25.Course Specification of Electrical Circuits (2)

I.Course Identification and General Information:

.1	Course Title:	Electrical Circuits (2).				
.2	Course Code & Number:	MT107.				
.3	Credit hours:	C.H.				TOTAL Cr.Hrs.
		Th.	Seminar	Pr	Tu.	
		2	-	2	2	4
.4	Study level/ semester at which this course is offered:	Second Year -Second Semester.				
.5	Pre –requisite (if any):	Electrical Circuits (1).				
.6	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered:	Mechatronics Engineering Program.				
8.	Language of teaching the course:	English Language.				
.9	Location of teaching the course:	Mechatronics Engineering Department.				
10.	Prepared By:	Asst. Prof. Dr. Muhammad Al-Yadoumi.				
11.	Date of Approval:					

II.Course Description:

This course is a continuation of Electrical Circuits I. The course is intended to enhance students' knowledge and develop their skills in electrical circuit analysis with regard to Alternating current circuits (AC). The course topics focus on fundamentals, calculations and analysis of AC circuits that includes: complex numbers and phasors, impedance, admittance, voltage, current, powers in AC circuits and their components, power factor improvement, polyphase circuits, and passive and active filters. The application of the different theorems, laws, and techniques premeditated in electrical circuit (1) is also presented. The course includes lab experiments, computer simulation, and group-based term projects to reinforce topics covered in the course.

III.Course Intended learning outcomes (CILOs) of the course

		Referenced PILOs
a1.	Describe knowledge and understanding of wave form fundamentals:wave variables, instantaneous value, phasors and trigonometry used in electric circuit analysis.	A1
a2.	Explain the circuit principles, theorems, laws and techniques used in circuits analysis and implementation.	A2
b1.	Explore circuit analysis techniques and computer simulation to investigate the behavior of basic mechatronic systems.	B1

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b2.	Compare between alternative technics used in DC and AC circuits analysis and select the appropriate one according to the needed specifications.	B4
c1.	Prescribe main electrical measuring devices and methods of electrical quantities measurements in AC circuits and conduct experiments safely to verify theoretical: concepts, rules, and theorems covered throughout the course.	C1
c2.	Apply knowledge acquired throughout the course to identify, formulate, simulate and solve different configurations of electrical circuits faced in mechatronics systems.	C2
d1.	Assess student's cooperative work though efficient team works.	D1
d2.	Review reports using commonly used applications.	D6

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
understanding **a1.** Describe knowledge and of wave form:fundamentals, variables, instantaneous value, phasors and trigonometry used in electric circuit analysis.	• Active Lectures. • Tutorials. • Self-Learning. • Discussion.	• Written Exams. • Homework. • Class Activities.
a2. Explain the circuit principles, theorems, laws and techniques used in circuits analysis and implementation	• Active Lectures. • Tutorials. • Laboratory Works. • Discussion.	• Written Exams. • Homework • Class Activities. • Lab. 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. Explore circuit analysis techniques and computer simulation to investigate the behavior of basic mechatronic systems.	• Active Lectures. • Tutorials. • Brainstorming. • Laboratory Works. • Circuit Simulations.	• Written Exams. • Homework. • Class Activities. • Lab. Reports.

b2. Compare between alternative technics used in DC and AC circuits analysis and select the appropriate one according to the needed specifications.	• Active Lectures. • Tutorials. • Laboratory Works. • Discussion.	• Written Exams. • Homework. • Class Activities. • Lab 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. Prescribe main electrical measuring devices and methods used in electrical quantities measurements of AC circuits; and conduct experiments safely to verify theoretical: concepts, rules, and theorems covered throughout the course	• Analysis and Problem Solving. • Laboratory Works. • Circuit Simulations • Shared Projects.	• Written Exams. • Homework • Class Activities. • Lab. Reports • Project reports.
c2. Apply knowledge acquired throughout the course to identify, formulate, simulate and solve different configurations of electrical circuits faced in mechatronics systems.	• Analysis and Problem Solving. • Laboratory Works. • Circuit Simulations	• Written Exams. • Homework. • Class Activities. • Simulations 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. Assess student's cooperative work though efficient team works.	• Group Works. • Projects.	• Project Reports. • Presentation.
d2. Review reports using commonly used applications.	• Group Works. • Projects.	• Homework and Lab. reports. • Project Reports.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Course Orientation. Time Dependent	a1, b1	• Course objectives, learning outcomes, requirements and guidelines to comply with the course.	1	2

