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| Electrical Network Analysis | | | | |
| Course Code: | EE-211 | | **Semester:** | Spring 2021 |
| Credit Hours: | 3+1 | | **Prerequisite Codes:** | EE-111 or Equivalent |
| Instructor: | Ahsan Azhar | | **Discipline:** | BEE |
| Office: | B-203 RIMMS First Floor | | **Telephone:** | +92-51-9085-2555 |
| Lecture Days:  Labs: | Monday, Wednesday - C  Monday, Tuesday – D  Wednesday, Thursday | | **E-mail:** | Ahsan.azhar@seecs.edu.pk |
| Class Rooms:  Lab: | CR- 13  Basic Electronics Lab SEECS | | **Consulting Hours:** | Monday 14:00 to 15:00 |
| Lab Engineer: | Engr. Kiran Liaqat | | **Lab Engineer Email:** | [kiran.Liaqat@seecs.edu.pk](mailto:kiran.Liaqat@seecs.edu.pk) |
| Knowledge Group: | | Electronics, Power and Control | **Updates on LMS:** | As required |

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| Course Description: | |
|  | This is the second course in two part sequence of Electrical Circuit Analysis stream. The course requires basic concepts and knowledge related to circuit analysis and theorems taught in the first course EE-111 titled Linear Circuit Analysis. The course introduces steady state solution of linear circuits (comprising resistors, capacitors, inductors and controlled sources) excited by sinusoidal sources using ‘Phasor Method’. AC power analysis and poly-phase circuits are introduced. Next part of the course introduces the students to magnetically coupled circuits and linear and ideal transformers. Laplace Transform techniques are introduced followed by their application to linear circuit analysis. Basic circuit synthesis is discussed. Concept of frequency response is discussed and applied to parallel and series resonant circuits. Bode plots are studied and applied to some basic filter design. The last part of the course covers two-port networks and their analysis using two-port network parameters. |

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| Course Objective: | |
|  | The course objective is that its successful completion should develop understanding of basic circuit theory and its application to electric circuits and systems. Further, it should lay down the analyzing and designing techniques for passive linear microwave devices. |

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| Course Learning Outcomes: |
| |  |  |  |  | | --- | --- | --- | --- | |  | After the completion of the course the students will be able to: | **PLO** | **BT Level\*** | | 1. | Apply phasor analysis to **solve** linear circuits with sinusoidal inputs for steady state solution. Perform AC power **analysis** of single and poly-phase circuits. | 1 | C-3 | | 2. | **Analyze** magnetically coupled circuits. **Understand** concept of two-port networks and their parameters. | 2 | C-3 | | 3. | Apply Laplace transform techniques to **solve** linear circuits. **Analyze** parallel and series resonant circuits. **Understand and use** Bode plot techniques to obtain frequency response of linear circuit. | 2 | C-4 | | 4. | **Implement & Test** different electric circuits using CAD tools and Test Equipment | 5 | P-3 | | 5. | **Analyze** and **interpret** experimental data | 4 | C-4 | | 6. | **Perform** Lab Experiment/Project as member of a group | 9 | A-3 | |  | \* BT= Bloom’s Taxonomy, C=Cognitive domain, P=Psychomotor domain, A=Affective domain |  |  | |

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| Mapping of CLOs to Program Learning Outcomes |
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| Mapping of CLOs to Assessment Modules and Weightages (In accordance with NUST statutes) |
| |  | | --- | | To be filled in at the end of the course. |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **Assessments/CLOs** | **CLO1** | **CLO2** | **CLO3** | **CLO4** | **CLO5** | **CLO6** | | Quizzes: 10% | √ | √ | √ |  |  |  | | Assignments: 10 % | √ | √ | √ |  |  |  | | OHT-1: 15% | √ |  | √ |  |  |  | | OHT-2: 15% | √ | √ | √ |  |  |  | | Labs & Project:25% |  |  |  |  | √ | √ | | End Semester Exam:50% | √ | √ | √ | √ |  |  | |

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| Books: | |
| Text Book: | Fundamentals of Electric Circuits (Fifth Edition); by Charles K Alexander and Matthew N.O. Sadiku |
| Reference Books: | Engineering Circuit Analysis (Eighth Edition); by W. H. Hayt Jr (late), Jack Kemmerly (late) and Steven Durbin |
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| Main Topics to be Covered | |
| Sinusoidal Input and Steady State Analysis |  |
| AC Circuit Power Analysis |  |
| Three-Phase Systems |  |
| Magnetically Coupled Circuits |  |
| Introduction to Laplace Transforms |  |
| Circuit Analysis in s-Domain |  |
| Frequency Response |  |
| Two Port Networks |  |

