Course Plan AC- Circuits

Department		Electronics and Electrical Technology			Major		Industrial Electronics		
Course Name		AC – Circuits			Course Code		YEE 104		
Prerequisites		YEE 101							
Trimester		1	2	3	4	5	6	7	8
Credit Hours						4			
Contact hours (hours per week)	*L*					2			
	W					3			
	T								
L= Lecture Hours, W=Workshop/Laboratory Hours, T=Tutorial Hours									

Course Description

This course will explain the fundamental and properties of alternating current wave forms and their characteristics. With the help of a basic single coil generator (model generator) the generation of a sinusoidal wave form of an alternating voltage (AC) will be explained.

The course will deal with the behavior of RLC connected circuits and the reactance of the most common circuit elements when connected to a steady-state condition of a sinusoidal waveform of alternating current (AC). The course investigates the behavior of R/L/C components connected in series and parallel circuits to a sinusoidal alternating current source and their behavior with change in supply voltage frequencies. Furthermore it will explain the basics of 3-Phase alternating voltage generation and investigate the electrical power flow in single- and 3- phase alternating current circuits. Therefore, this course lays the foundation for many other courses in the electrical and electronic fields, e.g. for electrical machines and power transmission.

Learning Outcomes

Knowledge

The trainee...

1. Understands the meaning of the power factor.
2. Differentiates between series and parallel connections in
3. Applies voltage and current divider rules.
4. Discriminates between resistive, capacitive, and inductive
5. Understands resonance in AC circuits.
6. Understands the difference between apparent, active, and
7. Describes three phase systems.
8. Differentiates between Star and Delta connections.
9. Recognizes the relations between line and phase quantities.

Course Plan AC- Circuits

Skills

The trainee...

1. Examines the effects on current caused by changes in impedances, and state the meaning of the term equivalent impedance
2. Analyses the sinusoidal steady-state behavior of single- and three-phase ac circuits using phasors, and study the effect of resistive, inductive, and capacitive loads in single-phase ac circuits
3. Draws the graphs in a diagram of electrical serial and parallel resonance circuits in which reactances are opposite and equal each other
4. Draws the phasor diagram of sinusoids voltage and current quantities of RLC circuits connected to sinusoidal supply voltage
5. Draws and explains the 3-Phase phasors diagram of a balanced 3-phase power supply with each individual phasor displacement
6. Explains what is meant by phase sequence.
7. Explains the definitions and values of sinusoidal waveform, like; Amplitude, Instantaneous values, peak and RMS values, phase angle and phase angle difference, periodic time and frequency
8. Explains a sinusoidal waveform generation/construction with the model of a "Basic Single Coil AC Generator"
9. Plots and interprets the graph and the characteristics of AC voltage and current waveforms
10. Explains the effect of frequency on Inductive and Capacitive Reactance

Competencies

The trainee...

1. Adds two or more vectors together to become a single vector, called the Resultant Vector
2. States and applies the equations for series and parallel AC circuits (R/L/C) that contain impedances, connected to alternating current supplies
3. Uses two watt-meters to measure three phase power.
4. Applies practically electrical circuit analysis theories in various circuits.
5. Uses measuring instruments to measure electrical quantities in desired procedures.

Safety Instructions

The trainees have to observe copyrights and keep secret information. They must observe all the security and safety procedures applied in the learning environment. The entail regulations for personal protection, fire prevention, housekeeping and Emergency / First Aid procedures.

Course Plan AC- Circuits

Recommended Didactic Units		
Hrs	Content	notes
5	**Characteristics of alternating Waveforms** - AC waveforms compared to DC waveforms - AC waveform characteristics (amplitude, period, frequency) - Types of periodic waveforms (sine, triangular, square, complex) - Relationship between Frequency and Periodic Time - Relationship between Frequency and wave length - Amplitude of an AC waveform - Non-sinusoidal Waveforms - Form Factor and Crest Factor	
5	**Characteristics of Sinusoidal Waveform** - Generation of a Sinusoidal Waveform - Basic Single Coil AC Generator (model generator) - Sinusoidal Waveform Construction - Graphs- and Phasor diagrams - Relationship between Vector Diagram and Graphs - Peak Value (û, î), Transient Value(u, i) - Degree and Radians - Relationship between Degrees and Radians - Frequency (f) and periodic time (T) - Radian frequency (ω), Angular Velocity of a Sinusoidal Waveform - Addition of sinusoidal voltages - Effective values (V,I,P), RMS (Root Mean Square) Value of an AC Waveform - Phase Difference, phase displacement - Phase Difference of a Sinusoidal Waveform - Sine wave, cosine wave	**Homwork** Calculations in a Wheatstone Bridge as preparation for the midtherm Quiz