	Wave Forms and Signals.		• Introduction to time dependent wave forms. • Difference between DC and AC signals.		
2.	Sinusoidal Wave Forms of Alternating Voltage and Current.	a1, a2	• General format of the sinusoidal wave in: time-domain form, phasor form. • Sinusoidal ac voltage characteristics and definitions: instantaneous, amplitude, maximum, peak-to- peak, average, and effective (r. m. s.) values.	1	2
3.	Response of the Basic AC Elements.	a1, a2, b4	• Response of basic R, L, and C elements to a sinusoidal voltage or current • Frequency response of the resistance, inductive and capacitive reactances (R, X_L, X_C)	1	2
4.	Mathematical Aspect of AC Circuit Analysis.	a_1,a_2,b1,b_2,c_2	• Complex numbers: rectangular form , polar form. • Conversion between forms. • Mathematical operations with complex numbers: addition, subtraction, multiplication and division of complex quantities.	1	2
5.	Series and Parallel AC Circuits.	a_1,a_2,b1,b_2,c_2	• Impedance resistance and inductance. • Admittance, conductance and susceptance. • Series configuration • Kirchhoff's voltage law (KVL). voltage divider rule (VDR). • Parallel circuits Kirchhoff's current law (KCL). current divider rule (CDR).	1	2

			• Series-parallel Combination		
6.	Methods of Analysis and Techniques used in AC Circuit Analysis.	$a1,a_2,b_1,b_2,c_1$	• Dependent (controlled) voltage and current sources. • Current sources conversion between sources. • Mesh analysis and nodal analysis of electric circuits. • Lader networks • Bridge networks • Star delta transformations Y to Δ and Δ to Y	1	2
7.	Network Theorems Application on AC Circuits.	a1,a2,b1, b2,c1.	• Super position theorem, • Thevenin's theorem, Norton's theorem • Theorem of maximum power.	1	2
8.	Mid-Term Exam.	a1, a2, b1, b2, c1, c2.	• Topics covered in the previous lectures.	1	2
9.	Powers of AC Circuits.	a1, a2, b1, b2, c1, c2.	• Apparent power. active power, reactive power • Power triangle. • Power factor improvement.	1	2
10.	Polyphase Systems.	a1, a2, b1, b2, c2.	Unbalance three-phase system. • Balance three-phase generator. • Phase sequence. • Three-phase system configurations: • Y and Δ connected generator. • Y and Δ connected load. • Y- Y connected system. • Y- Δ connected system. • Δ- Y connected system. • Δ-Δ connected system. • Three-wattmeter method 1048. • 23.12two-wattmeter Method 1049. • Unbalanced phase systems.	2	4

11.	Operational Amplifiers.	a1, a2, b1, b2, c2.	• Introduction to operational amplifiers op-amp input modes and parameter. • Op-amps with negative feedback • Effects of negative feedback on op-amp. • Parameters.	1	2
12.	Passive Filters.	a1, a2, b1, b2, c2.	• Filters classification • Filter networks: low-pass, high pass, bandpass, band-reject. • Decibels. • Filter characteristic. • Bandwidth and cut-off frequency. • Bode plots of filter characteristic.	2	4
13.	Active Filters.	a1, a2, b1, b2, c2.	• Configurations of active Filter: low-pass, high pass, bandpass, band-reject • Filter response characteristics • Role off • Multi-stage active filters.	1	2
14.	Final Exam.	a1, a2, b1, b2, c1, c2.	• All the Chapters.	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B - Tutorial Aspect:

Order	Tutorial	Learning Outcomes	Number of Weeks	Contact Hours
1.	Sinusoidal AC Voltage Characteristics and Definitions. Frequency Spectrum. General Format for the Sinusoidal Voltage or Current.	a1, b1	1	2

