EE599d: Switch Mode Power Supplies

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| **Lecture Schedule** | | Tuesday, Thursday  07:30 PM to 09:00 PM | **Course Type, Semester** | | Major for Power and Control  Spring, 2019 | | | |
| **Credit Hours** | | Three | **Pre-requisite** | | Power Electronics  Analog and Digital Electronics | | | |
| **Instructor** | | Dr. Tahir Izhar | **Contact** | | [tizhar@gmail.com](mailto:zubair.khan@uet.edu.pk) | | | |
| **Offices** | | Chairman Office | **Office Hours** | | With appointment | | | |
| **Teaching Assistant** | | None | **Lab Schedule** | | N/A | | | |
| **Course Description** | | Objective of this course is to introduce the students with the concept of Switch mode power supplies. Basic switch mode topologies with quantitative analysis will be discussed. The high frequency transformers and other magnetic element designs will be discussed. Advance topics and current research in this area will also be addressed. | | | | | | |
| **Measurable Learning Outcomes** | **CLOs** | **Description** | | | | | **PLOs** | **Taxonomy**  **Level** |
| CLO1 | Apply the concepts, theory and applications of Basic topologies used in the design of switch mode power supplies. | | | | | PLO1 | C-3 |
| CLO2 | design and analyze some common types of Switch mode power supplies | | | | | PLO2 | C-4 |
| CLO3 | Investigate the recent research in the area of high frequency and high efficiency switching power supplies | | | | | PLO3 | C-5 |
| **Books** | | **REQUIRED**:  Switching Power Supply Design, 2nd ed.2009  By Abraham I. Pressman  **OPTIONAL**:  Practical Switching Power Supply Design  By Marty Brown  Switch mode Power Supply Design  By P. R. K. Chetty   1. Reading materials form Research papers | | | | | | |
| **Grading Policy vis-à-vis CLO Mapping** | | Assignment, Quizzes & Class Participation, | | 30% | | CLO1 to CLO3 | | |
| Midterm Exam | | 30% | | CLO1 to CLO3 | | |
| Final Exam | | 40% | | CLO2 to CLO3 | | |

**Lecture Plan**

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| **Week #** | Topics |  |
| **1\*** | Scope of DC/DC converters and switch mode power supplies | CLO1 |
| **2\*** | Introduction of basic switch mode DC/DC converters: Buck, Boost and Polarity Inverting. Mathematical relations for output voltage and ripple voltage. Continuous and discontinuous modes for buck converter | CLO1 |
| **3\*** | Operation of Boost converter, mathematical relations for output voltage and ripple voltage. Continuous and discontinuous modes for buck converter | CLO1 |
| **4\*** | Operation of polarity inverting converter, mathematical relations for output voltage and ripple voltage. Continuous and discontinuous modes for buck converter | CLO1 |
| **5\*** | Design of Regulated switch mode power supply using buck topology. Inductor and capacitor design. Efficiency calculations under best case and worst case Scenarios. | CLO2 |
| **6\*** | Introduction to isolated converters: switch mode power supply design using Push pull topology. Cross-regulation in multiple output designs. Flux imbalance problem. | CLO1 |
| **7\*** | SMPS design using isolated single ended forward converters: multiple outputs, effect of equal and unequal number of turns in primary and reset windings. Calculation of voltage stresses across the switching transistor. | CLO2 |
| **8\*** | **Midterm exam** |  |
| **9\*** | Interleaved single ended forward converters and double ended forward converters. | CLO1 |
| **10\*** | Half-bridge and Full bridge types of forward converters used in off-line switch mode power supplies. | CLO1 |
| **11\*** | Fly back converter topology: advantages and disadvantages, fly back magnetic design. | CLO1 |
| **12\*** | Interleave and double ended fly back converter designs. | CLO1 |
| **13\*** | Control function: closing the loop, loop stabilization, gain margin and phase margin, error amplifier compensation, output transfer function, standard control chips. | CLO1 |
| **14\*** | High frequency transformer design for Forward converters and fly-back converters. Skin effect and proximity effects. Transformer core materials and geometries. Inductor and capacitor designs in switch mode power supplies. | CLO2 |
| **15\*** | Low power low cost switch mode power supplies for mobile chargers and other housekeeping applications. High frequency ballasts and energy savers. | CLO2 |
| **16\*** | Introduction to Resonant converters: types of converters, advantages and disadvantages. | CLO3 |

**\* -** Tentative