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**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Course Descriptive File**

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| 1 | Course Title | Linear Circuit Analysis |
| 2 | Course Code | EE- 100 |
| 3 | Credit Hours | 4(3,1) |
| 4 | Pre-requisites | None  |
|  5 |  post-requisites | Electrical Network Analysis |
| 6 | Semester | I |
| 7 | Resource Person | Ms. Ahlam Jameel |
| 8 | Contact Hours (Theory) | 48 |
| 9 | Contact Hours (Lab) | 48 |
| 10 | Office Hours  | 8am to 3 Pm |
| 11 | Email | ahlam.khan@hotmail.com |
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| 12 | Course Outline as per Scheme of Studies ( SoS) |
| * Electric quantities, electric signals, electric circuits**.**
* Kirchhoff's laws, circuit elements. Resistance, series parallel combination, voltage and current dividers, resistive bridges.
* Nodal analysis, loop analysis, linearity and superposition, source transformation, one ports, circuit theorems, power calculations. Dependent sources, circuit analysis with dependent sources.
* The operational amplifier, basic op-amp configurations, ideal op-amp circuit analysis, summing and difference amplifiers, amplifier types**.**
* Capacitance, inductance (including mutual inductance), natural response of RC and RL circuits. Response to DC forcing function.
* AC fundamentals; RMS or effective, average and maximum values of current & voltage for sinusoidal signal wave forms.
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| 13 | Course Objectives as per SoS |
| 1. Identify linear systems and represent/model those systems in schematic form
2. Simplify electric systems using series and parallel equivalents and using Thevenin and Norton equivalents
3. Design inverting, non-inverting, summing, difference and cascaded operational amplifier circuits
4. Identify and model first order electric systems involving capacitors and inductors and predict their transient behavior.
5. Model the various types of sources and loads for three-phase electric systems
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| 14 | Books  |
| 1. S. Franco, "Electric Circuits Fundamentals", Oxford University Press, (Latest Edition).
2. R E Thomas, A J Rosa and G J Toussaint, "The Analysis and Design of Linear Circuits" John Wiley, 6th Edition, 2009
3. C Alexander and M Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, 4th Edition, 2008
4. J D Irwin and R M Nelms, "Basic Engineering Circuit Analysis", Wiley, 9th Edition, 2008
5. W Hayt, J Kemmerly and S Durbin, "Engineering Circuit Analysis", McGraw- Hill, 7th Edition, 2007.
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| 15 | Course Learning Outcomes (CLOs) |
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| Sr.  | CLO  | Domain  | Taxonomy level  | PLO  |
| 1.  | Apply circuit reduction techniques such as series, parallel and source conversions and circuit solving for linear circuits and op-amp techniques like Mesh and Node Analysis to analyze for steady state solutions for both sinusoidal AC and DC.  | Cognitive  | 2  | 1  |
| 2.  | Analyze for transients in RC and RL circuits for DC.  | Cognitive  | 4  | 1  |
| 3.  | Apply phasor techniques for the solution of steady state AC response including voltage, current, power and power factor.  | Cognitive  | 3  | 1  |
| Course Learning Outcomes- Lab(CLOs) |
| 1. | Conduct experiments in laboratory in order to interpret experimental data and observe its conformance with analyzed results of circuits.  | Psychomotor  | 2 | 4  |

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| **16** | **Marks Breakup**  |
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| Quizzes | 10 |
| Homework/assignments  | 10 |
| Midterm exam | 25 |
| Terminal exam (3 hours) | 30 |
| Total (theory) | 100% |

Theory

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| Lab Assessments | 30 |
| Lab Sessional Exams( Lab performance + Lab Assessments) | 20 |
| Lab Terminal Exam  (20%Viva +20%Project+10%Paper) | 50 |
| Total (lab) | 100% |

Lab

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| Final marks | Theory marks \* 0.75 + Lab marks \* 0.25 |