	The Sinusoidal Waveform Phase Relations instantaneous, amplitude, maximum, peak-to- peak, average, and effective (r. m. s.) values.			
2.	• Response of Basic *R*, *L*, and *C* Elements to a Sinusoidal Voltage or Current. • Frequency Response of the R, X_L, X_C Elements. • Average Power and Power Factor. • Conversion between Polar and Rectangular Forms • Mathematical Operations of Complex Numbers and Phasors	a1, b1, c2	1	2
3.	• Impedance and the Phasor Diagram. • Series Configuration. • Voltage Divider Rule. • Admittance and Susceptance. • Parallel ac Networks. • Current Divider Rule. • Equivalent Circuits.	a1, b2,	2	4
4.	• Independent versus Dependent. • (Controlled) Sources. • Source Conversions. • Mesh Analysis. • Nodal Analysis. • Bridge Networks. • Y-Δ and Δ-Y Conversions.	a1, a2, b1, b2,,c1	1	2
5.	Network Theorems (AC). • Superposition Theorem. • Thévenin's Theorem. • Norton's Theorem. • Maximum Power Transfer Theorem.	a1, a2, b1, b2	2	4
6.	Powers of AC Circuits. • Apparent Power. • Active Power, Reactive Power. • Power Triangle. • Power Factor Improvement.	a1,a2,b1, b2,,c1	1	2
7.	Solutions of Mid-Term Exam.	a1, a2, b1, b2, c1	1	2

8.	Operational Amplifiers. • Introduction to Operational Amplifiers Op-Amp Input Modes and Parameters • Op-Amps with Negative Feedback • Effects of Negative Feedback on Op-Amp • Parameters	a1,a2,b1, b2,,c1, c2.	2	4
9.	Passive Filters. • Classification of Filters. • Filter Networks: Low-Pass, High Pass, Bandpass, Band-Reject. • Decibels. • Filter Characteristics. • Bandwidth and Cut-off Frequency. • Bode Plots of Filter characteristics.	a1,a2,b1, b2,,c1., c2	1	2
10.	Active Filters: • Active Filter Configurations: Low-Pass, High Pass, Bandpass, band-Reject • Filter Response Characteristics. • Role off. • Multi-Stage Active Filters.	a1,a2,b1, b2,,c1, c2.	1	2
11.	General Review and Discussion.	a1,a2,b1, b2,,c1, c2.	1	2
Number of Weeks /and Units Per Semester			**14**	**28**

B - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	Lab 1 • Orientation • Oscilloscope and Function Generator Familirastion.	1	2	c1, c2, b2,d1,d2.
2.	Experiments No. 1 Average and RMS Values.	1	2	a2, b1, b2, c1, d1, d2.
3.	Experiments No. 2	1	2	a2, b1, b2, c1, d1, d2.

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	• Frequency Response of the R, X_L, X_C Elements.			
4.	Experiments No. 3 Capacitive and Inductive Reactance.	1	2	a2, b1, b2, c1, d1, d2.
5.	Experiments No. 4 Series RLC Circuits. Computer Simulation.	1	2	a2, b1, b2, c1, c2, d1,d2.
6.	Experiments No. 5 Parallel RLC Circuits. Computer Simulation.	1	2	a2, b1, b2, c1, c2, d1,d2.
7.	Experiments No.6 AC Superposition. Computer Simulation.	1	2	a2, b1, b2, c1, c2, d1,d2.
8.	Experiments No. 7 AC Thevenin's Theorem. AC Maximum Power Transfer. Computer Simulation.	1	2	a2, b1, b2, c1, c2, d1,d2.
9.	Experiments No. 8 Power Relationships and Power Factor. Computer Simulation.	1	2	a2, b1, b2, c1, c2, d1,d2.
10.	Experiments No. 9. Basic OP-AmP Circuits. Computer Simulation.	1	2	a2, b1, b2, c1, c2, d1,d2.
11.	Experiments No. 10 Active Filters. Computer Simulation.	1	2	a2, b1, b2, c1, c2, d1,d2.
12.	Experiment No. 11 Course Project: Preparing for the Design and Implementation of Electrical Network that can be used in the Verification of the Theoretical Aspects explained throughout the Course. A Report must be prepared Students Work in Groups.	2	4	a2, b1, b2, c1, c2, d1,d2.
13.	Lab.Exam.	1	2	a1,a2,b1,b2,,c1, c2, d1,d2
Number of Weeks /and Units Per Semester		**14**	**28**	

