University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering

Course Specification of Electrical Circuits 2

Course Code (BE112)

I. Course Identification and General Information:						
1	**Course Title:**	Electrical Circuits 2				
2	**Course Code & Number:**	BE112				
3	**Credit hours:**	C.H				TOTAL
		Th.	Seminar	Pr	Tr.	
		2	--	2	--	3
4	**Study level/ semester at which this course is offered:**	Second Level / Second Semester				
5	**Pre –requisite (if any):**	Electrical Circuits 1 (BE111)				
6	**Co –requisite (if any):**	None				
7	**Program (s) in which the course is offered:**	Biomedical Engineering Program				
8	**Language of teaching the course:**	English				
9	**Location of Teaching the Course:**	Faculty of Engineering				
10	**Prepared by:**	Assoc. Prof. Dr. Radwan AL Bouthigy				
11	**Reviewed by:**	Assoc. Prof. Dr. Farouk Al-Fahaidy				
12	**Date of Approval:**					

II. Course Description:

This course aims to provide students with the fundamentals, calculations and analysis of single phase and three phase Alternating Current Circuits (AC), to enhance their theoretical knowledge and practical skills related to AC circuits practicing in the field of biomedical engineering. Course Topics includes: complex numbers, phasors, Sinusoidal signals measures and phasors; impedance & admittance; Power in AC circuit: apparent power, active , reactive, power triangle, and power factor; Three Phase balanced AC circuits: three phase EMF generation, phase sequence , delta and star connection. Throughout lab experiments, group-based course projects, and computer simulation, students develop their skills related to AC circuits analysis.

III. Course Intended learning outcomes (CILOs) of the course (maximum 8CILOs)		**Referenced PILOs** (Only write code number of referenced Program Intended learning outcomes)
Knowledge and Understanding: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
a1	Demonstrate an understanding of science and mathematics fundamentals, as well as, their applications in Alternating Current Circuits (AC) analysis.	A1 Describe and explain the underlying mathematical methods and theories; life scientific-principles; and engineering core concepts related to the Biomedical Engineering context.
a2	Recognize the laws, rules, theorems and techniques to be used in the design and/or analyzing of AC circuit.	A3 Recognize and explain the need for a high level of management, professional and ethical behavior, responsibility, quality assurance systems, codes of practice, standards, health and safety requirements, and environmental impacts in biomedical systems.
B. Cognitive/ Intellectual Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
b1	Analyze the performance of the	B2 Identify, formulate and solve the complex

	electric circuit elements in the frequency domain with an understanding of the limitations.	problems related to the Biomedical Engineering fields in a creative and innovative manner by using a systematic and analytical thinking methods.
b2	Explore appropriate electrical techniques to design biomedical energy-based systems within realistic constraints.	B3 Design the biomedical systems or processes within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
C. Professional and Practical Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
c1	Use the techniques, skills, and modern engineering tools such as computer aided circuit analysis, necessary for engineering practice.	C2 Use a wide range of analytical tools, techniques, IT, modern engineering tools, software packages and develop required computer programs to solve, modeling and analyzing Biomedical Engineering problems.
c2	Carry experiments of electric AC circuits to verify Ohm's law, maximum power transfer, Thevenin and Norton theorems and the response of capacitors & inductors in AC circuits	C3 Use computational facilities and techniques, measuring instruments, workshops and laboratory equipment to design and conduct experiments, collect, analyse and interpret data and present results in the biomedical systems practice.
D. Transferable Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
d1	Work coherently and successfully as a part of a team in the Lab.	D1 Lead and motivate individuals, show capability to work in stressful environments and within constraints, collaborate effectively

		within multidisciplinary team.
d2	Practice technical writing skills via: exam solution, exercises, homework, lab reports, and projects reporting.	D5 Demonstrate efficient IT capabilities and communicate effectively both orally and in writing technical reports.

