Ministry of Higher Education and
Scientific Research - Iraq
Al-Furat Al-Awsat Technical University
Al-Musaib Technical College
Department of Electrical Engineering Techniques

MODULE DESCRIPTOR FORM

نموذج وصف المادة الدراسية

Module Information

معلومات المادة الدراسية

Module Title	**ELECTROMAGNETIC FIELDS**	**Module Delivery**	
Module Type	CORE	✓ **Theory** **Lecture** ✓ **Lab** **Tutorial** ✓ **Practical** ✓ **Seminar**	
Module Code	**ATU23054**		
ECTS Credits	5		
SWL (hr/sem)	**125**		
Module Level	٣	**Semester of Delivery**	1
Administering Department	**DEPARTMENT OF ELECTRICAL ENGINEERING TECHNIQUES**	**College**	**AL-FURAT AL-AWSAT TECHNICAL UNIVERSITY/AL-MUSAIB TECHNICAL COLLEGE**
Module Leader	Dr. Muhammed AlKafaji	**e-mail**	Com.muh7@atu.edu.iq
Module Leader's Acad. Title	Assist. Prof	**Module Leader's Qualification**	Ph.D
Module Tutor	Dr. Muhammed AlKafaji	**e-mail**	Com.muh7@atu.edu.iq
Peer Reviewer Name	None	**e-mail**	None
Review Committee Approval	14/06/2023	**Version Number**	1.0

Relation With Other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Objectives أهداف المادة الدراسية	1. **General review in vector and coordinate system**: Review the basic concepts of vectors and coordinate systems, including vector addition and subtraction, scalar multiplication, dot product, cross product, and coordinate transformations. 2. **Coulomb's law and electric field intensity**: Understand Coulomb's law and its application to point charges and continuous charge distributions. Understand the concept of electric field intensity and its relationship to Coulomb's law. 3. **Electric flux density and Gauss law**: Understand the concept of electric flux density and its relationship to electric field intensity. Understand Gauss's law and its application to calculating electric fields for symmetric charge distributions. 4. **Divergence and gradient theories**: Understand the concepts of divergence and gradient in vector calculus. Understand their applications in electrostatics. 5. **Energy potential and energy density in electric field**: Understand the concept of energy potential in electrostatics. Understand how to calculate energy density in an electric field. 6. **Current density and electric boundary conditions**: Understand the concept of current density in electrostatics. Understand the boundary conditions for electric fields at interfaces between different materials.

	7. **Resistance and capacitance**: Understand the concepts of resistance and capacitance in circuits. Be able to solve problems involving resistors and capacitors in series and parallel. 8. **Poisson's and Laplace equations application and examples**: Understand Poisson's equation and Laplace's equation in electrostatics. Be able to solve problems involving these equations for simple charge distributions. 9. **Biot-Savart law, Ampere's law, and curl**: Understand Biot-Savart's law for calculating magnetic fields due to current-carrying wires. Understand Ampere's law for calculating magnetic fields around closed loops. Understand the concept of curl in vector calculus. 10. **Magnetic field intensity and magnetic flux density**: Understand the concept of magnetic field intensity and its relationship to magnetic force on moving charges. Understand the concept of magnetic flux density and its relationship to magnetic fields. 11. **Scalar and vector magnetic potential**: Understand the concepts of scalar potential and vector potential in magnetostatics. 12. **Magnetic force, magnetic boundary conditions, and inductance**: Understand the force on a moving charge in a magnetic field. Understand the boundary conditions for magnetic fields at interfaces between different materials. Understand the concept of inductance in circuits. 13. **Faraday's law, displacement current, Maxwell's equations in potential and integral form**: Understand Faraday's law of electromagnetic induction. Understand displacement current as an extension of Ampere's law. Be able to derive Maxwell's equations from these concepts.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. **General review in vector and coordinate system**: Understand the basic concepts of vectors and coordinate systems, including vector addition and subtraction, scalar multiplication, dot product, cross product, and coordinate transformations. 2. **Coulomb's law and electric field intensity**: Understand Coulomb's law and its application to point charges and continuous charge distributions. Understand the concept of electric field intensity and its relationship to Coulomb's law. 3. **Electric flux density and Gauss law**: Understand the concept of electric flux density and its relationship to electric field intensity. Understand Gauss's law and its application to calculating electric fields for symmetric charge distributions. 4. **Divergence and gradient theories**: Understand the concepts of divergence and gradient in vector calculus. Understand their applications in electrostatics. 5. **Energy potential and energy density in electric field**: Understand the concept of energy potential in electrostatics. Understand how to calculate energy density in an electric field. 6. **Current density and electric boundary conditions**: Understand the concept of current density in electrostatics. Understand the boundary conditions for electric fields at interfaces between different materials. 7. **Resistance and capacitance**: Understand the concepts of resistance and capacitance in circuits. Be able to solve problems involving resistors and capacitors in series and parallel. 8. **Poisson's and Laplace equations application and examples**: Understand Poisson's equation and Laplace's equation in electrostatics. Be able to solve problems involving these equations for simple charge distributions. 9. **Biot-Savart law, Ampere's law, and curl**: Understand Biot-Savart's law for calculating magnetic fields due to current-carrying wires. Understand Ampere's law for calculating magnetic fields around closed loops. Understand the concept of curl in vector calculus. 10. **Magnetic field intensity and magnetic flux density**: Understand the concept of magnetic field intensity and its relationship to magnetic force on moving charges.