Course Plan AC- Circuits

	- The Phasor Diagram - Phasor Diagram of a Sinusoidal Waveform - Phasor Addition	
9	**Coils connected to alternating voltages circuits** - Inductance of coil (L) - Equivalent circuit of coil (active, reactive component) - Active Resistance of coil (R) - Inductive Reactance of coil (XL) - Impedance of coil (Z) - RL-Series circuit of Resistance (R) and Inductive Reactance (XL) - Vector Diagrams of voltage triangle for VR and VL - Vector Diagram of Impedance (Z) Triangle for R and XL - RL-Parallel circuit of Resistance (R) and Inductive Reactance (XL) - Current Triangles - Admittance Triangle (Y, G, SL)	
1	**Midterm Quiz** - Calculations in a Wheatstone Bridge - V_{RMS}, V_P, V_{PP}, v - Frequency, Wavelength, Periodic Time - Calculations X_C, C, f	
10	**Capacitors connected to alternating voltages circuits** - Capacitance (C) - Capacitive Reactance XC - RC-Series circuit of Resistance (R) and Capacitive Reactance (XC) - Vector Diagram of voltage triangle for VR and VC - Vector Diagram of Impedance Triangle for R and XC - RC High pass filter - RC Low pass filter	

Course Plan AC- Circuits

	- RC-Parallel circuit of Resistance (R) and Capacitive Reactance (XC) - Current Triangle - Admittance Triangle (Y, G, SC)	
3	**Midterm practical exam** - Given are capacitors and inductors with unknown values. Task: Find the values while measuring V and I in AC circuits	
10	**RLC-Circuits consisting of Coil, Capacitor and Resistor** - RLC-Series circuit of Resistance (R), Inductive Reactance (XL) and Capacitive Reactance (XC) - RLC-Parallel circuit of Resistance (R), Inductive Reactance (XL) and Capacitive Reactance (XC) - Resonant circuits / Oscillating circuits - Oscillation (damped oscillation, transient condition) - Resonance, Resonance frequency - Series Resonant Circuit - Parallel Resonant Circuit - Quality Factor (Q)	
7	**Power in single phase AC circuits** - Active power (P) - Reactive power (QL, QC) - Apparent power (S) - Power triangle - Power factor (cos φ) - Power measurement in single phase circuits.	
10	**Three phase AC circuits** - Description of three phase systems - Generation of three phase voltages - Phase sequence - Representation of three phase quantities - Star and Delta connections	

Course Plan AC- Circuits

	- Relation between line and phase quantities in case of Star and Delta connections - Conversion from Star to Delta connections and vice versa - Power in balanced three phase circuits	
3	**Final practical exam** - Measuring in a Wheatstone Bridge - Find values of L and C in electronic AC circuits	
2	**Final written exam** - Three phase quantities - Star and Delta connections - Calculation in RL and RC circuits	

Resources

- Trade Handbook "Electrical Engineering" Tables – Standards – Formulas, ISBN 978-3-8085-3033-7
- Electric Circuits, Joseph Edminister, Mahmood Nahoi - Electrical Technology, Edward Hughas
- Introductory Circuit Analysis, Robert L. Boylestad
- Principles of Electric circuits, Thomas L. Floyd
- Fundamentals of Electric Circuits, Charles K. Alexander, O. Sadiaka
- Electric Circuits, Joseph Edminister, Mahmood Nahoi

· Required Materials

1. Calculator
2. Drawing notebook
3. Projector, Whiteboard
4. Laboratory AC Technology

Assessment Strategy

Formative Assessment:50% of final mark

- Homework – 10%
- Folder – 10%
- Quiz – 15%
- Midterm practical task – 15%

Summative Assessment: 50% of final mark

- Final written exam – 25%
- Final practical exam – 25%