26. Course Specification of Electromagnetic Field Theory I

I. Course Identification and General Information:

1.	Course Title:	Electromagnetic Field Theory I				
2.	Course Code & Number:	CNE211				
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:	3^{rd} Level/ 1^{st} Semester				
5.	Pre –requisite (if any):	Engineering Mathematics (BR223) Engineering Physics (FR002)				
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 fundamental concepts of electromagnetic theory. Topics include: Vector Analysis; vector algebra and calculus, coordinate systems and transformations. Electrostatic Fields; Coulomb's law, electric field intensity due to different charge configurations, electric flux density, Gauss's law and its applications, divergence and Maxwell's first equation, divergence theorem, energy and potential, conductors and dielectrics, electric fields in dielectric materials, electric boundary conditions, resistance and capacitance, Poisson's and Laplace equations are discussed. Magnetostatic Fields; Biot–Savart's law, Ampere's circuital laws and its applications, magnetic flux density and Maxwell's second equation, curl and Stoke's theorem, magnetic potentials, magnetic forces and torque, magnetic materials, magnetic boundary conditions, inductors and inductances, magnetic circuits, force on magnetic materials, magnetic energy, and Maxwell's equations for static fields are also emphasized.

	III. Course Intended learning outcomes (CILOs) of the course	**Referenced PILOs**
a1	Demonstrate the fundamental concepts of electrostatic and magnetostatics fields, and applied mathematical tools.	A1, A2
a2	Classify the properties of conductors, dielectrics and magnetic materials.	A1, A2,
b1	Analyze the behavior of static electric and magnetic fields in the presence of dielectric and magnetic materials and at the boundary between different materials.	B3
b2	Formulate static Maxwell's equations in integral and differential forms, and apply them to solve practical electromagnetic engineering problems.	B1
c1	Use Coulomb's law, Gauss' Law, Biot-Savart's law, Ampere's circuital law, to find the electrostatic and magnetostatics fields.	C1
c2	Design electromagnetic energy storage devices like capacitors and inductors and choose suitable materials required to assemble such electromagnetic energy storage devices.	C2
d1	Engage in independent lifelong learning.	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 – Demonstrate knowledge of the fundamental concepts of electrostatic and magnetostatic fields, and applied mathematical tools.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving ▪ Independent readings	▪ Assignments ▪ Quizzes ▪ Mid-semester Exam ▪ Final Exam
a2 – Classify the properties of conductors, dielectrics and magnetic materials.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving ▪ Independent readings	▪ Assignments ▪ Mid-semester 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 – Analyze the behavior of static electric and magnetic fields in the presence of dielectric and magnetic materials and at the boundary between different materials.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving	▪ Assignments ▪ Quizzes ▪ Mid-semester Exam ▪ Final Exam
b2 – Formulate static Maxwell's equations in integral and differential forms, and apply them to solve practical electromagnetic engineering problems.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving	▪ Assignments ▪ Mid-semester Exam ▪ 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 Coulomb's law, Gauss' Law, Biot- Savart's law, Ampere's circuital law, to find the electrostatic and magnetostatics fields.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving ▪ Independent readings	▪ Assignments ▪ Mid-semester Exam ▪ Final Exam
c2 – Design electromagnetic energy storage devices like capacitors and inductors and choose suitable materials required to assemble such electromagnetic energy storage devices.	▪ Interactive Lectures ▪ Demonstrations ▪ Problem Solving	▪ Assignments ▪ Mid-semester 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 - Engage in independent lifelong learning.	▪ Demonstrations ▪ Web based Investigations ▪ Independent readings	▪ Assignments ▪ Final Exam

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Vector Analysis	a1	- Introduction, Scalars and Vectors, - Vector Algebra, - Coordinate Systems and Transformations	1	2
2.	Electrostatic Fields	a1, b1	- Coulomb's Law, - Forces Between Electric Charges, - Electric Field Intensity, - Electric Fields Due to Continuous Charge Distributions (a line charge, a surface charge, a volume charge)	2	4
3.	Electric Flux Density, Gauss's Law and Divergence	a1, b1, b2	- Electric Flux Density, - Gauss's Law, - Applications of Gauss's Law, - Divergence of a Vector and Maxwell's First Equation,	2	4