	Understand the concept of magnetic flux density and its relationship to magnetic fields. 11. **Scalar and vector magnetic potential**: Understand the concepts of scalar potential and vector potential in magnetostatics. 12. **Magnetic force, magnetic boundary conditions, and inductance**: Understand the force on a moving charge in a magnetic field. Understand the boundary conditions for magnetic fields at interfaces between different materials. Understand the concept of inductance in circuits. 13. **Faraday's law, displacement current, Maxwell's equations in potential and integral form**: Understand Faraday's law of electromagnetic induction. Understand displacement current as an extension of Ampere's law. Be able to derive Maxwell's equations from these concepts.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following: • Part A – General Vector and coordinate System. This section provides an overview of vectors and coordinate systems, including vector addition and subtraction, scalar multiplication, dot product, cross product, and coordinate transformations. [8 hrs] • Part B Electric fields. Coulomb's law and its application to point charges and continuous charge distributions. Electric flux density and its relationship to electric field intensity. Divergence and gradient in vector calculus. Energy potential and current density in electrostatics. Resistance and capacitance in circuits. Poisson's equation and Laplace's equation in electrostatics. [30 hrs] • Part C Magnetic fields Biot-Savart's law. Magnetic field intensity and magnetic flux density. Scalar potential and vector potential in magnetostatics. Magnetic force, magnetic boundary conditions, and inductance. [12 hrs] • Revision problem classes [6 hrs]

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	**General review in vector and coordinate system**: Start by reviewing basic vector algebra and coordinate systems. Practice vector addition and subtraction, scalar multiplication, dot product, cross product, and coordinate transformations. **Coulomb's law and electric field intensity**: Understand the concept of electric charge and how it relates to electric fields. Practice applying Coulomb's law to point charges and continuous charge distributions. **Electric flux density and Gauss law**: Understand the concept of electric flux density and how it relates to electric field intensity. Practice applying Gauss's law to calculate electric fields for symmetric charge distributions. **Divergence and gradient theories**: Review the concepts of divergence and gradient in vector calculus. **Energy potential and energy density in electric field**: Understand the concept of energy potential in electrostatics. Learn how to calculate energy density in an electric field. **Current density and electric boundary conditions**: Understand the concept of current density in electrostatics. Learn the boundary conditions for electric fields at interfaces between different materials. **Resistance and capacitance**: Understand the concepts of resistance and capacitance in circuits. Practice solving problems involving resistors and capacitors in series and parallel.