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| Lecture Breakdown: | | | | | | | | |
|  | **Week No.** | | **Topics** | **Sections** | | | |  |
|  | 1 | Lecture 1: Introduction/ Properties of Sinusoids  Lecture 2: Forced Response to Sinusoidal Function  Lecture 3: Complex Forcing Function  Lab 01 | | 9.1 – 9.7 | |  | | |
|  | 2 | Lecture 4: Nodal & Mesh Analysis  Lecture 5: Superposition, Source Transformations and Thevenin’s Theorem  Lecture 6: Phasor Diagrams  Lab 02 | | 10.1 – 10.6 | |  | | |
|  | 3 | Lecture 7: AC Circuit Power Analysis/ Instantaneous Power  Lecture 8: Average Power  Lecture 9: Effective Values of Current & Voltage  Lab 03 | | 11.1 -11.4 | |  | | |
|  | 4 | Lecture 10: Apparent Power and Power Factor/ Complex Power  Lecture 11: Polyphase Circuits/Single Phase Three-Wire Systems  Lecture 12: Three Phase Y-Y connection  Lab 04 | | 11.5-11.8  12.1- 12.3 | |  | | |
|  | 5 | **OHT-1** | |  | |  | | |
|  | 6 | Lecture 13: The delta (**Δ)** Connection  Lecture 14: Magnetically Coupled Circuits/ Mutual Inductance  Lecture 15: Energy Considerations  Lab 05 | | 12.4-12.7  13.1 – 13.3 | |  | | |
|  | 7 | Lecture 16: Linear Transformer  Lecture 17: Ideal Transformer  Lecture 18: Review  Lab 06 | | 13.4 - 13.5 | |  | | |
|  | 8 | Lecture 19: Complex Frequency & The Damped Sinusoidal Forcing Function  Lecture 20: Intro to Laplace Transform & LT of Simple Time Functions  Lecture 21: Inverse Transform Techniques  Lab 07 | | | 15.1 – 15.4 | |  | |
|  | 9 | Lecture 22: Basic Theorems for the Laplace Transform  Lecture 23: Circuit Analysis in the **s**-Domain/ **Z**(**s**) and **Y**(**s**)  Lecture 24: Nodal & Mesh Analysis in the **s**-Domain  Lab 08 | | | 16.1 – 16.4 | |  | |
|  | 10 | **OHT-2** | | |  | |  | |
|  | 11 | Lecture 25: Additional Circuit Analysis Techniques  Lecture 26: Poles, Zeros and Transfer Functions  Lecture 27: Convolution  Lab 09 | | | 16.1 – 16.4 | |  | |
|  | 12 | Lecture 28: The Complex-Frequency Plane  Lecture 29: Natural Response and the **s** Plane  Lecture 30: A Technique for Synthesizing the Voltage Ratio H(s)  Lab 10 | | | 16.1 – 16.4 | |  | |
|  | 13 | Lecture 31: Frequency Response/Parallel Resonance  Lecture 32: Bandwidth & High-**Q** Circuits  Lecture 33: Review of Chapters 14 & 15  Lab 11 | | | 14.1 – 14.6 | |  | |
|  | 14 | Lecture 34: Series Resonance/Other Resonant Forms  Lecture 35: Scaling  Lecture 36: Bode Diagrams  Lab 12 | | 14.1 – 14.6 | | | |  |
|  | 15 | Lecture 37: Bode Diagrams Contd  Lecture 38: Basic Filter Design  Lecture 39: Two Port Networks/ One Port Networks  Lab 13 | | 14.1 – 14.6 | | | |  |
|  | 16 | **ESE** | |  | | | |  |

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| Lab Experiments: | |
| Lab 01: | Function Generator and Digital Oscilloscope Operation |
| Lab 02: | Sinusoidal Response Analysis and Simulation |
| Lab 03: | Sinusoidal Response Analysis and Simulation of Phase Shifter |
| Lab 04: | Capacitive Phase Shift and Reactive Power (Part 1) |
| Lab 05: | Inductive Phase Shift and Reactive Power |
| Lab 06: | Power in AC Circuits |
| Lab 07: | Balanced Three-Phase Delta and Wye Circuits (**Part One**) |
| Lab 08: | Balanced Three-Phase Delta and Wye Circuits (**Part Two**) |
| Lab 09: | Use of Matlab for s-Domain Circuit Analysis |
| Lab 10: | Use of PSpice for Phasor Domain Circuit Analysis and Frequency Response Analysis |
| Lab 11: | Analysis of Series RLC Circuit in Terms of Amplitude and Phase Angle – Hardware |
| Lab 12: | Implementation of Tuned Circuit and Frequency Response |
| Lab 13: | Two-Port Network - Impedance, admittance and Hybrid Parameters Using PSpice |

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| Tools / Software Requirement: | |
|  | OrCAD Pspice / Matlab is required for practical work. |

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| Grading Policy: | |
| Quiz Policy: | The quizzes will be unannounced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is at the instructor’s discretion |
| 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. |

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