			- Del Operator and Divergence Theorem		
4.	Energy and Electric Potential	a1, b2, c2	- Energy Expended in Moving a Point Charge in Electric Field, - Electric Potential, - Potential Difference, - Maxwell's Second Equation, - Potential Gradient, - Electric Dipole and Flux Lines, - Energy Density in Electrostatic Fields	2	4
5.	Electric Fields in Material Space	a1, a2, b1, c1	- Properties of Materials, - Convection and Conduction Currents, - Conductors, Polarization in Dielectrics, - Dielectric Constant, and Dielectrics, - Continuity Equation and Relation Time, - Boundary Conditions	1	2
6.	Electrostatic Boundary-Value Problems	a1, c1	- Poisson's and Laplace Equations, - Resistance and Capacitance, - Method of Images	1	2
7.	Magnetostatic Fields	a1, b1, b2	- Biot-Savart's Law, - Ampere's Circuit Law, - Curl, Stokes' Theorem, - Maxwell's Third Equation, - Applications of Ampere's Circuital Law,	3	6

			- Magnetic Flux and Magnetic Flux Density, - Maxwell's Forth Equation, - Scalar and Vector Magnetic Potentials		
8.	Magnetic Forces, Materials and Devices	a1, a2, c1, c2	- Forces Due to Magnetic Fields, - Magnetic Torque and Moment, - Magnetic Dipole, - Magnetic Materials and Magnetization, - Magnetic Boundary Conditions, - Inductors, Inductances, - Magnetic Circuits, Magnetic Energy, - Force on Magnetic Materials	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.	Vector Analysis • Introduction, Scalars and Vectors • Vector Algebra • Coordinate Systems and Transformations	1	2	a1
2.	Electrostatic Fields • Coulomb's Law • Forces Between Electric Charges • Electric Field Intensity • Electric Fields Due to Continuous Charge Distributions (a line charge, a surface charge, a volume charge)	2	4	a1, b1

3.	Electric Flux Density, Gauss's Law and Divergence • Electric Flux Density • Gauss's Law • Applications of Gauss's Law • Divergence of a Vector and Maxwell's First Equation • Del Operator and Divergence Theorem	2	4	a1, b1, b2
4.	Energy and Electric Potential • Energy Expended in Moving a Point Charge in Electric Field • Electric Potential • Potential Difference • Maxwell's Second Equation • Potential Gradient • Electric Dipole and Flux Lines • Energy Density in Electrostatic Fields	2	4	a1, b2, c2
5.	Electric Fields in Material Space • Properties of Materials، • Convection and Conduction Currents • Conductors, Polarization in Dielectrics • Dielectric Constant, and Dielectrics • Continuity Equation and Relation Time • Boundary Conditions	1	2	a1, a2, b1, c1
6.	Electrostatic Boundary-Value Problems • Poisson's and Laplace Equations • Resistance and Capacitance • Method of Images	1	2	a1, c1
7.	Magnetostatic Fields • Biot-Savart's Law • Ampere's Circuit Law • Curl, Stokes' Theorem • Maxwell's Third Equation	3	6	a1, b1, b2

	• Applications of Ampere's Circuital Law • Magnetic Flux and Magnetic Flux Density • Maxwell's Forth Equation • Scalar and Vector Magnetic Potentials			
8.	Magnetic Forces, Materials and Devices • Forces Due to Magnetic Fields • Magnetic Torque and Moment • Magnetic Dipole • Magnetic Materials and Magnetization • Magnetic Boundary Conditions • Inductors, Inductances • Magnetic Circuits, Magnetic Energy • Force on Magnetic Materials	2	4	a1, a2, c1, c2
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

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

VI. Assignments:

No	Assignments	Aligned CILOs	Week Due	Mark
1.	Problems on vector analysis	a1, d1	2nd	1
2.	Problems on electrostatic fields	a1, b1, d1	4th	1
3.	Problems on electric flux density, Gauss's law, and divergence	a1, b1, b2, d1	6th	1
4.	Problems on energy and electric potential	a1, b2, c2, d1	8th	1

5.	Problems on electric fields in material space and electrostatic boundary-value problems	a1, a2, b1, c1, d1	9th	1
6.	Problems on using Biot-Savart's law to calculate the magnetic field intensity, Curl, Stokes' Theorem, Maxwell's third Equation	a1, b1, b2, d1	10th	1
7.	Problems on applications of Ampere's circuital law, magnetic flux and magnetic flux density, Maxwell's forth equation, scalar and vector magnetic potentials	a1, b1, b2, d1	13th	1
8.	Problems on magnetic forces, materials and Devices	a1, a2, c1, c2, d1	15th	0.5
	Total			**7.5**

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	Every Second Week	7.5	5%	a1, a2, b1, b2, c1, c2, d1
2.	Quizzes	5th, 13th	15	10%	a1, b1, c1
3.	Participation	Weekly	7.5	5%	a1
4.	Midterm Exam	8th	30	20%	a1, b1, b2, c2
5.	Final Exam	16th	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", Sixth Edition, USA, Oxford University Press.

