Sana'a University
Faculty of Engineering
Mechanical Engineering Department
Mechanical Engineering Program

23. Course Specification of Electrical Circuits

I. Course Identification and General Information:						
1.	Course Title:	Electrical Circuits				
2.	Course Code & Number:	PME110				
3.	Credit hours:	C.H				TOTAL CR. HRS
		Th.	Seminar/Tu	Pr	Tr.	
		2	-	2	-	3
4.	Study level/ semester at which this course is offered:	Second Year- First Semester				
5.	Pre –requisite (if any):	Engineering Physics (FR002)				
6.	Co –requisite (if any):	None				
7.	Program (s) in which the course is offered:	B.Sc. Mechanical Engineering Program				
8.	Language of teaching the course:	English Language				
9.	Location of teaching the course:	Mechanical Engineering Department				
10.	Prepared By:	Asst. Prof. Dr. Adel Ahmed Al-Shogairy				
11.	Date of Approval:					

II. Course Description:

This course aims to present the electrical circuit analysis in a manner that is clear, more interesting, and easy to understand. It covers the principles of basic electrical circuits analysis including different laws such as Ohm's law, current and voltage Kirchhoff's laws, and power and energy laws. A different circuit analysis methods and Theorem's are introduced in this course. DC and AC circuit analysis is the main part of the course. Since this course is devoted to students in Mechanical Engineering Program, an analogy is given between mechanical and electrical systems.

III. Alignment Course intended learning outcomes (CILOs) of the course		Referenced PILOs
a1	Illustrate knowledge and understanding of Mathematics, Science and Engineering tools relevant to Mechanical Engineering.	A1

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a2	Describe knowledge tools and analytical skills necessary for solving electrical Engineering problems.	A4
b1	Solve the electrical systems problems in innovative ways with analogy to mechanical systems	B1
b2	Design the electrical engineering systems based on different Laws and Theorem's of circuit analysis	B2
c1	Use the various techniques, skills, equipment and modern engineering tools and methods necessary for Mechanical Engineering practice.	C1
c2	Conduct experiments; analyze data and present results for various electrical systems.	C2
d1	Evaluate and manage tasks, time, processes and resources of electrical engineering systems effectively	D2
d2	Review the literature resources and use databases as well as evaluate information and evidence from various electrical engineering sources.	D4
d3	Argue concepts and experimental results in clear and logical fashion, both verbally and in writing.	D5

(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- Illustrate knowledge and understanding of Mathematics, Science and Engineering tools relevant to Mechanical Engineering.	- Active Lectures - Problem Based Learning	- Written Exam - Short Essays - Oral Exams
a2- Describe knowledge tools and analytical skills necessary for solving electrical Engineering problems.	- Active Lectures - Examples - Interactive Class Discussions - Laboratory Work	- Written Exam - Homework and Assignment - Reports

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1- Solve the electrical systems problems in innovative ways with analogy to mechanical systems	- Active Lectures - Examples - Interactive Class Discussions - Laboratory Work	- Written Exam - Homework and Assignment - Reports
b2- Design the electrical engineering systems based on different Laws and Theorem's of circuit analysis	- Active Lectures - Examples - Interactive Class Discussions - Laboratory Work	- Written Exam - Homework and Assignment - Reports

© 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 the various techniques, skills, equipment and modern engineering	- Active Lecture - Small Project	- Written Quizzes - Written Exams

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tools and methods necessary for Mechanical Engineering practice.	- Examples - Laboratory Work	- Presentations - Reports
c2- and Conduct experiments; analyze data present results for various electrical systems.	- Active Lecture - Small Project - Laboratory Work	- Written Quizzes - Written Exam - Presentations - Reports

