|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| EE111: Linear Circuit Analysis | | | | | | | |
| Course Code: | EE-111 | | **Semester:** | | Fall 2020 | | |
| Credit Hours: | 3+1 | **Prerequisite Codes:** | | | | | FSc Algebra, Calculus and Physics |
| Instructor: | MrMansoor Shaukat (C & D)  MrMuhammad Ramzan (A & B) | | | **E-mail:** | [mansoor.shaukat@seecs.edu.pk](mailto:mansoor.shaukat@seecs.edu.pk)  [muhammad.ramzan@seecs.edu.pk](mailto:muhammad.ramzan@seecs.edu.pk) | | |
| Office: | Room 120, [C & D]  Room 217,[ A & B] | | | **Telephone:** | 90852103 [C & D]  90852113[A & B] | | |
| Students Batch: | **BEE-12** | | | **Discipline:** | Electrical Engineering | | |
| Lecture/Lab Days: | As Per Time Table | | | **Consulting Hours:** | By Appointment via Tel / Email | | |
| Department: | Electrical Engineering | | | **Updates on LMS:** | | On Required Basis | |

|  |  |
| --- | --- |
| Course Description: | |
|  | The Linear Circuit Analysis is the first course covering the Electric Circuits and Electronics stream. This course provides the undergraduate students with the foundation of basic laws and theory of basic linear electric circuits using passive elements. The course introduces concepts of charge, current and voltage to be followed with the description of current and voltage sources. An introduction to networks and circuits is accompanied by detailed discussion of Ohm’s law and the Kirchhoff’s laws. This is followed by circuit analysis techniques using Nodal and Mesh Analysis with particular reference to *super-node* and *super-mesh.* A comparison of Nodal and Mesh analysis is also made. The course also covers Circuit Analysis Techniques including linearity and superposition and source transformations; important theorems like Thevenin’s, Norton’s and Maximum Power Transfer Theorem. The circuit reduction techniques covering Delta-Wye conversion are also covered to allow the students to analyze the simplified circuits. After the resistive circuit analysis, the study of energy storage elements capacitors and inductors is made. Transient and Steady State analysis of first order RC and RL circuits with unit step forcing function followed by more complex series and parallel RLC circuits are covered. |

|  |
| --- |
| Course Learning Outcomes: |
| |  |  |  |  | | --- | --- | --- | --- | | **CLO** | **Description** | **BT** | **PLOs** | | 1. | Find a given current or voltage in a resistive circuit with control sources by applying node and mesh analysis techniques. | C3 | 1 | | 2. | Apply Thevenin and Norton Theorems to simplify resistive circuits with control sources. Use Super position, Sources Transformation and Maximum Power Transfer Theorems to solve resistive circuits. | C3 | 2 | | 3. | Understand terminal characteristics of capacitor and inductor and perform power calculations. | C2 | 1 | | 4. | Solve first order RC and RL circuits for transient and steady state response with unit step forcing function. Solve second order series and parallel RLC circuits for transient and steady state response with unit step forcing function. Understand the concept of damping. | C3 | 2 | | 5. | Usage of PSpice and Proteus software to design, analyze and simulate Electric and Electronic circuits. | C4 | 5 | |

*Key: Remembering (C1), Understanding (C2), Applying (C3), Analyzing (C4), Evaluating (C5), Creating (C6)*

|  |
| --- |
| Mapping of CLOs to Program Learning Outcomes |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **PLOs/CLOs** | **CLO1** | **CLO2** | **CLO3** | **CLO4** | **CLO5** | | PLO 1 (Engineering Knowledge) | √ | √ | √ | √ | √ | | PLO 2 (Problem Analysis) | √ | √ |  | √ | √ | | PLO 3 (Design/Development of Solutions) |  |  |  |  |  | | PLO 4 (Investigation) |  |  |  |  |  | | PLO 5 (Modern tool usage) |  |  |  |  | √ | | PLO 6 (The Engineer and Society) |  |  |  |  |  | | PLO 7 (Environment and Sustainability) |  |  |  |  |  | | PLO 8 (Ethics) |  |  |  |  |  | | PLO 9 (Individual and Team Work) |  |  |  |  |  | | PLO 10 (Communication) |  |  |  |  |  | | PLO 11 (Project Management) |  |  |  |  |  | | PLO 12 (Lifelong Learning) |  |  |  |  |  | |

|  |
| --- |
| Mapping of CLOs to Assessment Modules |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Assessments/CLOs** | **CLO1** | **CLO2** | **CLO3** | **CLO4** | **CLO5** | | Assignments: 10-20% |  |  | √ |  |  | | Mid Semester Exam: 30-40% | √ | √ |  |  |  | | Labs:25% |  |  |  |  | √ | | End Semester Exam:50-60% |  |  |  | √ |  | |