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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

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 enquires.
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.

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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**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

26. Template for Course Plan of Electromagnetic Field Theory I

I. Information about Faculty Member Responsible for the Course:								
Name of Faculty Member	Assoc. Prof. Dr. Mohammed A. Saeed Al-Mekhlafi	**Office Hours**						
Location& Telephone No.	Faculty of Engineering	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	almekmasee@hotmail.com						

II. Course Identification and General Information:						
1-	Course Title:	Electromagnetic Field Theory I				
2-	Course Number & Code:	CNE211				
3-	Credit hours:	C.H				Total C.H.
		Th.	Tu.	Pr.	Tr.	
		2	2	-	-	3
4-	Study level/year at which this course is offered:	3rd Level/ 1st Semester				
5-	Pre –requisite (if any):	Engineering Mathematics (BR223) Engineering Physics (FR002)				
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-	System of Study:	Regular				
10-	Mode of delivery:	Lectures				
11-	Location of teaching the course:	Faculty of Engineering, Sana’a University				

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III. Course Description:

This course introduces the fundamental concepts of electromagnetic theory. Topics include: Vector Analysis; vector algebra and calculus, coordinate systems and transformations. Electrostatic Fields; Coulomb's law, electric field intensity due to different charge configurations, electric flux density, Gauss's law and its applications, divergence and Maxwell's first equation, divergence theorem, energy and potential, conductors and dielectrics, electric fields in dielectric materials, electric boundary conditions, resistance and capacitance, Poisson's and Laplace equations are discussed. Magnetostatic Fields; Biot–Savart's law, Ampere's circuital laws and its applications, magnetic flux density and Maxwell's second equation, curl and Stoke's theorem, magnetic potentials, magnetic forces and torque, magnetic materials, magnetic boundary conditions, inductors and inductances, magnetic circuits, force on magnetic materials, magnetic energy, and Maxwell's equations for static fields are also emphasized.

IV. Intended learning outcomes (ILOs) of the course:

- Brief summary of the knowledge or skill the course is intended to develop**:**

1- Demonstrate the fundamental concepts of electrostatic and magnetostatics fields, and applied mathematical tools.
2- Classify the properties of conductors, dielectrics and magnetic materials.
3- Analyze the behavior of static electric and magnetic fields in the presence of dielectric and magnetic materials and at the boundary between different materials.
4- Formulate static Maxwell's equations in integral and differential forms, and apply them to solve practical electromagnetic engineering problems.
5- Use Coulomb's law, Gauss' Law, Biot-Savart's law, Ampere's circuital law, to find the electrostatic and magnetostatics fields.
6- Design electromagnetic energy storage devices like capacitors and inductors and choose suitable materials required to assemble such electromagnetic energy storage devices.
7- Engage in independent lifelong learning.

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Vector Analysis	- Introduction, Scalars and Vectors, - Vector Algebra, - Coordinate Systems and Transformations	1st	2
2.	Electrostatic Fields	- Coulomb's Law, - Forces Between Electric Charges, - Electric Field Intensity, - Electric Fields Due to Continuous Charge - Distributions (a line charge, a surface charge, a volume charge)	2nd, 3rd	4
3.	Electric Flux Density, Gauss's Law and Divergence	- Electric Flux Density, - Gauss's Law, - Applications of Gauss's Law, - Divergence of a Vector and Maxwell's First Equation, - Del Operator and Divergence Theorem	4th, 5th	4
4.	Energy and Electric Potential	- Energy Expended in Moving a Point Charge in Electric Field, - Electric Potential, - Potential Difference, - Maxwell's Second Equation, - Potential Gradient, - Electric Dipole and Flux Lines, - Energy Density in Electrostatic Fields	6th, 7th	4
5.	Midterm Exam	All previous topics	8th	2
6.	Electric Fields in Material Space	- Properties of Materials, - Convection and Conduction Currents, - Conductors, Polarization in Dielectrics, - Dielectric Constant, and Dielectrics,	9th	2