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1- Evaluate and manage tasks, time, processes and resources of electrical engineering systems effectively	- Active Lecture - Laboratory Work - Case Study	- Written Report - Presentations
d2- Review the literature resources and use databases as well as evaluate information and evidence from various electrical engineering sources.	- Active Lecture - Laboratory Work - Case Study - Small Project	- Written Report - Presentations
d3- Argue concepts and experimental results in clear and logical fashion, both verbally and in writing.	- Active Lecture - Laboratory Work - Case Study - Small Project	- Written Report - Presentations

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub topics List	Number of Weeks	Contact hours
1.	Resistive Circuits	a1, a2, b1, b2,c1,d1,d2, d3	- Course Overview - System of Units - Basic Quantities - Circuit Elements - Ohm's Law - Kirchhoff's Laws - Single-Loop Circuits - Single-Node-Pair Circuits - Series and Parallel Resistor Combinations - Circuits with Series-Parallel - Combinations of Resistors - Wye Delta Transformations - Circuits with Dependent Sources	2	4
2.	Nodal & Loop Analysis Techniques	a1, a2, b1, b2,c1,d1,d2, d3	- Nodal Analysis - Loop Analysis	1	2
3.	Operational Amplifiers	a1, a2, b1, b2,c1,d1,d2, d3	- Introduction - Op-Amp Models - Fundamental Op-Amp Circuits - Comparators	1	2
4.	Additional Analysis Techniques	a1, a2, b1, b2,c1,d1,d2, d3	- Introduction - Superposition	1	2

			- Thévenin's and Norton's Theorems		
5.	Capacitance & Inductance	a1, a2, b1, b2,c1,d1,d2, d3	- Capacitors - Inductors - Capacitor and Inductor Combinations - RC Operational Amplifier Circuits	1	2
6.	First- & Second-Order Transient Circuits	a1, a2, b1, b2,c1,d1,d2, d3	- Introduction - First-Order Circuits - Second-Order Circuits	1	2
7.	Mid-Term Exam	a1, a2, b1, b2,c1,d1,d2, d3	- All Previous Topics	1	2
8.	AC Steady-State Analysis	a1, a2, b1, b2,c1,d1,d2, d3	- Sinusoids - Sinusoidal and Complex Forcing Functions - Phasors - Phasor Relationships for Circuit Elements - Impedance and Admittance - Phasor Diagrams - Basic Analysis Using Kirchhoff's Laws - Analysis Techniques	2	4
9.	Steady-State Power Analysis	a1, a2, b1, b2,c1,d1,d2, d3	- Instantaneous Power - Average Power - Maximum Average Power Transfer - RL and RC Circuits Effective(RMS) - The Power Factor - Complex Power	2	4

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			- Power Factor Correction - Single-Phase Three-Wire Circuits - Safety Considerations		
10.	Magnetically Coupled Networks	a1, a2, b1, b2,c1,d1,d2, d3	- Mutual Inductance - Energy Analysis - The Ideal Transformer - Safety Considerations	1	2
11.	Polyphase Circuits	a1, a2, b1, b2,c1,d1,d2, d3	- Three-Phase Circuits - Three-Phase Connections - Source/Load Connections - Power Relationships - Power Factor Correction	1	2
12.	Variable-Frequency Network Performance	a1, a2, b1, b2,c1,d1,d2, d3	- Variable Frequency-Response Analysis - Sinusoidal Frequency Analysis - Resonant Circuits - Scaling - Filter Networks	1	2
13.	Final Exam	a1, a2, b1, b2,c1,d1,d2, d3	- All Topics	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B – Practical Aspect:

Order	Tasks/ Experiments	Learning Outcomes	Number of Weeks	Contact hours
1.	Resistive Circuits	a1, a2, b1, b2, c1,c2,d1,d2, d3	2	4