V.Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- The Use of Computer and Web-Based Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.
- Laboratory Works
- Self and Cooperative Learning.
- Dialogue, Discussion and Class Activities.
- Analysis and Problem solving.
- Project Work.
- Design Exercises.
- Simulation Tools.
- Brainstorming.

VI.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Problem Set No. 1 Sinusoidal ac Voltage Characteristics.	a1, b2, d1,d2	2	1.67
2.	Problem Set No. 2 • Response of Basic *R*, *L*, and *C* Elements to a Sinusoidal Voltage or Current. • Frequency Response of the R, X_L, X_C Elements. • Average Power and Power Factor. • Conversion between Polar and Rectangular Forms. • Mathematical Operations of Complex Numbers and Phasors.	a1, b1,b2, c1, d1,d2.	3	1.67
3.	Problem Set No. 3 • Impedance and the Phasor Diagram. Resistance: Metric Units Temperature Effects Color Coding.	a1, b1,b2, c1, d1,d2.	4	1.67
4.	Problem Set No. 4 • Series AC Circuits.	a1, b1,b2, c1, c2, d1,d2.	5	1.67

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	• Parallel AC Networks.			
5.	Problem Set No. 5 • Independent versus Dependent. (Controlled) Sources • Source Conversions. • Mesh Analysis.	a1, b1,b2, c1, c2, d1,d2.	6	1.67
6.	Problem Set No. 6 • Nodal Analysis. • Bridge Networks. Y-Δ and Δ-Y Conversions.	a1, b1,b2, c1, c2, d1,d2.	7,8	1.67
7.	Problem Set No. 7 Network Theorems (AC). • Superposition Theorem. • Thévenin's Theorem. • Norton's Theorem. • Maximum Power Transfer Theorem.	a1, b1,b2, c1, c2, d1,d2.	9	1.67
8.	Problem Set No. 8 Powers of AC Circuits. • Apparent Power. • Active Power, Reactive Power. • Power Triangle. • Power Factor Improvement.	a1, b1,b2, c1, c2, d1,d2.	10,11	1.67
9.	Problem Set No. 9 Operational Amplifiers Part 1 Theorem. Millman's Theorem. Substitution Theorem.	a1, b1,b2, c1, c2, d1,d2.	12	1.67
10.	Problem set No. 10 Operational Amplifiers Part 2	a1, b1,b2, c1, c2, d1,d2.	13	1.67
11.	Passive Filters.	a1, b1,b2, c1, c2, d1,d2.	14	1.67
12.	Active Filters:	a1, b1,b2, c1, c2, d1,d2.	15	1.67
Total				**20**

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.	Attendance.	Every Class	10	5%	a1, b1,b2, c1, d1,d2.
2.	Assignments.	Weekly	20	10 %	a1, b1,b2, c1, d1,d2.
3.	Lab Reports.	Weekly	20	10 %	a1, b1,b2, c1, d1,d2.
4.	Course Project.	15	20	10%	a1, b1,b2, c1, c2, d1,d2.
5.	Mid -Term Exam.	8	20	10%	a1, b1,b2, d1,d2.
6.	Lab Exam.	15	10	5%	a1, b1,b2, c1, d1,d2.
7.	Final Exam.	16	100	50%	a1, b1,b2, c1, c2 d1,d2.
	Total		**200**	**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- Robert L. Boylestad, 2007, Introductory Circuit Analysis, 11 th Ed, Pearson Prentice. Hall, New Jersey, USA.
2- Floyd TL, 2008, Electronic Devices, 8th Ed. Pearson/Prentice Hall.

2- Essential References.

