Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NEEC511	Digital Control of Power Electronics and Drives	3	1	0	4

Course Objective

- The Syllabus is aimed to achieve thorough understanding on application of digital control theory in the field of Power Electronics. The topics covered are aimed to impart necessary knowledge for design, operation, control and protection of power electronic converters.

Learning Outcomes

Upon successful completion of this course,

- The students should be capable to analyse and model a power electronic system.
- The students should be able to design a closed loop system in discrete domain and know essentials to implement different algorithm on digital controller platform.

Unit No.	Topics to be Covered	Lecture + Tutorial Hours	Learning Outcome
1	**Basic concepts and definitions:** Requirement of digital control in power electronics, Different types of power converters and available digital controllers.	3L+0T	The challenges in design of digital controller, different power converter topologies and available different digital platforms for controlling power electronic system.
2	**Review of control theory:** Representation of systems in digital domain, Laplace transform, Z transform, Digital Filter, Mapping between s-plane and z-plane, Effect of sampling, Continuous to discrete domain conversion, Control system performance requirements; ADC and DAC; ZOH and FOH.	6L+2T	The students will gain knowledge of control theory necessary for closed loop operation of power electronic converter.
3	**System Modelling Theories:** Transfer function, Differential equation linearization, State space representation, Circuit averaging and small signal modelling	9L+1T	Students will gain knowledge on system modelling theories.
4	**System Modelling Example:** Transfer function modelling of a DC motor and its control, Voltage mode control and Current mode control of a DC-DC converter.	6L+2T	Students will gain knowledge on example for system modelling and apply it for closed-loop control.
5	**Controller Design Techniques:** Controller design techniques: Bode diagram method, Root locus method, State space method.	9L+1T	Students will gain knowledge of control theory techniques for power convert control.
6	**Digital Control of Power Converter:** Open loop control and closed loop control of Power Converters using digital controller	6L+2T	Students will lean example of open and closed loop digital control of power converters.
7	**Programming with digital controller:** Numeric formats: Fixed point and floating-point systems, Programming in Digital control Platform, Implementation of PI controller with anti-windup, PWM generation etc.	3L+6T	Discussion on implementation of different mathematical operation in a digital platform like DSP and FPGA. Students will gain knowledge on different algorithms necessary to implement closed loop control of different power electronic system in a digital control platform.
	Total Contact Hours	**42L+14T**	

Text Books:

1. L Umanand, Power Electronics: Essentials & Applications, Wiley.
2. G. F. Franklin and J. D. Powell, Digital Control of Dynamic Systems, Pearson.

Reference Books:

1. J. G. Kassakian, M. F. Schlecht and G. C. Verghese, Principles of Power Electronics, Pearson.
2. Simone Buso & Paolo Mattavelli, Digital Control in Power Electronic, Morgan and Claypool.
3. R. W. Erickson & D. Maksimovic, Fundamentals of Power Electronics, Springer