POWE 271 – Electromagnetic Fundamentals

Curricular Area	**Electrical Engineering/ Communication Section**		
Type of Course	Mandatory – Major		
Catalogue Description	Three-dimensional orthogonal coordinate systems: Cartesian, Cylindrical and Spherical. Vector Analysis: Gradient, Divergence and Curl of fields, Divergence theorem, Stokes's theorem. Fundamental Postulates of Electrostatics in free space, Coulomb's Law in space, Gauss's Law in space. Material Media: Conductors and Dielectrics, Polarization, Electric Flux Density. Boundary Conditions. Capacitors and Electrostatic Energy. Poisson's Equation, Laplace's Equation, Method of Images, Boundary Value Problems, Steady Electric Currents: conduction and convection currents, equation of continuity, boundary conditions for current density. Resistance and Power calculations. Fundamental Postulates of Magnetostatics in free space, Biot-Savart law in space, Ampere's Law in space. Magnetic materials: Magnetization, Inductance and Magnetostatic Energy. Magnetic circuit analysis. Introduction to Magnetic Forces and Torques. Time varying fields: Faraday's Law for Electromagnetic Induction (stationary circuit in a time-varying magnetic field, Transformers, moving circuit in steady and time-varying magnetic fields), Maxwell's Equations, Electromagnetic boundary conditions.		
Prerequisites by Courses	PHYS281: Electricity and Magnetism		
Prerequisites by Topics	Electrostatics: Electric charge, Electric field, Coulomb's Law, Gauss's Law, Faraday's law		
Instructors	Dr. Hamza Issa h.issa@bau.edu.lb Engineering Building – Department of Electrical Engineering Office G 110 (Phone: 07 985 585 Ext 3403)		
Office Hours	Monday: 14:00 – 16:00; Wednesday: 14:00 – 16:00; Friday: 12:00 – 14:00;		
Load	3 credits; 2 Lecture-sessions/week – Fall semester: 14 weeks – 80 min per session, Section 1: Monday: 08:00-09:40; Room: EG127; THuesday: 08:00-08:50; Room: Science B211 Section 2: Monday: 10:00-11:50; Room: EG127; THuesday: 09:00-09:50; Room: Science B211		
Textbook	David K. Cheng, "Fields and Waves Electromagnetics", Addison Wesley, 2nd edition, 1989		
Topics	*Subjects covered*	*80 min. lectures*	*Week: Date*
	Three-dimensional orthogonal coordinate systems: Cartesian, Cylindrical and Spherical. Vector Analysis: Gradient, Divergence and Curl of fields, Divergence theorem, Stokes's theorem.	5	1: 06/09/2017 2: 11/09/2017 & 13/09/2017 3: 18/09/2017 & 20/09/2017
	Fundamental Postulates of Electrostatics in free space,	1	4: 25/09/2017
	Coulomb's Law in space, Gauss's Law in space.	3	4: 27/09/2017,

			5: 02/10/2017 & 04/10/2017
	Material Media: Conductors and Dielectrics, Polarization, **Quiz 1**	2.5 +0.5 = 3	6: 09/10/2017 & 11/10/2017 7: **16/10/2017**
	Electric Flux Density. Boundary Conditions.	1	7: 18/10/2017
	Capacitors and Electrostatic Energy. Poisson's Equation, Laplace's Equation, Method of Images,	4	8: 23/10/2017 8: 25/10/2017 9: 30/10/2017 9: 01/11/2017
	Boundary Value Problems,	1.5	10: 06/11/2017 10: 08/11/2017
	Steady Electric Currents: conduction and convection currents, equation of continuity, boundary conditions for current density. Resistance and Power calculations.	1.5	10: 08/11/2017 11: 13/11/2017
	Fundamental Postulates of Magnetostatics in free space, Biot-Savart law in space, Ampere's Law in space.	3	11: 15/11/2017 12: 20/11/2017 & 22/11/2017 (substituted 24/11/2017)
	Magnetic materials: Magnetization, Inductance and Magnetostatic Energy. Magnetic circuit analysis. Introduction to Magnetic Forces and Torques.	2	13: 27/11/2017 & 29/11/2017
	Time varying fields: Faraday's Law for Electromagnetic Induction (stationary circuit in a time-varying magnetic field, Transformers, moving circuit in steady and time-varying magnetic fields),	2	14: 04/12/2017 14: 06/12/2017
	Maxwell's Equations, Electromagnetic boundary conditions.	1	14: 11/12/2017
	Total	28	14 weeks

At the end of this course the students should be able to:

Learning Outcomes **Correlation with**	**Program Outcomes**	**Program Objectives**
Identify the differences between vector and scalar quantities	a, c, d	1, 2
Identify different orthogonal coordinate systems	a, d	1, 2
Convert quantities and vectors between different coordinate systems	a, c, d, k	1, 2, 3
Calculate vector integrals and differentiations	a, c, d, k	1, 2, 3
List fundamental postulates of electrostatics and magnetostatics	a, b, c, d, k	1
State Gauss's law and Coulomb's law	A	1
Apply Gauss's law and Coulomb's law	a, b, c, d, k	1, 2
Combine different laws to solve an electrostatic problem	a, b, c, d, k	1, 2
Differentiate different material types that interact with electric and magnetic fields	a, b, c, d, k	1, 2
Discuss the concept of polarization in electrostatics	a, b, c, d, k	1
Describe the concept of electric flux density	a, b, c, d, k	1
Derive different boundary conditions (in electrostatic, magnetostatics and time-varying fields conditions)	a, b, d, k	1, 2
Analyze and evaluate capacitors, resistances and inductors in electromagnetic problems	a, b, c, k	1, 2
Evaluate the energy stored in electromagnetic fields (in electrostatic, magnetostatics and time-varying fields problems)	a, b, c, d	1, 2
Solve problems with given boundary values	a, b, c, d	1, 2
Apply Poisson's Equation and Laplace's Equation to solve electromagnetic problems	a, b, c, d, k	1, 2
State Biot-Savart law and Ampere's Law	A	1
Apply Biot-Savart law and Ampere's Law	a, b, c, d, k	1, 2
Calculate Magnetic Forces and Torques	a, b, c	1, 2
Solve problems using the concept of magnetic circuits	a, b, c	1, 2
Recite Faraday's Law for Electromagnetic Induction	A	1
Solve problems using Faraday's Law for Electromagnetic Induction	a, b, c, d, k	1, 2
List Maxwell's equations and explain the meaning of each one	a, b, d	1
Explain what is meant by Time-Harmonic Fields	a, c, d	1
Describe how Time-Harmonic Fields can be generated	a, b, c, d	1, 2
Solve problems including Time-Harmonic Fields	a, b, c, d, k	1, 2

Learning Outcomes Assessment Tools	**Exams**	**HW s**	**Lab Reports**	**Project**	**Course Survey**
Identify the differences between vector and scalar quantities	☒	☒			☒
Identify different orthogonal coordinate systems	☒	☒			☒
Convert quantities and vectors between different coordinate systems	☒	☒			☒
Calculate vector integrals and differentiations	☒	☒			☒
List fundamental postulates of electrostatics and	☒				☒

magnetostatics					
State Gauss's law and Coulomb's law	☒				☒
Apply Gauss's law and Coulomb's law	☒	☒			☒
Combine different laws to solve an electrostatic problem	☒	☒			☒
Differentiate different material types that interact with electric and magnetic fields	☒				☒
Discuss the concept of polarization in electrostatics	☒				☒
Describe the concept of electric flux density	☒				☒
Derive different boundary conditions (in electrostatic, magnetostatics and time-varying fields conditions)	☒	☒			☒
Analyze and evaluate capacitors, resistances and inductors in electromagnetic problems	☒	☒			☒
Evaluate the energy stored in electromagnetic fields (in electrostatic, magnetostatics and time-varying fields problems)	☒	☒			☒
Solve problems with given boundary values	☒	☒			☒
Apply Poisson's Equation and Laplace's Equation to solve electromagnetic problems	☒	☒			☒
State Biot–Savart law and Ampere's Law	☒				☒
Apply Biot–Savart law and Ampere's Law	☒	☒			☒
Calculate Magnetic Forces and Torques					☒
Solve problems using the concept of magnetic circuits	☒	☒			☒
Recite Faraday's Law for Electromagnetic Induction	☒				☒
Solve problems using Faraday's Law for Electromagnetic Induction	☒	☒			☒
List Maxwell's equations and explain the meaning of each one	☒				☒
Explain what is meant by Time–Harmonic Fields	☒				☒
Describe how Time–Harmonic Fields can be generated	☒	☒			☒
Solve problems including Time–Harmonic Fields	☒	☒			☒

Assessment:

Assessment type	Dates	Weighing
Quiz 1 + Assignments + **Drop Quizzes**	Weeks 1 → 7 Monday: 16/10/2017	**10%**+5%+**15%** = 30%
Assignments + **Drop Quizzes**	Weeks 8 → 12	5%+**15%**= 20%
Assignments + **Drop Quizzes**	Weeks 13, 14	2.5%+**7.5%**= 10%
Assignments	Per two weeks	Included above
Final Exam	TBS	40%
Total		100%

Attendance:

As set by BAU regulations, and specified in Student Manual, students who miss more than 20% of the sessions of any course excluding the first week of the semester will be withdrawn from the course with and will get a grade of "AW". The first attendance warning is issued after 10% absence. The second is issued when the absence percentage becomes 15%. The course is withdrawn when the percentage exceeds 20%. The "AW" grade is not taken into account in the calculation of the SGPA.

Course Coordinator	Dr. Hamza Issa

04/09/2017