(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 an understanding of science and mathematics fundamentals, as well as, their applications in Alternating Current Circuits (AC) analysis.	• Staff-led lectures, • Interactive class discussions, • Exercises and home works.	• Written tests (mid and final terms and quizzes), • Home works and assignments, • Design and problem solving exercises, • Coursework activities assessment,
a2. Recognize the laws, rules, theorems and techniques to be used in the design and/or analyzing of AC circuit.	• Staff-led lectures, • Interactive class discussions, • Problem based learning, • Exercises and home works,	• Written tests (mid and final terms and quizzes), • Home works and assignments, • Design and problem solving exercises, • Coursework activities assessment,

(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 performance of the electric circuit elements in the frequency domain with an understanding of the limitations.	• Staff-led lectures, • Interactive class discussions, • Problem based learning, • Exercises and home works, • Computer laboratory-based sessions,	• Written tests (mid and final terms and quizzes), • Home works and assignments, • Design and problem solving exercises, • Computer Lab performance assessment, • Coursework activities assessment,
b2. Explore appropriate electrical techniques to design biomedical energy-based systems within realistic constraints.	• Staff-led lectures, • Interactive class discussions, • Problem based learning, • Individual design projects, • Exercises and home works, • Computer laboratory-based sessions,	• Written tests (mid and final terms and quizzes), • Home works and assignments, • Design and problem solving exercises, • Computer Lab performance assessment, • Coursework activities assessment,

(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 the techniques, skills, and modern engineering tools such as computer aided circuit analysis, necessary for engineering practice.	• Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Team work (cooperative learning).	• Computer Lab performance assessment, • Project work assessment, • Project reports (individual and group) assessment.
c2. Carry experiments of electric AC	• Directed self- study,	• Design and problem

circuits to verify Ohm's law, maximum power transfer, Thevenin and Norton theorems and the response of capacitors & inductors in AC circuits.	• Problem based learning, • Individual design projects, • Laboratory/Practical experiments based session, • Computer laboratory-based sessions,	solving exercises, • Essay and report writing assessment, • Computer Lab performance assessment, • Project work assessment,

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Work coherently and successfully as a part of a team in the Lab.	• Laboratory/Practical experiments based session, • Computer laboratory-based sessions, • Team work (cooperative learning),	• Essay and report writing assessment, • Computer Lab performance assessment, • Coursework activities assessment, • Oral and visual presentations, • Project work assessment, • Project reports (individual and group) assessment.
d2. Practice technical writing skills via: exam solution, exercises, homework, lab reports, and projects reporting.	• Directed self- study, • Student-led seminars and presentations, • Individual design projects, • Computer laboratory-based sessions,	• Essay and report writing assessment, • Computer Lab performance assessment, • Oral and visual

	• Team work (cooperative learning)	presentations, • Project work assessment, • Project reports (individual and group) assessment.

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1	**Introduction,** **Time dependent wave forms and signals.**	a1, a2	– **Course objectives, learning outcomes, requirements and guidelines to comply with the course.** – **Introduction to time dependent wave forms.** – **Difference between DC and AC signals**	1	2
2	**Sinusoidal wave Forms of Alternating Voltage and current**	a1, a2, b2	– **Generation of sinusoidal AC voltage** – **General Format of the Sinusoidal wave in time domain and phasor forms,** – **Sinusoidal ac Voltage and Current characteristics:** – **instantaneous, peak, average, effective**	1	2

			(r.m.s.) values, form factor, peak factor, and Phase Relations.		
3	**Response of the Basic Elements (R, L, C) to AC source.**	a1, a2, b1	– **Response of Basic R, L, and C Elements to a Sinusoidal Voltage or Current,** – **Frequency Response of the resistance, inductive and capacitive reactance (R, X_L, X_C)**	1	2
4	**Mathematical aspect of AC circuit analysis**	a1, a2	– **Complex numbers: Rectangular Form , Polar Form, and Conversion Between Forms,** — **Mathematical Operations with Complex Numbers:** – **Addition, subtraction, multiplication and division of complex quantities.**	1	2
5	**AC Circuit Topology and Kirchhoff's Laws**	a1, a2, b1 b2	– **Resistance, Inductance, and Impedance.** – **Conductance, Susceptance and Admittance.** – **Series Configuration** – **Kirchhoff's voltage law (KVL). Voltage divider rule (VDR).** – **Parallel circuits**	2	4