Dorf, Richard C.& Svoboda, James A, 2010, Introduction to Electric Circuits, 8 th Ed.

3- Electronic Materials and Web Sites *etc*.

All About Circuits : Free **Electric Circuits** Textbooks
www.allabout**circuits**.com/
http://www.uta.edu/ee/hw/pspice/
http://www.youtube.com/watch?feature=player_detailpage&v=dZUPBLNuaHk
http://denethor.wlu.ca/PSpice/pspice_tutorial.html
www.seas.upenn.edu/~jan/.../**PSpice_Library**guideOrCAD.pdf

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.

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.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. Head of Mechatronics Engineering Department: Assoc. Prof. Dr. Abdul-Malik Momin.
	Deputy Rector for Academic Affairs Assoc. Prof. Dr. Ibrahim AlMutaa. Assoc. Prof. Dr. Ahmed Mujahed. Asst. Prof. Dr. Munaser Alsubari.

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Template for Course Plan of Electrical Circuits (2)

I.Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Asst. Prof. Dr. Muhammad Al-Yadoumi.	**Office Hours**					
Location& Telephone No.	Electrical Engineering Department. 777811668.	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	Alyadoumi@hotmail.com.						

II.Course Identification and General Information:						
1.	Course Title:	Electrical Circuits (2).				
2.	Course Number & Code:	MT107.				
3.	Credit hours:	**C.H**				**Total Credit Hours**
		Th.	**Seminar**	**Pr.**	**Tu.**	
		2	-	2	2	4
4.	Study level/year at which this course is offered:	Second Year -Second Semester.				
5.	Pre –requisite (if any):	Electrical Circuits (1).				
6.	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered	Mechatronics Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	System of Study:	Semesters.				
10.	Mode of delivery:	Lectures, Tutorials and Labs.				
11.	Location of teaching the course:	Mechatronics Engineering Department.				

III.Course Description:

This course is a continuation of Electrical Circuits I. The course is intended to enhance students' knowledge and develop their skills in electrical circuit analysis with regard to Alternating current circuits (AC). The course topics focus on fundamentals, calculations and analysis of AC circuits that includes: complex numbers and phasors, impedance, admittance, voltage, current, powers in AC circuits and their components, power factor improvement, polyphase circuits, and passive and active filters. The application of the different theorems, laws, and techniques premeditated in electrical circuit (1) is also presented. The course includes lab experiments, computer simulation, and group-based term projects to reinforce topics covered in the course.

IV.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Describe knowledge and understanding of wave form fundamentals: wave variables, instantaneous value, phasors and trigonometry used in electric circuit analysis.	A1
a2.	Explain the circuit principles, theorems, laws and techniques used in circuits analysis and implementation.	A2
b1.	Explore circuit analysis techniques and computer simulation to investigate the behavior of basic mechatronic systems.	B1
b2.	Compare between alternative technics used in DC and AC circuits analysis and select the appropriate one according to the needed specifications.	B4
c1.	Prescribe main electrical measuring devices and methods of electrical quantities measurements in AC circuits and conduct experiments safely to verify theoretical: concepts, rules, and theorems covered throughout the course.	C1
c2.	Apply knowledge acquired throughout the course to identify, formulate, simulate and solve different configurations of electrical circuits faced in mechatronics systems.	C2
d1.	Assess student's cooperative work though efficient team works.	D1
d2.	Review reports using commonly used applications.	D6

V.Course Content:

- Distribution of Semester Weekly Plan of Course Topics/Items and Activities.

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Course Orientation.	• Course objectives, learning outcomes, requirements and guidelines to comply with the course.	1	2

