standing Wave Ratio, and Power	1	2	b1, b2
8.	Transmission Lines-B • The Smith Chart	1	2	b1, b2
9.	Waveguides - 1 • TM and TE Modes	1	2	b1

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10.	Waveguides – 2 • Wave Propagation in the Guide • Power Transmission and Attenuation	1	2	b1, b2
11.	Waveguides – 3 • Waveguide Resonators	1	2	b1
12.	Electromagnetic Radiation and Antennas - 1 • Radiation from Infinitesimal Current Elements • Hertzian Dipole	1	2	a2, b1, c2
13.	Electromagnetic Radiation and Antennas - 2 • Half-Wave Dipole Antenna, • Quarter-Wave Monopole Antenna, • Small-Loop Antenna	1	2	a2, b1, c2
14.	Electromagnetic Radiation and Antennas - 3 • Antenna Characteristics • Antenna Arrays	1	2	a2, b1, c2
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Interactive Lectures
- Demonstrations
- Problem Solving
- Web-based Investigations

VI. Assignments:

No	Assignments	Aligned CILOs	Week Due	Mark
1.	Problems on Faraday's law, electromotive forces, displacement current, Maxwell's equations.	a1, c1	4th	1.5
2.	Problems on Electromagnetic Wave Propagation	a2, c2	7th	1.5
3.	Problems on Transmission Lines	b1, b2	11th	1.5
4.	Problems on Waveguides and Resonators	b1, b2	13th	1.5
5.	Problems on Electromagnetic Radiation and Antennas	a2, b1, c2	16th	1.5
	Total			**7.5**

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VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assignments	4^{th} , 7^{th} , 11^{th} , 13^{th} , and 16^{th}	7.5	5%	a1, a2, b1, b2, c1, c2
2.	Quizzes	4^{th}, 12^{th}	15	10%	a1, b1, c1
3.	Attendance & Participation	Weekly	7.5	5%	a1, a2, b1, b2, c1, c2
4.	Midterm Exam	7^{th}	30	20%	a1, c1
6.	Final Exam	16^{th}	90	60%	a1, a2, b1, b2, c1, c2
Total			**150**	**100%**	

VIII. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1. Matthew O. Sadiku, 2014, "Elements of Electromagnetics", 6th Edition, USA, Oxford University Press, (Chapters 1-8).
2. William H. Hayt, Jr. and John A. Buck, 2012, "Engineering Electromagnetics", Eighth Edition, USA, McGraw-Hill.

2- Essential References.

1. Fawwaz T. Ulaby and Umberto Ravaioli, 2015, "Fundamentals of Applied Electromagnetics", Seventh Edition, UK, Pearson.

3- Electronic Materials and Web Sites *etc*.

1- 8.02X: Electricity & Magnetism.
https://web.mit.edu/8.02/www/Spring02/info.htm
2- Goggling the Internet

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	IX. Course Policies:
1.	**Class Attendance:** - The students should have more than 75% of attendance according to rules and regulations of the faculty.
2.	**Tardy:** - The students should respect the timing of attending the lectures. They should attend within 15 minutes from starting of the lecture.
3.	**Exam Attendance/Punctuality:** - The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final exam.
4.	**Assignments & Projects:** - The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time.
5.	**Cheating:** - If any cheating occurred during the examination, the student is not allowed to continue and he has to face the examination committee for enquiries.
6.	**Plagiarism:** - If one student attends the exam on another behalf; he will be dismissed from the faculty according to the policy, rules and regulations of the university.
7.	**Other policies:** - All the teaching materials should be kept out the examination hall and mobile phones are not allowed. - Mutual respect should be maintained between the student and his teacher and also among students. Failing in keeping this respect is subject to the policy, rules and regulations of the university.

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Asst. Prof. Dr.Mohammed Al-Suraby**
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