			Kirchhoff's current law (KCL). Current divider rule (CDR). – **Series-Parallel Combination**		
6	**Methods of Analysis and Techniques used in AC Circuit analysis**	a2, b1 b2,	– **Dependent (Controlled) voltage and current sources** – **Conversion between sources,** – **Mesh and Nodal Analysis,** – **Ladder Networks,** – **Star delta transformations Y to Δ and Δ to Y,** – **bridge networks.**	1	2
7	**Mid-Term Theoretical Exam**	a1, a2, b1 b2,	– **All Topics**	1	2
8	**Techniques used in AC Circuit analysis (continue)**	a1, a2, b2	– **Ladder Networks,** – **Star delta transformations Y to Δ and Δ to Y,** – **bridge networks.**	1	2
9	**Application of Network's Theorems on AC Circuits.**	a1, a2, b1, b2	– **Super Position Theorem,** – **Thevenin's Theorem, Norton's Theorem** – **Theorem of Maximum Power** – **Transfer Theorem,** – **Reciprocity Theorem**	3	6

10	**Powers in AC circuits.**	a1, b2	– **Apparent power, active power, reactive power (S, P, Q).** – **power triangle** – **Power factor and Power factor correction.**	1	2
11	**Three Phase balanced AC circuits.**	a1, a2, b1, b2	– **Three phase EMF generation,** – **Phase sequence,** – **Delta and star connection (Δ-Y),** – **Line and Phase quantities,** – **Power in 3-phase circuits.** – **Three-Phase system configurations: Y-Y, Y-Δ, Δ-Y, Δ-Δ.**	2	4
12	**Final Theoretical Exam**	a1, a2, b1, b2	– **All Topics**	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B - Practical Aspect: (if any)

Order	Tasks/ Experiments	Number of Weeks	contact hours	Learning Outcomes
1	**Lab 1 Orientation:** • **Safety regulations,** • **Lab-Report Construction,** • **Lab Policy and Grading,** • **Student Responsibilities.**	1	2	d1, d2

2	**Experiments No. 1 Lab equipment familiarization.** • **Oscilloscope Measurement Techniques,** • **Function generators,** • **Periodic Signals.**	1	2	c1, c2, , d2
3	**Experiments No. 2 Sinusoidal wave Characteristics** • **Measurement of Sinusoidal ac Voltage and Current characteristics: instantaneous, peak, peak to beak, Phase Relations, period, and frequency.** • **Calculation of effective (r.m.s.), average values, form factor, peak factor**	1	2	c2, d1, d2
4	**Experiments No. 3 Frequency Domain Analysis** • **Capacitive and inductive reactance,** • **Frequency Response of the R, X_L, X_C Elements**	1	2	c1, c2, d1, d2,
5	**Experiments No. 4 Series RLC Circuits** • **Current and Voltage measurements** • **Impedance determination,** • **Verification of:** – **Kirchhoff's voltage law (KVL).** – **Voltage divider rule (VDR).**	1	2	c1, c2, d1, d2
6	**Experiments No. 5 Parallel RLC Circuits** • **Current and Voltage measurements**	1	2	c1, c2,d1, d2,

	• **Impedance determination,** • **Verification of:** – **Kirchhoff's current law (KCL).** – **Current divider rule (CDR).**			
7	**Experiments No. 6 mesh AC analysis** • **Verification of mesh and Nodal analysis AC circuits by:** – **hardware implementation, and** – **digital simulation.**	1	2	c1, d1, d2
8	**Experiments No. 7 nodal AC analysis** • **Verification of mesh and Nodal analysis AC circuits by:** – **hardware implementation, and** – **digital simulation.**	1	2	c1, d1, d2
9	**Mid-Term Practical Exam**	1	2	c1, c2
10	**Experiments No. 7 AC Superposition Theorem** • **Verification of Superposition theorem by:** – **hard ware implementation, and** – **digital simulation.**	1	2	c1, c2, d1, d2