	Time Dependent Wave Forms and Signals.	• Introduction to time dependent wave forms. • Difference between DC and AC signals.		
2.	Sinusoidal Wave Forms of Alternating Voltage and Current.	• General format of the sinusoidal wave in: • time-domain form, • phasor form. • Sinusoidal ac voltage characteristics and definitions: • instantaneous, amplitude, maximum, peak-to- peak, average, and effective (r. m. s.) values.	2	2
3.	Response of the Basic AC Elements.	• Response of basic R, L, and C elements to a sinusoidal voltage or current • Frequency response of the resistance, inductive and capacitive reactances • (R, X_L, X_C)	3	2
4.	Mathematical Aspect of AC Circuit Analysis.	• Complex numbers: • rectangular form , polar form. • Conversion between forms. • Mathematical operations with complex numbers: • addition, subtraction, multiplication and division of complex quantities.	4	2
5.	Series and Parallel AC Circuits.	• Impedance resistance and inductance. • Admittance, conductance and susceptance. • Series configuration • Kirchhoff's voltage law (KVL). voltage divider rule (VDR). • Parallel circuits Kirchhoff's current law (KCL). current divider rule (CDR). • Series-parallel Combination	5	2
6.	Methods of Analysis and Techniques used in AC Circuit Analysis.	• Dependent (controlled) voltage and current sources. • Current sources conversion between sources. • Mesh analysis and nodal analysis of electric circuits. • Lader networks • Bridge networks	6	2

		• Star delta transformations • Y to Δ and Δ to Y		
7.	Network Theorems Application on AC Circuits.	• Super position theorem, • Thevenin's theorem, Norton's theorem • Theorem of maximum power.	7	2
8.	Mid-Term Exam.	• Topics covered in the previous lectures.	8	2
9.	Powers of AC Circuits.	• Apparent power. • active power, reactive power • Power triangle. • Power factor improvement.	9	2
10.	Polyphase Systems.	• Unbalance three-phase system. • Balance three-phase generator. • Phase sequence. • Three-phase system configurations: • Y and Δ connected generator. • Y and Δ connected load. • Y- Y connected system. • Y- Δ connected system. • Δ- Y connected system. • Δ-Δ connected system. • Three-wattmeter method 1048. • 23.12two-wattmeter Method 1049. • Unbalanced phase systems.	10,11	4
11.	Operational Amplifiers.	• Introduction to operational amplifiers op-amp input modes and parameter. • Op-amps with negative feedback • Effects of negative feedback on op-amp. • Parameters.	12	2
12.	Passive Filters.	• Filters classification • Filter networks: low-pass, high pass, bandpass, band-reject. • Decibels. • Filter characteristic. • Bandwidth and cut-off frequency. • Bode plots of filter characteristic.	13,14	4
13.	Active Filters.	• Configurations of active Filter: low-pass, high pass, bandpass, band-reject • Filter response characteristics	15	2

		• Role off • Multi-stage active filters.		
14.	Final Exam.	All the Chapters.	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B - Tutorial Aspect:

Order	Tutorial	Learning Outcomes	Number of Weeks	Contact Hours
1.	Sinusoidal AC Voltage Characteristics and Definitions. Frequency Spectrum. General Format for the Sinusoidal Voltage or Current. The Sinusoidal Waveform Phase Relations instantaneous, amplitude, maximum, peak-to- peak, average, and effective (r. m. s.) values.	a1, b1	1	2
2.	• Response of Basic *R*, *L*, and *C* Elements to a Sinusoidal Voltage or Current. • Frequency Response of the R, X_L, X_C Elements. • Average Power and Power Factor. • Conversion between Polar and Rectangular Forms • Mathematical Operations of Complex Numbers and Phasors	a1, b1, c2	2	2
3.	• Impedance and the Phasor Diagram. • Series Configuration. • Voltage Divider Rule. • Admittance and Susceptance. • Parallel ac Networks. • Current Divider Rule. • Equivalent Circuits.	a1, b2,	3,4	4
4.	• Independent versus Dependent. • (Controlled) Sources. • Source Conversions. • Mesh Analysis. • Nodal Analysis.	a1, a2, b1, b2,,c1	5	2