	Poisson's and Laplace equations application and examples: Understand Poisson's equation and Laplace's equation in electrostatics. **Biot-Savart law, Ampere's law, and curl**: Understand Biot-Savart's law for calculating magnetic fields due to current-carrying wires. **Magnetic field intensity and magnetic flux density**: Understand the concept of magnetic field intensity and its relationship to magnetic force on moving charges. **Scalar and vector magnetic potential**: Understand the concepts of scalar potential and vector potential in magnetostatics. **Magnetic force, magnetic boundary conditions, and inductance**: Understand the force on a moving charge in a magnetic field. Learn the boundary conditions for magnetic fields at interfaces between different materials.

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	93	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	6.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	32	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	2.1
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5, 10	LO #5 and 10
	Assignments	6	10% (10)	2, 12	LO # 3, 4, 6 and 7
	Projects / Lab.	6	10% (10)	2, 12	LO # 3, 4, 6 and 7
	Report	6	10% (10)	2, 12	LO # 5, 8 and 10
Summative assessment	**Midterm Exam**	2 hr	10% (10)	8	LO # 1-8
	Final Exam	3 hr	50% (50)	15	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

	Material Covered
١, ٢	General review in vector and coordinate system.
٣	Coulombs law and electric field intensity.
٤	Electric flux density and Gauss law.
٥	Divergence and gradient theories.
٦	Energy potential and energy density in electric field.
٧	Current density and electric boundary conditions.
٨	Several examples on resistance and capacitances use of it.
٩	Poisons and Laplace equations application and examples.
١٠	Biot- savant law and ampere law and curl.
١١	Magnetic field intensity and magnetic flux density.
١٢	The scalar and vector magnetic potential.
١٣	Magnetic force, magnetic boundary conditions and inductance.
١٤	Faradays law, displacement current and Maxwell's equations in potential and integral form.
١٥	Final Examination

Delivery Plan (Weekly Lab. Syllabus)
المنهاج الاسبوعي للمختبر

	Material Covered
١	LAB 1: INTRODUCTION TO MATLAB PROGRAM AND M FILE
٢	LAB 2: VECTOR ANALYSIS
٣	LAB 3: SURFACE INTEGRALS
٤	LAB 4: VOLUME INTEGRALS
٥	LAB 5: E FIELD OF LINEAR CHARGE
٦	LAB 6: E FIELD OF SURFACE CHARGES
٧	LAB7: ELECTRIC FLUX DENSITY
٨	LAB 8: ELECTRIC FLUX THROUGH A SURFACE
٩	LAB9: ELECTRIC POTENTIAL
١٠	LAB10: ELECTRIC ENERGY
١١	LAB 11: ELECTRIC CURRENT
١٢	LAB12: BOUNDARY CONDITIONS
١٣	LAB 13: CAPACITANCE
١٤	Review

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Engineering Electromagnetics - William_Hayt, 2010.	Yes
Recommended Texts	Electromagnetics – Schaum's series	No
Websites	No	

APPENDIX:

GRADING SCHEME
مخطط الدرجات

Group	Grade	التقدير	Marks (%)	Definition
Success Group (٥٠ - ١٠٠)	**A** - Excellent	امتياز	٩٠ - ١٠٠	Outstanding Performance
	B - Very Good	جيد جدا	٨٠ - ٨٩	Above average with some errors
	C - Good	جيد	٧٠ - ٧٩	Sound work with notable errors
	D - Satisfactory	متوسط	٦٠ - ٦٩	Fair but with major shortcomings
	E - Sufficient	مقبول	٥٠ - ٥٩	Work meets minimum criteria
Fail Group (٠ – ٤٩)	**FX** – Fail	مقبول بقرار	(٤٥-٤٩)	More work required but credit awarded
	F – Fail	راسب	(٠-٤٤)	Considerable amount of work required

Note:

NB Decimal places above or below ٠,٥ will be rounded to the higher or lower full mark (for example a mark of ٥٤,٥ will be rounded to ٥٥, whereas a mark of ٥٤,٤ will be rounded to ٥٤. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.