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| **17** |
| **Week** | **Topic** | **CLO** | **Taxonomy****Level** | **Specific Outcome** | **Contact Hours** | **Assessment** |
| 1 | **Basic Concepts**System of Units, Charge and Current Voltage, Power and Energy Circuit Elements | CLO1 | C2 | Identify linear systems and represent/model those systems in schematic form | 03 Hours +01 Hour Tutorial | Assignment 1Quiz 1 |
| 2 | **Basic Laws**Ohm’s Law Nodes, Resistor combinations, Braches and Loops Kirchhoff’s Laws  | CLO1 | C2 | 03 Hours +01 Hour Tutorial |
| 3 | **Methods of Analysis**Series Resistors and Voltage Division Parallel Resistors and Current Division Mesh Analysis Mesh Analysis with Current Sources  | CLO1 | C2 | Simplify electric systems using series and parallel equivalents and using Thevenin and Norton equivalents | 03 Hours +01 Hour Tutorial | Assignment 2 Quiz 2 |
| 4 | **Methods of Analysis**Nodal Analysis Nodal Analysis with Voltage Sources Nodal versus Mesh Analysis  | CLO1 | C2 | 03 Hours +01 Hour Tutorial |
| 5 | **Circuit Theorems**Linearity Property Superposition Theorem  | CLO1 | C2 | 03 Hours +01 Hour Tutorial | Assignment 3 Quiz 3 |
| 6 | **Circuit Theorems**Source Transformation Thevenin’s Theorem  | CLO1 | C2 | 03 Hours +01 Hour Tutorial |
| 7 | **Circuit Theorems**Thevenin’s Theorem Norton’s Theorem | CLO1 | C2 | 03 Hours +01 Hour Tutorial |
| 8 | **Operational Amplifiers**Operational Amplifiers Ideal Op Amp Inverting Amplifier Non-inverting Amplifier Summing Amplifier Difference Amplifier | CLO1 | C1 | Design inverting, non-inverting, summing, difference and cascaded operational amplifier circuits  | 03 Hours +01 Hour Tutorial | Assignment 4  |
| 9 | **Revision + Mid Term** |  |  |  | 03 Hours +01 Hour Tutorial |  |
| 10 | **Capacitors and Inductors** Capacitors Series and Parallel Capacitors Inductors Series and Parallel Inductors | CLO2 | C3 | Identify and model first order electric systems involving capacitors and inductors and predict their transient behavior. | 03 Hours +01 Hour Tutorial | Assignment 5 Quiz 4Quiz 5 |
| 11 | **First Order Circuits** The Source-Free RC Circuit Step Response of an RC Circuit  | CLO2 | C4 | 03 Hours +01 Hour Tutorial |
| 12 | **First Order Circuits**The Source-Free RL Circuit Step Response of an RL Circuit | CLO2 | C4 | 03 Hours +01 Hour Tutorial |
| 13 | **Sinusoids and Phasors** Sinusoids Phasors Phasor Relationships for Circuit Elements Impedance and Admittance Kirchhoff’s Laws in Frequency Domain Impedance Combinations  | CLO3 | C2 | Model the various types of sources and loads for three-phase electric systems | 03 Hours +01 Hour Tutorial | Assignment 6 Quiz 6 |
| 14 | **AC Power Analysis** Instantaneous and Average Power Effective or RMS value Apparent Power and Power Factor Complex Power Conservation of AC Power  | CLO3 | C3 | 03 Hours +01 Hour Tutorial |
| 15 | **Three-Phase Circuits** Balanced Three-Phase Voltages Balanced Wye-Wye Connection Balanced Wye-Delta Connection Balanced Delta-Delta Connection Power in a Balanced System | CLO3 | C2 | 03 Hours +01 Hour Tutorial | Toturial Sheet |
| 16 | **Revision** |  |  |  | 03 Hours +01 Hour Tutorial |  |

* Every instructor have his/her plan for course material used for assignments and quizzes, table above is just a guideline.