|  |  |  |
| --- | --- | --- |
| Books: | | |
| Text Book: | * Engineering Circuit Analysis (Seventh/Eighth edition) by Hayt, Kemmerly, and Durbin | |
| Reference Books: | | * Fundamentals of Electric Circuits by Charles K Alexander   Electric Circuits by Nilsson and Reidel |

|  |  |
| --- | --- |
| Main Topics to be Covered: | |
| The course spans over a number of different topics as under: | |
| * Introduction to course | * Analysis Approaches |
| * Basic definitions of: Charge, Current, Voltage and Power | * + Basic Nodal Analysis, The Supernode |
| * Voltage and Current Sources | * + Basic Mesh Analysis, The Supermesh |
| * Independent sources, Dependent sources | * Comparison of Nodal and Mesh Analysis |
| * Network and Circuits – An Introduction | * Circuit Analysis Techniques |
| * Ohm’s Law, Conductance | * Linearity and Superposition, Source transformations |
| * Power absorption | * Thevenin’s Theorem, Norton’s Theorem |
| * Definitions of Nodes, Paths, Loops and Branches | * Maximum Power Transfer Theorem |
| * Kirchhoff’s Laws:- | * Delta – Wye conversion |
| * + Kirchhoff’s Current law | * Capacitors and Inductors |
| * + Kirchhoff’s Voltage law | * Basic RL and RC Circuits |
| * Concept of nodes, loop, branches | * Source-free RL circuits |
| * + The single Loop Circuit | * Source-free RC circuits |
| * + The single Node-pair Circuit | * RL & RC Circuits with a Unit step forcing function |
| * + Series and parallel connected independent sources | * Basic RLC Circuits |
| * + Resistors in series and parallel | * Source-free RLC circuits |
| * + Voltage and current division | * Unit step function |
|  | * RLC Circuits with a Unit step forcing function |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Lecture Breakdown: | | | | | | |
|  | **Week No** | **Lecture No** | | | **Topics** | **Text Book Sections** |
|  | **1** | 1 | **Introduction to the Course:**   * Introduction to Electrical Engineering. * Course Conduct and Policies * Learning Strategies | | | **Chap 1 (HKD)**  1.3  1.6 |
|  |  | 2 | | **Basic Components & Electric Circuits:**   * Review of Units and Scales. * Charge, Current, Voltage. | | **Chap 2(HKD)**  2.1  2.2 |
|  |  | 3 | | **Basic Components & Electric Circuits:**   * Power * Problem regarding power * Circuit Elements | | 2.2  2.2  2.3 |
|  | **2** | 4 | | | **Basic Components & Electric Circuits:**   * Introduction to voltage and current sources * Independent/dependent sources | 2.3  2.3 |
|  |  | 5 | | | **Basic Components & Electric Circuit:**   * Networks and Circuits * Ohm’s Law, Conductance | 2.3  2.4 |
|  |  | | | | | |
|  | **3** | 6  7 | | | **Voltage and Current Laws**   * Defining Nodes, Paths, Loops and Branches * Examples of Nodes, Paths, Loops and Branches   Kirchhoff’s Current law | **Chap 3(HKD)**  3.1  3.1  3.2 |
|  |  | 8 | | | * **Voltage and Current Laws :** Kirchhoff’s Voltage law   + Single loop circuit | 3.3  3.4 |
|  |  | 9  10 | | | * **Voltage and Current Laws :** Single node-pair circuit | 3.5 |
|  | **4** | 11 | | | * **Voltage and Current Laws :** Voltage and current division | 3.8 |
|  |  | 12 | | | **Basic Nodal & Mesh Analysis:**   * Introduction, Basic Nodal Analysis | **Chap 4(HKD)**  4.1 |
|  | **5** | 13  14 | | | **Basic Nodal & Mesh Analysis:**   * The Super-node * Basic Mesh Analysis | 4.2  4.3 |
|  |  | 15 | | | **Basic Nodal & Mesh Analysis:**   * The Super-mesh | 4.4 |
|  |  |  | | |  |  |
|  | **6** | 16 | | | **Basic Nodal & Mesh Analysis:**   * Comparison of Nodal and Mesh Analysis * Computer Aided Circuit analysis | 4.5  4.6 |
|  |  | 17 | | | Practice Problems Nodal and Mesh analysis |  |
|  |  | 18 | | | **Useful Circuit Analysis Techniques**   * Linearity , Superposition principle | **Chap 5(HKD)**  5.1 |
|  | **7** | 19 | | | **Useful Circuit Analysis Techniques**   * Source Transformations, Practical sources | 5.2 |
|  |  | 20 | | | Practice Problems Superposition and Transformation |  |
|  |  | 21 | | | **Useful Circuit Analysis Techniques**   * Thevenin’s Theorem, Practice Problems | 5.3 |
|  | **8** | 22 | | | **Useful Circuit Analysis Techniques**   * Norton’s Theorem, Practice Problems | 5.3 |
|  |  | 23 | | | More practice problems on Thevenin and Norton | 5.3 |
|  |  | 24 | | | **Useful Circuit Analysis Techniques**   * Maximum Power Transfer Theorem, Practice Problems | 5.4 |
|  | **9** | 25 | | | **Useful Circuit Analysis Techniques**   * Delta – Wye Conversion | 5.5 |
|  | 10 |  | | | **Mid Term Exam** |  |
|  | **11** | 26 | | | **Capacitors and Inductors**   * Capacitors: Voltage Current relationship, Energy Storage | **Chap 7(HKD)**  7.1 |
|  |  | 27 | | | **Capacitors and Inductors**   * Inductors: Voltage Current relationship, Energy Storage | 7.2 |
|  | **12** | 28 | | | Practice Problems of Capacitors and Inductors |  |
|  |  | 29 | | | **Capacitors and Inductors**   * Inductance and Capacitance combinations | 7.3  7.5 |
|  |  | 30 | | | **Basic RL and RC circuits**   * Source-free RL circuits (covering exponential response) | **Chap 8(HKD)**  8.1 |
|  |  |  | | |  |  |
|  | **13** | **31** | | | **Basic RL and RC circuits**   * Source-free RC circuits | 8.3 |
|  |  | 32 | | | **Basic RL and RC circuits:**   * Unit Step function * Driven RL circuits | 8.5  8.6 |
|  |  | 33 | | | **Basic RL and RC circuits:**   * Natural and Forced Response | 8.7 |
|  | **14** | 34 | | | **Basic RL and RC circuits:**   * Driven RC Circuits | 8.8 |
|  |  | 35 | | | **The RLC Circuit**   * Parallel RLC Circuit, Differential equation * Definition of frequency terms | **Chap 9(HKD)**  9.1  9.1 |
|  |  | 36 | | | **The RLC Circuit**   * Over-damped RLC Circuit * Graphical representation | 9.2  9.2 |
|  | **15** | 37 | | | **The RLC Circuit**   * Critically damped RLC Circuit * Under damped RLC Circuit | 9.3  9.4 |
|  |  | 38 | | | Practice Problems for parallel RLC Circuits |  |
|  |  | 39 | | | **The RLC Circuit**   * Source free series RLC Circuit | 9.5 |
|  |  | 40 | | | **The RLC Circuit**   * Complete response | 9.6 |
|  | **16** |  | | | **END SEMESTER EXAM** |  |

