EPE-901 – Advanced Convertor Control Techniques

Course Code EPE 901	Credit Hours (Th-Pr) 3.0-0	Advanced Converter Control Techniques	Contact Hrs/Week (Th-Pr) 3.0-0	Total Contact Hrs (Th-Pr) 45-0

Background

1. Power electronics converters are ubiquitous everywhere to process and control the power ranging from the fractions of milli-Watts to multiple of Mega-Watts. In the advent of modern power systems with smart grids and renewable energy generation integration and storage, power electronics has a cardinal role to play. Power electronics converters are the enabling technologies for smart grid and efficient power system. If the circuit topology makes the heart of the converter system, then the feedback control is certainly the brain.

Rationale

2. Rationale for offering/launching this new course is:
   a. There is a serious dearth of qualified human resource in the area of power electronics. The universities of our country usually don't offer any further than a basic level course on power electronics.
   b. Mastering the advanced concepts in control systems for power electronics, will empower us to nurture our indigenous intelligentsia for the zeitgeist of the modern power system.

Educational Objectives

3. The objectives of the course are:
   a. To analyze, model, design and simulate state-of-the-art current and voltage control for dc-dc converters, ac-dc rectifiers, and dc-ac inverters
   b. To learn the applications of the advanced control techniques in power systems and renewable energy conversion systems.

Input Obtained from Industry/Corporate Sector/Subject Specialists/ Academia

4. Relevant input will be obtained in CRC from subject/Academia specialist from Industry

International Practice

5. Similar scheme of studies is adapted in international universities, such as
   a. University of Colorado Boulder, US [Times Higher Education Ranking: 116]
   b. Royal Institute of Technology, Sweden [Times Higher Education Ranking: 159]
   c. Aalborg University, Denmark [Times Higher Education Ranking: 201]

Proposed Timeframe of Commencement

6. Fall 2018

7. **Course Contents**
   a. Course Code: EEE-901
   b. Title: Advanced Converter Control Techniques
   c. Credit Hours: 03

Objectives

8. The objectives of this course are to:
   a. To analyze, model, design and simulate state-of-the-art current and voltage control for dc-dc converters, ac-dc rectifiers, and dc-ac inverters
   b. To learn the applications of the advanced control techniques in power systems and renewable energy conversion systems.

Outcomes

9. By the end of this course students will be able to:
   a. Model and simulate power converters
   b. Design current controllers for power converters
   c. Apply advanced control techniques in power systems and renewable energy conversion systems.

10. Contents with suggested contact hours

No.	Topics	Book	Contact Hours
1.	Review of Modeling of Power Converters	R.E.	3
2.	Circuit Averaging and Averaged Switch Modeling ➢ Derivation and Spice implementation of averaged switch models ➢ Analysis based on average circuit models ➢ Design verification using average circuit simulations	R.E.	9

	➢ Simulation and design examples: PWM dc-dc converters in CCM and DCM		
3.	Current Programmed Mode (CPM) Control ➢ Peak current mode control ➢ Simple model ➢ Stabilization using artificial ramp ➢ Simulation and design examples	R.E.	9
4.	More accurate modeling of CPM controlled converters ➢ Spice model of the CPM controller ➢ Transfer functions, stability analysis and design of CPM controlled converters ➢ Simulation and design examples	R.E.	9
5.	Average Current Mode Control ➢ Transfer functions of ACM controlled converters ➢ Current and voltage control loops ➢ Simulation and design example: ACM controlled boost dc-dc converter	R.E.	9
6	Application to low-harmonic power factor correction ac-dc rectifiers Application to dc-ac inverters for photovoltaic (PV) power systems	R.E.	6
Total			**45**

11. Details of lab work, workshops practice (if applicable). Projects will complement the course work.

12. Recommended Reading (including Textbooks and Reference books).

S. No.	Title	Author(s)	Assigned Code	Remarks
1.	Fundamentals of Power Electronics	R.W. Erickson, D. Maksimovic	R.E	Text
2.	Power Electronics: Converters, Applications and Design	N. Mohan, T.M. Undeland, W.P. Robbins	N.M	Reference

13. Details of online resources: University of Colorado Boulder Course on Coursera

Recommended journals

a. IEEE Transactions on Power Electronics
b. IEEE Transactions on Industrial Electronics
c. IEEE Transactions on Energy Conversion
d. IEEE Transactions on Industry Applications