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2.	Nodal & Loop Analysis Techniques	a1, a2, b1, b2 ,c1,c2,d1,d2, d3	1	2
3.	Operational Amplifiers	a1, a2, b1, b2, c1,c2,d1,d2, d3	1	2
4.	Additional Analysis Techniques	a1, a2, b1, b2, c1,c2,d1,d2, d3	1	2
5.	Capacitance & Inductance	a1, a2, b1, b2, c1,c2,d1,d2, d3	1	2
6.	First- & Second-Order Transient Circuits	a1, a2, b1, b2, c1,c2,d1,d2, d3	1	2
7.	AC Steady-State Analysis	a1, a2, b1, b2, c1,c2,d1,d2, d3	2	4
8.	Steady-State Power Analysis	a1, a2, b1, b2, c1,c2,d1,d2, d3	1	2
9.	Magnetically Coupled Networks	a1, a2, b1, b2 , c1,c2,d1,d2, d3	1	2
10.	Submission of Reports.	a1, a2, b1, b2 , c1,c2,d1,d2, d3	1	2
11.	Polyphase Circuits	a1, a2, b1, b2, c1,c2,d1,d2, d3	1	2
12.	Final Practical Exam	a1, a2, b1, b2, c1,c2,d1,d2, d3	1	2
Number of Weeks /and Units Per Semester			**14**	**28**

V. Teaching strategies of the course:

- Active Lectures
- Problem Based learning
- Examples
- Interactive Class Discussions
- Laboratory Work
- Small Project
- Case Study

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VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Lab Work & Experiments Reports	a1, a2, b1, b2, c1,c2,d1,d2, d3	Weekly	10
2	Homework	a1, a2, b1, b2, c1, d2,d3	Weekly	10
3	Term-Project Report & Presentation	a1, a2, b1, b2, c1, c2, d1, d2,d3	11^{th} & 12^{th} weeks	5
Total				**25**

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	Weekly	25	16.7%	a1, a2, b1, b2, c1, c2, d1, d2,d3
2	Quizzes	2^{nd}, 4^{th} , 8^{th} & 12^{th} weeks	10	6.7 %	a1, a2, b1, b2
3	Mid-Term Exam	8^{th} week	20	13.33 %	a1, a2, b1, b2, c1, d2, d.3
4	Final-Term Exam (Laboratory)	14^{th} week	20	13.33 %	c1, c2, d1, d2,d3
5	Final-Term Exam	16^{th} week	75	50 %	a1, a2, b1, b2, c1, d1, d2
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- J. David Irwin, Robert M. Nelms, 2010, Basic Engineering Circuit Analysis, 10^{th} Edition, John Wiley & Sons.

2- Essential References.

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	1. Charles K. Alexander, Matthew N. O. Sadiku, Fundamentals of Electrical Circuits, 3rd Edition- McGraw-Hill. 2. Robert L. Boylestad, 2016, Introductory Circuit Analysis, 13th Edition, Pearson Hall. 3. A Fitzgerald, Arthur Eugene Fitzgerald, Charles Kingsley, Stephen Umans, 2002, Electrical Machinery, McGraw-Hill.
3- Electronic Materials and Web Sites *etc*.	
	1- http://www.ocw.mit.edu/courses. 2- Faculty Electronic Library.

IX. Course Policies:

1	**Class Attendance:** - The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and consider as exam failure. If the student absent due to illness, he/she should bring an approved statement from university Clinic.
2	**Tardy:** - For late in attending the class, the student will be initially notice. If he repeated late in attending class he will consider as absent.
3	**Exam Attendance/Punctuality:** - The student should attend the exam on time. He is Permitted to attend the exam half one hour from exam beginning, after that he/she will not permitted to take exam and he/she deals as absent in exam.
4	**Assignments & Projects:** - In general one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment
5	**Cheating**: - For cheating in exam, the student considered as failure. Case the cheating repeated three times during study the student will be disengaged from the Faculty
6	**Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university.
7	**Other policies:**

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	- The mobile phone is not allowable to use during class lecture. It must be closed, otherwise the student will ask to leave the lecture room - The mobile phone is not allowed to take with in class during the examination. - Lecture notes and assignments my given directly to students using soft or hard copy.

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: Assoc.Prof. Dr. Khalil Al-Hatab**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

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