	• Bridge Networks. • Y-Δ and Δ-Y Conversions.			
5.	Network Theorems (AC). • Superposition Theorem. • Thévenin's Theorem. • Norton's Theorem. • Maximum Power Transfer Theorem.	a1, a2, b1, b2	6,7	4
6.	Powers of AC Circuits. • Apparent Power. • Active Power, Reactive Power. • Power Triangle. • Power Factor Improvement.	a1,a2,b1,b2,,c1	8	2
7.	Solutions of Mid-Term Exam.	a1, a2, b1, b2, c1	9	2
8.	Operational Amplifiers. • Introduction to Operational Amplifiers Op-Amp Input Modes and Parameters • Op-Amps with Negative Feedback • Effects of Negative Feedback on Op-Amp • Parameters	a1,a2,b1,b2,,c1, c2.	10,11	4
9.	Passive Filters. • Classification of Filters. • Filter Networks: Low-Pass, High Pass, Bandpass, Band-Reject. • Decibels. • Filter Characteristics. • Bandwidth and Cut-off Frequency. • Bode Plots of Filter characteristics.	a1,a2,b1,b2,,c1., c2	12	2
10.	Active Filters: • Active Filter Configurations: Low-Pass, High Pass, Bandpass, band-Reject • Filter Response Characteristics. • Role off. • Multi-Stage Active Filters.	a1,a2,b1,b2,,c1, c2.	13	2
11.	General Review and Discussion.	a1,a2,b1,b2,,c1, c2.	14	2

Number of Weeks /and Units Per Semester	14	28

B - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	Lab 1 • Orientation • Oscilloscope and Function Generator Familirastion.	1	2	c1, c2, b2,d1,d2.
2.	Experiments No. 1 Average and RMS Values.	2	2	a2, b1, b2, c1, d1, d2.
3.	Experiments No. 2 • Frequency Response of the R, X_L, X_C Elements.	3	2	a2, b1, b2, c1, d1, d2.
4.	Experiments No. 3 Capacitive and Inductive Reactance.	4	2	a2, b1, b2, c1, d1, d2.
5.	Experiments No. 4 Series RLC Circuits. Computer Simulation.	5	2	a2, b1, b2, c1, c2, d1,d2.
6.	Experiments No. 5 Parallel RLC Circuits. Computer Simulation.	6	2	a2, b1, b2, c1, c2, d1,d2.
7.	Experiments No.6 AC Superposition. Computer Simulation.	7	2	a2, b1, b2, c1, c2, d1,d2.
8.	Experiments No. 7 AC Thevenin's Theorem. AC Maximum Power Transfer. Computer Simulation.	8	2	a2, b1, b2, c1, c2, d1,d2.
9.	Experiments No. 8 Power Relationships and Power Factor. Computer Simulation.	9	2	a2, b1, b2, c1, c2, d1,d2.
10.	Experiments No. 9. Basic OP-AmP Circuits. Computer Simulation.	10	2	a2, b1, b2, c1, c2, d1,d2.
11.	Experiments No. 10 Active Filters.	11	2	a2, b1, b2, c1, c2, d1,d2.

	Computer Simulation.			
12.	Experiment No. 11 Course Project: Preparing for the Design and Implementation of Electrical Network that can be used in the Verification of the Theoretical Aspects explained throughout the Course. A Report must be prepared Students Work in Groups.	12,13	4	a2, b1, b2, c1, c2, d1,d2.
13.	Lab.Exam.	14	2	a1,a2,b1,b2,,c1, c2, d1,d2
Number of Weeks /and Units Per Semester		**14**	**28**	

VI.Teaching strategies of the course:

- Active Lectures.
- Tutorials.
- The Use of Computer and Web-Based Learning.
- Directed Self Study.
- Group Learning and Problem Based Learning.
- Laboratory Works.
- Self and Cooperative Learning.
- Dialogue, Discussion and Class Activities.
- Analysis and Problem Solving.
- Project Work.
- Design Exercises.
- Simulation Tools.
- Brainstorming.