11	**Experiments No. 8 AC Thevenin's Theorems** • **Verification of Thevenin's of Norton's theorems by:** – **hardware implementation , and** – **digital simulation.**	1	2	c1, c2, d1, d2,
12	**Experiments No. 9 AC Norton's Theorems** • **Verification of Thevenin's of Norton's theorems by:** – **hardware implementation , and** – **digital simulation.**	1	2	c1, c2, d1, d2,
13	**Experiments No.10 AC Maximum power Theorem** • **Verification of Maximum power theorem by:** – **hardware implementation , and** – **digital simulation.**	1	2	c1, c2, d2,
14	**Experiments No. 11 AC Bridge Networks** • **Un balance Bridge Networks** • **Verification of balance Bridge Networks theorems by:**	1	2	c1, c2, d1, d2,

	– hardware implementation , and – digital simulation.			
15	Final Practical Exam	1	2	c1, c2
Number of Weeks /and Units Per Semester			15	30

C. Tutorial Aspect:

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	None…..it's wrong			
2	It must be tutorial			
3				
Number of Weeks /and Units Per Semester		15	30	

V. Teaching Strategies of the Course:

- Staff-led lectures,
- Interactive class discussions,
- Directed self- study,
- Problem based learning,
- Individual design projects,
- Exercises and home works,
- Laboratory/Practical experiments based session,
- Computer laboratory-based sessions,

V. Teaching Strategies of the Course:

- Team work (cooperative learning).

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Home works and assignments,
- Design and problem solving exercises,
- Essay and report writing assessment,
- Computer Lab performance assessment,
- Coursework activities assessment,
- Oral and visual presentations,
- Project work assessment,
- Project reports (individual and group) assessment.

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	**Homework no 1** • **Resistance, inductance, and impedance.** • **Conductance, capacitance and admittance.** • **Series circuits** • **Kirchhoff's voltage law (KVL).** • **Voltage divider rule (VDR).** • **Parallel circuits, Kirchhoff's current law (KCL), current divider rule (CDR).** • **Series-parallel combination.**	a1, a2	4	2

2	**Homework no 2** • **Dependent (Controlled) voltage and current sources, conversion between sources,** • **Mesh and Nodal Analysis,** • **Ladder Networks,** • **Star delta transformations Y to Δ and Δ to Y,** • **Bridge networks.**	b1, b2 , c2	8	2
3	**Homework no 3** • **Superposition theorem,** • **Thevenin's and Norton's theorems,** • **Maximum power theorem,** • **Transfer theorem,** • **Reciprocity theorem.**	a1, a2, b1, b2	10	2
4	**Homework no4** • **Apparent power, active power, reactive power (S, P, Q).** • **Power triangle,** • **Power factor and Power factor correction.**	b1, b2 ,d1	12	2
5	**Homework no 5** • **Three phase EMF generation,** • **Phase sequence,** • **Delta and star (Δ-Y) connection,** • **Line and Phase quantities,** • **Power in 3-phase circuits.** • **Three-Phase system configurations: Y-Y,**	a1, b2, d2	13	2

	Y-Δ, Δ-Y, Δ-Δ			
Total				10

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	**Assignments**	4,8,10,12,13	10	6.67%	a1,a2, b1,b2,c2,d1,d2
2	**Quizzes 1 & 2**	6, 12	10	6.67%	a1, a2, b1,b2
3	**Mid-Term Theoretical Exam**	8	20	13.33%	a1, a2, b1,b2
4	**Mid-Term Practical Exam**	9	20	13.33%	c1,c2
5	**Final Practical Exam**	15	30	20%	c1,c2
6	**Final Theoretical Exam**	16	60	40%	a1, a2, b1,b2
Total			150	100%	

IX. Learning Resources:

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

Example

1- Niku, Saeed B., 2011, **Introduction to Robotics: Analysis, Control, Applications**, 2nd Edition, USA, Wiley.

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

1. Boylestad, Robert L., 2016, Introductory Circuit Analysis, 13th Edition, NJ, Pearson Prentice Hall
2. Richard C. Dorf, 2018, Introduction to Electric Circuits, 9th Ed., John Wiley and Sons,.

2- Essential References.