		- Continuity Equation and Relation Time, - Boundary Conditions		
7.	Electrostatic Boundary-Value Problems	- Poisson's and Laplace Equations, - Resistance and Capacitance, - Method of Images	10th	2
8.	Magnetostatic Fields	- Biot-Savart's Law, - Ampere's Circuit Law, - Curl, Stokes' Theorem, - Maxwell's Third Equation, - Applications of Ampere's Circuital Law, - Magnetic Flux and Magnetic Flux Density, - Maxwell's Forth Equation, - Scalar and Vector Magnetic Potentials	11th, 12th, 13th	6
9.	Magnetic Forces, Materials and Devices	- Forces Due to Magnetic Fields, - Magnetic Torque and Moment, - Magnetic Dipole, - Magnetic Materials and Magnetization, - Magnetic Boundary Conditions, - Inductors, Inductances, - Magnetic Circuits, Magnetic Energy, - Force on Magnetic Materials	14th, 15th	4
10.	Final Exam	All topics	16th	3
Number of Weeks /and Units Per Semester			**16**	**32**

B - Tutorial Aspect:

Order	Tutorial Skills List	Number of Weeks	C.H.
1.	Vector Analysis • Introduction, Scalars and Vectors • Vector Algebra • Coordinate Systems and Transformations	2^{nd}	2
2.	Electrostatic Fields • Coulomb's Law • Forces Between Electric Charges • Electric Field Intensity • Electric Fields Due to Continuous Charge Distributions (a line charge, a surface charge, a volume charge)	3^{rd}, 4^{th}	4
3.	Electric Flux Density, Gauss's Law and Divergence • Electric Flux Density • Gauss's Law • Applications of Gauss's Law • Divergence of a Vector and Maxwell's First Equation • Del Operator and Divergence Theorem	5^{th}, 6^{th}	4
4.	Energy and Electric Potential • Energy Expended in Moving a Point Charge in Electric Field • Electric Potential • Potential Difference • Maxwell's Second Equation • Potential Gradient • Electric Dipole and Flux Lines • Energy Density in Electrostatic Fields	7^{th}, 8^{th}	4
5.	Electric Fields in Material Space • Properties of Materials، • Convection and Conduction Currents • Conductors, Polarization in Dielectrics • Dielectric Constant, and Dielectrics • Continuity Equation and Relation Time • Boundary Conditions	9^{th}	2
6.	Electrostatic Boundary-Value Problems • Poisson's and Laplace Equations	10^{th}	2

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	• Resistance and Capacitance • Method of Images		
7.	Magnetostatic Fields • Biot-Savart's Law • Ampere's Circuit Law • Curl, Stokes' Theorem • Maxwell's Third Equation • Applications of Ampere's Circuital Law • Magnetic Flux and Magnetic Flux Density • Maxwell's Forth Equation • Scalar and Vector Magnetic Potentials	11th, 12th, 13th	6
8.	Magnetic Forces, Materials and Devices • Forces Due to Magnetic Fields • Magnetic Torque and Moment • Magnetic Dipole • Magnetic Materials and Magnetization • Magnetic Boundary Conditions • Inductors, Inductances • Magnetic Circuits, Magnetic Energy • Force on Magnetic Materials	14th, 15th	4
Number of Weeks /and Units Per Semester		**14**	**28**

VI. Teaching strategies of the course:

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

VII. Assignments:

No	Assignments	Aligned CILOs	Week Due	Mark
1.	Problems on vector analysis	a1, d1	2nd	1
2.	Problems on electrostatic fields	a1, b1, d1	4th	1
3.	Problems on electric flux density, Gauss's law, and divergence	a1, b1, b2, d1	6th	1

4.	Problems on energy and electric potential	a1, b2, c2, d1	8^{th}	1
5.	Problems on electric fields in material space and electrostatic boundary-value problems	a1, a2, b1, c1, d1	9^{th}	1
6.	Problems on using Biot-Savart's law to calculate the magnetic field intensity, Curl, Stokes' Theorem, Maxwell's third Equation	a1, b1, b2, d1	10^{th}	1
7.	Problems on applications of Ampere's circuital law, magnetic flux and magnetic flux density, Maxwell's forth equation, scalar and vector magnetic potentials	a1, b1, b2, d1	13^{th}	1
8.	Problems on magnetic forces, materials and Devices	a1, a2, c1, c2, d1	15^{th}	0.5
	Total			**7.5**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1.	Assignments	Every Second Week	7.5	5%
2.	Quizzes	5^{th}, 13^{th}	15	10%
3.	Participation	Weekly	7.5	5%
4.	Midterm Exam	8^{th}	30	20%
5.	Final Exam	16^{th}	90	60%
	Total		**150**	**100%**

IX. Learning Resources:

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

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

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2- Essential References.

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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.
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