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| **18** | **Course Learning Outcomes (CLOs) and Assessment Plan** |
| \*Add columns according to number of course CLO’s for your respective course. Complete as per your planned quiz and assignments for this session.  |

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| **19** | **Lab Details** |
| Learn the use of basic instruments in electrical engineering such as function generators, power supplies, oscilloscopes. Design and implement circuits using R, RL and RC and verify the node voltages and loop currents using instruments. Verify Circuit-theorems using lab instruments. Verify circuit transformations using lab instruments. Complex Engineering Problem using OP-AMP as black box.Marks breakup as given in section 16. |
| **Laboratory Resources** |
| * Hardware based
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| **Computer Resources** |
| * Software based (depends on student’s interest)

Circuit Maker, Multisim |
| **20** | **Mapping of CLOs to PLOs**  |

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| PLOCLOs | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 | PLO11 | PLO12 |
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| CLO1 |  C2 |  |  |  |  |  |  |  |  |  |  |  |
| CLO2 | C4 |  |  |  |  |  |  |  |  |  |  |  |
| CLO3 | C3 |  |  |  |  |  |  |  |  |  |  |  |
| CLO4 |  |  |  | P2 |  |  |  |  |  |  |  |  |

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| **21** | **List of Experiment With Objectives as Per OBE Format**  |
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| **Lab No.** | **Related Topic** | **Objective** | **CLO Mapping** | **Bloom** |
|  | - | 1- To introduce the students to the basic electrical equipments in the lab. 2- To be able to set and deal with some of the frequently used instruments and equipment; like the digital multimeter and DC Power supply.  | CLO-4 | P2 |
|  | - | To become familiar with the protoboard/ bread board connections and measurement of equivalent resistance values using a digital multimeter (DMM).  | CLO-4 | P2 |
|  | Ohm’s Law | This exercise examines and set up lab equipment for Ohm’s law, one of the fundamental laws governing electrical circuits. It states that voltage is equal to the product of current times resistance.  | CLO-4 | P2 |
|  | Series Circuit, Kirchhoff’s Voltage Law and voltage divider rule | The focus of this exercise is an examination of basic series DC circuits with resistors. A key element is Kirchhoff’s Voltage Law which states that the sum of voltage rises around a loop must equal the sum of the voltage drops. The voltage divider rule will also be investigated.  | CLO-4 | P2 |
|  | Parallel circuits, Kirchhoff’s Current Law and current divider rule | The focus of this exercise is an examination of basic parallel DC circuits with resistors. A key element is Kirchhoff’s Current Law which states that the sum of currents entering a node must equal the sum of the currents exiting that node. The current divider rule will also be investigated.  | CLO-4 | P2 |
|  | Series parallel circuits | This exercise will involve the analysis of basic series-parallel DC circuits with resistors. The use of simple series-only and parallel-only sub-circuits is examined as one technique to solve for desired currents and voltages.  | CLO-4 | P2 |
|  | Nodal Analysis | The study of nodal analysis is the objective of this exercise, specifically its usage in multi-source DC circuits. Its application to finding circuit currents and voltages will be investigated.  | CLO-4 | P2 |
|  | Superposition theorem | The objective of this exercise is to investigate the application of the superposition theorem to multiple DC source circuits in terms of both voltage and current measurements. Power calculations will also be examined.  | CLO-4 | P2 |
|  | Thevenin’s Theorem | The objective of this exercise is to examine the use of Thevenin’s Theorem to create simpler versions of DC circuits as an aide to analysis. Multiple methods of experimentally obtaining the Thevenin resistance will be explored.  | CLO-4 | P2 |
|  | Oscilloscope and Function generator  | To become familiar with the oscilloscope and function generator, how to calibrate, set and record the readings from the analog oscilloscope screen.  | CLO-4 | P2 |
|  | Multisim circuit simulation Software | The objective of this exercise is to become familiar with some of IDEs used for circuit simulation.( Multisim) | CLO-4 | P2 |
|  | capacitors | The objective of this exercise is to become familiar with the basic behavior of capacitors. This includes determination of time constant and charging and discharging curve of the capacitor. (hardware) | CLO-4 | P2 |
|  | To observe the charging and discharging curve on Multisim software tool. Also learn to set the transient response parameters in software. | CLO-4 | P2 |
|  | Thevenin’s Theorem And Multisim | The objective of this exercise is to examine the use of Thevenin’s Theorem to create simpler versions of DC circuits as an aide to analysis. (On software) | CLO-4 | P2 |

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