	1. James W. Nilsson and Susan A. Riedel, 2014, Electric Circuits, 19th edition, Prentice Hall, N.J., USA. 2. Floyd , 2007, Electric Circuits: Conventional Current Version, 8th ed, Pearson Prentice Hall.
3- Electronic Materials and Web Sites *etc*.	
	Websites: 1- All About Circuits : Free *Electric Circuits* Textbooks https//www.allaboutcircuits.com/ 2- Class Central, Circuits and Electronics: https://www.classcentral.com/course/edx-circuits-and-electronics-1-basic-circuit-analysis-444

X. Course Policies:

1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.
2	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam
4	**Assignments & Projects**:

	In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.
5	**Cheating:** For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6	**Plagiarism:** Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she 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 or according to the university roles.
7	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed; **otherwise** the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering

Template for Course Plan (Syllabus)

Electrical Circuits 2 EE357

I. Course Identification and General Information:					
1	**Course Title:**	Electrical Circuits 2			
2	**Course Code & Number:**	BE112			
3	**Credit Hours:**	**Credit Hours**	**Theory Hours**		**Lab. Hours**
			Lecture	**Exercise**	
		3	2	--	2
4	**Study Level/ Semester at which this Course is offered:**	Second Level / Second Semester			
5	**Pre –Requisite (if any):**	Electrical Circuits 1 (BE111)			
6	**Co –Requisite (if any):**	None			
7	**Program (s) in which the Course is Offered:**	Bachelor of Biomedical Engineering			
8	**Language of Teaching the Course:**	English			
9	**Location of Teaching the Course:**	Faculty of Engineering			
10	**Prepared by:**	Assoc. Prof. Dr. Radwan AL Bouthigy			
11	**Reviewed by:**	Assoc. Prof. Dr. Farouk Al-Fahaidy			
12	**Date of Approval:**				

II. Course Description:

This course aims to provide students with the fundamentals, calculations and analysis of single phase and three phase Alternating Current Circuits (AC), to enhance their theoretical knowledge and practical skills related to AC circuits practicing in the field of biomedical engineering. Course Topics includes: complex numbers, phasors, Sinusoidal signals measures and phasors; impedance &

admittance; Power in AC circuit: apparent power, active , reactive, power triangle, and power factor; Three Phase balanced AC circuits: three phase EMF generation, phase sequence , delta and star connection. Throughout lab experiments, group-based course projects, and computer simulation, students develop their skills related to AC circuits analysis.

III. Course Intended Learning Outcomes (CILOs): (مخرجات تعلم المقرر)

A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:	
a1	Demonstrate an understanding of science and mathematics fundamentals, as well as, their applications in Alternating Current Circuits (AC) analysis.
a2	Recognize the laws, rules, theorems and techniques to be used in the design and/or analyzing of AC circuit.
B. Intellectual Skills: Upon successful completion of the course, students will be able to:	
b1	Analyze the performance of the electric circuit elements in the frequency domain with an understanding of the limitations.
b2	Explore appropriate electrical techniques to design biomedical energy-based systems within realistic constraints.
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:	
c1	Use the techniques, skills, and modern engineering tools such as, computer aided circuit analysis necessary for engineering practice.
c2	Carry experiments on AC circuits to verify Ohm's law, maximum power transfer, Thevenin and Norton theorems and the response of capacitors & inductors in AC circuits
D. Transferable Skills: Upon successful completion of the course, students will be able to:	
d1	Work coherently and successfully as a part of a team in the Lab.
d2	Practice technical writing skills via: exam solution, exercises, homework, lab reports, and projects reporting.