|  |  |
| --- | --- |
| Weightages: |  |
|  |  |
| Assignments: | 10-20% |
| Mid Semester Exam: | 30-40% |
|  |  |
| Labs: | 25% |
| End Semester Exam: | 50-60% |

|  |
| --- |
| List of Lab Experiments |
| [Lab1: Introduction To Basic Laboratory Equipment](#_Toc300800673) and Identification of Resistor colour codes  Lab 2: Introduction To Multisim  Lab3: Verification of KVL,KCL, Voltage & Current Divider Rule  Lab 4: Introduction ToPSPICE  [Lab 5: Introduction To Nodal Analysis](#_Toc300800680)  [Lab 6: Introduction ToMesh Analysis](#_Toc300800680)  [Lab 7&8: Thevenin’s / Norton’s Equivalent Circuit](#_Toc300800683)  Lab 9: Verification of Maximum Power Transfer Theorem  [Lab 10: Operation Of Oscilloscope and Function Generator](#_Toc300800686) |
| Lab11 & 12: RC, RL AND RLC CIRCUITS |
| Lab13: Verification of DELTA-WYE Conversion |
| Lab14: Series and Parrallel combination of resistances |
| Lab15: Verification of Delta-Wye Conversion and series & parrallel combination of Resistors Using Multisim/Pspice |

|  |  |
| --- | --- |
| Grading Policy: | |
| Assignment Policy: | In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No ‘best-of’ policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams. |
| Lab Conduct: | The labs will be conducted for three hours every week. A lab handout will be given in advance for study and analysis The lab handouts will also be placed on LMS. The students are to submit their results by giving a lab report at the end of lab for evaluation. One lab report per group will be required. However, students will also be evaluated by oral viva during the lab. |
| Plagiarism: | SEECS maintains a zero tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people’s work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action. |

|  |  |
| --- | --- |
| Tools / Software Requirement: | |
|  | PSpice and Proteus software are used to design, analyze and simulate Electric and Electronic circuits. The students can download the student version of this software from the following site. However the software would be available on the PCs which are installed in the Labs. |

­­­