VII.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Problem Set No. 1 Sinusoidal AC Voltage Characteristics.	a1, b2, d1,d2	2	1.67
2.	Problem Set No. 2 • Response of Basic *R*, *L*, and *C* Elements to a Sinusoidal Voltage or Current.	a1, b1,b2, c1, d1,d2.	3	1.67

	• Frequency Response of the R, X_L, X_C Elements. • Average Power and Power Factor. • Conversion between Polar and Rectangular Forms. • Mathematical Operations of Complex Numbers and Phasors.			
3.	Problem Set No. 3 • Impedance and the Phasor Diagram. Resistance: Metric Units Temperature Effects Color Coding.	a1, b1,b2, c1, d1,d2.	4	1.67
4.	Problem Set No. 4 • Series AC Circuits. • Parallel AC Networks.	a1, b1,b2, c1, c2, d1,d2.	5	1.67
5.	Problem Set No. 5 • Independent versus Dependent (Controlled) Sources • Source Conversions • Mesh Analysis.	a1, b1,b2, c1, c2, d1,d2.	6	1.67
6.	Problem Set No. 6 • Nodal Analysis. • Bridge Networks. Y-Δ and Δ-Y Conversions.	a1, b1,b2, c1, c2, d1,d2.	7,8	1.67
7.	Problem Set No. 7 Network Theorems (AC) • Superposition Theorem. • Thévenin's Theorem. • Norton's Theorem • Maximum Power Transfer Theorem.	a1, b1,b2, c1, c2, d1,d2.	9	1.67
8.	Problem Set No. 8 Powers of AC Circuits. • Apparent Power. • Active Power, Reactive Power. • Power Triangle.	a1, b1,b2, c1, c2, d1,d2.	10,11	1.67

	• Power Factor Improvement.			
9.	Problem Set No. 9 Operational Amplifiers. Part 1 Theorem. Millman's Theorem. Substitution Theorem.	a1, b1,b2, c1, c2, d1,d2.	12	1.67
10.	Problem Set No. 10 Operational Amplifiers Part 2	a1, b1,b2, c1, c2, d1,d2.	13	1.67
11	Passive Filters.	a1, b1,b2, c1, c2, d1,d2.	14	1.67
12	Active Filters.	a1, b1,b2, c1, c2, d1,d2.	15	1.67
Total				**20**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Attendance.	Every Class	10	5%	a1, b1,b2, c1, d1,d2.
2.	Assignments.	Weekly	20	10 %	a1, b1,b2, c1, d1,d2.
3.	Lab. Reports.	Weekly	20	10 %	a1, b1,b2, c1, d1,d2.
4.	Course Project.	15	20	10%	a1, b1,b2, c1, c2, d1,d2.
5.	Mid -Term Exam.	8	20	10%	a1, b1,b2, c1, c2 .
6.	Lab. Exam.	15	10	5%	a1, b1,b2, c1, d1,d2.
7	Final Exam.	16	100	50%	a1, b1,b2, c1, c2.
	Total		**200**	**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).

3- Robert L. Boylestad, 2007, Introductory Circuit Analysis, 11 th Ed, Pearson Prentice Hall, New Jersey, USA.
1- Floyd TL, 2008, Electronic Devices, 8th Ed. Pearson/Prentice Hall.

Head of the Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
Assoc. Prof. Dr. Abdul-Malik Momin	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad	Prof. Dr. Al-Qassim Mohammed Abbas

2- Essential References.	
	Dorf, Richard C.& Svoboda, James A, 2010, Introduction to Electric Circuits, Eight Ed.
3- Electronic Materials and Web Sites *etc*.	
	All About Circuits : Free **Electric Circuits** Textbooks www.allabout**circuits**.com/ http://www.uta.edu/ee/hw/pspice/ http://www.youtube.com/watch?feature=player_detailpage&v=dZUPBLNuaHk http://denethor.wlu.ca/PSpice/pspice_tutorial.html www.seas.upenn.edu/~jan/.../**PSpice_Library**guideOrCAD.pdf

	X.Course Policies:
	Unless otherwise stated, the normal course administration policies and rules of the Faculty of Engineering apply. For the policy, see: ----------
.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.

Head of the Department Assoc. Prof. Dr. Abdul-Malik Momin	Quality Assurance Unit Assoc. Prof. Dr. Mohammad Algorafi	Dean of the Faculty Prof. Dr. Mohammed AL-Bukhaiti	Academic Development Center & Quality Assurance Assoc. Prof. Dr. Huda Al-Emad	Rector of Sana'a University Prof. Dr. Al-Qassim Mohammed Abbas