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction, Time dependent wave forms and signals.	– Course objectives, learning outcomes, requirements and guidelines to comply with the course. – Introduction to time dependent wave forms. – Difference between DC and AC signals	1	2
2	Sinusoidal wave Forms of Alternating Voltage and current	– Generation of sinusoidal AC voltage – General Format of the Sinusoidal wave in time domain and phasor forms, – Sinusoidal ac Voltage and Current characteristics: – instantaneous, peak, average, effective (r.m.s.) values, form factor, peak factor, and Phase Relations.	1	2
3	Response of the Basic Elements (R, L, C) to AC source.	– Response of Basic R, L, and C Elements to a Sinusoidal Voltage or Current, – Frequency Response of the resistance, inductive and capacitive reactance (R, X_L, X_C)	1	2
4	Mathematical aspect of AC circuit analysis	– Complex numbers: Rectangular Form , Polar Form, and Conversion Between Forms,	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– Mathematical Operations with Complex Numbers: – Addition, subtraction, multiplication and division of complex quantities.		
5	AC Circuit Topology and Kirchhoff's Laws	– Resistance, Inductance, and Impedance. – Conductance, Susceptance and Admittance. – 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	2	4
6	Methods of Analysis and Techniques used in AC Circuit analysis	– Dependent (Controlled) voltage and current sources – Conversion between sources, – Mesh and Nodal Analysis, – Ladder Networks, – Star delta transformations Y to Δ and Δ to Y, – bridge networks.	1	2
7	Mid-Term Theoretical Exam	– All Topics	1	2
8	Techniques used in AC Circuit	– Ladder Networks,	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
	analysis (continue)	– Star delta transformations Y to Δ and Δ to Y, – bridge networks.		
9	Application of Network's Theorems on AC Circuits.	– Super Position Theorem, – Thevenin's Theorem, Norton's Theorem – Theorem of Maximum Power – Transfer Theorem, – Reciprocity Theorem	3	6
10	Powers in AC circuits.	– Apparent power, active power, reactive power (S, P, Q). – power triangle – Power factor and Power factor correction.	1	2
11	Three Phase balanced AC circuits.	– Three phase EMF generation, – Phase sequence, – Delta and star connection (Δ-Y), – Line and Phase quantities, – Power in 3-phase circuits. – Three-Phase system configurations: Y-Y, Y-Δ, Δ-Y, Δ-Δ.	2	4
12	Final Theoretical Exam	– All Topics	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
Number of Weeks /and Units Per Semester			16	32

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	**Lab 1 Orientation:** • Safety regulations, • Lab-Report Construction, • Lab Policy and Grading, • Student Responsibilities.	1	2
2	**Experiments No. 1 Lab equipment familiarization.** • Oscilloscope Measurement Techniques, • Function generators, • Periodic Signals.	1	2
3	**Experiments No. 2 Sinusoidal wave Characteristics** • Measurement of Sinusoidal ac Voltage and Current characteristics: instantaneous, peak, peak to beak, Phase Relations, period, and frequency. • Calculation of effective (r.m.s.), average values, form factor, peak factor	1	2
4	**Experiments No. 3 Frequency Domain Analysis** • Capacitive and inductive reactance, • Frequency Response of the R, X_L, X_C Elements	1	2
5	**Experiments No. 4 Series RLC Circuits** • Current and Voltage measurements • Impedance determination, • Verification of: – Kirchhoff's voltage law (KVL).	1	2

B. Case Studies and Practical Aspect:			
No.	**Tasks/ Experiments**	**Number of Weeks**	**Contact Hours**
	– Voltage divider rule (VDR).		
6	**Experiments No. 5 Parallel RLC Circuits** • Current and Voltage measurements • Impedance determination, • Verification of: – Kirchhoff's current law (KCL). – Current divider rule (CDR).	1	2
7	**Experiments No. 6 mesh AC analysis** • Verification of mesh and Nodal analysis AC circuits by: – hardware implementation, and – digital simulation.	1	2
8	**Experiments No. 7 nodal AC analysis** • Verification of mesh and Nodal analysis AC circuits by: – hardware implementation, and – digital simulation.	1	2
9	**Mid-Term Practical Exam**	1	2
10	**Experiments No. 7 AC Superposition Theorem** • Verification of Superposition theorem by: – hard ware implementation, and – digital simulation.	1	2
11	**Experiments No. 8 AC Thevenin's Theorems** • Verification of Thevenin's of Norton's theorems by: – hardware implementation , and – digital simulation.	1	2

B. Case Studies and Practical Aspect:			
No.	**Tasks/ Experiments**	**Number of Weeks**	**Contact Hours**
12	**Experiments No. 9 AC Norton's Theorems** • **Verification of Thevenin's of Norton's theorems by:** – **hardware implementation , and** – **digital simulation.**	1	2
13	**Experiments No.10 AC Maximum power Theorem** • **Verification of Maximum power theorem by:** – **hardware implementation , and** – **digital simulation.**	1	2
14	**Experiments No. 11 AC Bridge Networks** • **Un balance Bridge Networks** • **Verification of balance Bridge Networks theorems by:** – **hardware implementation , and** – **digital simulation.**	1	2
15	**Final Practical Exam**	1	2
Number of Weeks /and Units Per Semester		**15**	**30**

C. Tutorial Aspect:			
No.	**Tutorial**	**Number of Weeks**	**Contact Hours**
1	NONE		
2			
Number of Weeks /and Units Per Semester		**--**	**--**

V. Teaching Strategies of the Course:

- Staff-led lectures,
- Interactive class discussions,
- Directed self- study,
- Problem based learning,
- Individual design projects,
- Exercises and home works,
- Laboratory/Practical experiments based session,
- Computer laboratory-based sessions,
- Team work (cooperative learning).

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Home works and assignments,
- Design and problem solving exercises,
- Essay and report writing assessment,
- Computer Lab performance assessment,
- Coursework activities assessment,
- Oral and visual presentations,
- Project work assessment,
- Project reports (individual and group) assessment.

VII. Assignments:

No.	Assignments	Week Due	Mark
1	**Homework no 1** • **Resistance, inductance, and impedance.** • **Conductance, susceptance and admittance.** • **Series circuits** • **Kirchhoff's voltage law (KVL).** • **Voltage divider rule (VDR).** • **Parallel circuits, Kirchhoff's current law (KCL), current divider rule (CDR).** • **Series-parallel combination.**	4	2
2	**Homework no 2** • **Dependent (Controlled) voltage and current sources, conversion between sources,** • **Mesh and Nodal Analysis,** • **Ladder Networks,** • **Star delta transformations Y to Δ and Δ to Y,** • **Bridge networks.**	8	2
3	**Homework no 3** • **Superposition theorem,** • **Thevenin's and Norton's theorems,** • **Maximum power theorem,** • **Transfer theorem,** • **Reciprocity theorem.**	10	2

VII. Assignments:

No.	Assignments	Week Due	Mark
4	**Homework no4** • **Apparent power, active power, reactive power (S, P, Q).** • **Power triangle,** • **Power factor and Power factor correction.**	12	2
5	**Homework no 5** • **Three phase EMF generation,** • **Phase sequence,** • **Delta and star (Δ-Y) connection,** • **Line and Phase quantities,** • **Power in 3-phase circuits.** • **Three-Phase system configurations: Y-Y, Y-Δ, Δ-Y, Δ-Δ**	13	2
Total			**10**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	**Assignments**	4,8,10,12,13	10	6.67%
2	**Quizzes 1 & 2**	6, 12	10	6.67%
3	**Mid-Term Theoretical Exam**	8	20	13.33%
4	**Mid-Term Practical Exam**	9	20	13.33%
5	**Final Practical Exam**	15	30	20%

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
6	**Final Theoretical Exam**	16	60	40%
Total				

IX. Learning Resources:

- *Written in the following order:*

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

Example

1- Niku, Saeed B., 2011, **Introduction to Robotics: Analysis, Control, Applications**, 2nd Edition, USA, Wiley.

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

1- Boylestad, Robert L., 2016, Introductory Circuit Analysis, 13th Edition, NJ, Pearson Prentice Hall

2- Richard C. Dorf, 2018, Introduction to Electric Circuits, 9th Ed., John Wiley and Sons,.

2- Essential References:

1- James W. Nilsson and Susan A. Riedel, 2014, Electric Circuits, 19th edition, Prentice Hall, N.J., USA.

2- Floyd , 2007, Electric Circuits: Conventional Current Version, 8th ed, Pearson Prentice Hall.

3- Electronic Materials and Web Sites etc.:

Websites:

1- All About Circuits : Free Electric Circuits Textbooks

https//www.allaboutcircuits.com/

2- Class Central, Circuits and Electronics:

https://www.classcentral.com/course/edx-circuits-and-electronics-1-basic-circuit-analysis-444

X. Course Policies:	
1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.
2	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam
4	**Assignments & Projects**: In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.
5	**Cheating**: For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she 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 or according to the university roles.

7	**Other policies**: - Mobile phones are not allowed to use during a class lecture. It must be closed; **otherwise** the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.