NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**II**
Course Code:	**6EE165**
Course Title:	**Control of Power Electronic Converters**
Course Type:	(□ Core/ □ Value Added Course / √ **Department Elective** / □ Institute Elective/ □ University Elective/ □ Open Elective / □ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	PW	W	S	
2	0	2	-	-	-	3

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to -

1. design controllers for power electronic converters **(BL6)**
2. implement control techniques for dc-dc converters **(BL6)**
3. apply appropriate current PWM technique for inverters **(BL4)**
4. apply appropriate voltage PWM technique for inverters **(BL4)**

Syllabus: **Teaching Hours: 30**

Unit – 1: Controller design techniques: **10**

Transfer function based controller design – Bode plot, State space equation based controller design – full state feedback, full state feedback with estimator- estimator design, output feedback, optimal control – linear quadratic, optimal estimator – Kalman filter

Unit – 2: Control of dc-dc converters **07**

Introduction to voltage mode control and current mode control, Average current control mode – Introduction and transfer functions, design of average current controller, Peak current control mode – introduction, transfer function and design.

Unit – 3: Current Controlled PWM for Inverters: **06**

Advantages, different types of current controlled PWM techniques - Linear Control, Hysteresis Control, Predictive Control, and delta modulation current regulator

Unit – 4: Voltage Controlled PWM for Inverters: **07**

Advantages of voltage controlled PWM techniques, Modulating function techniques- co-sinusoidal function, harmonic modulating function, trapezoidal modulating function, Space Vector PWM – Voltage space phasor structure, analysis, overmodulation, random PWM

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Experiments:
This shall consist of at least 08 experiments / simulations based on the above syllabus.

Suggested Readings:

1. Ned Mohan, Tore M. Undeland and William P. Robbins, Power Electronics: Converters, Applications and Design, John Wiley & Sons, Inc., New York
2. L Umanand, Power Electronics, Essentials & Applications, Wiley India
3. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi
4. D. G. Holmes and T. A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, IEEE press and Wiley Interscience, USA
5. L. Corradini, D. Maksimovic, P. Mattavelli and R. Zane, Digital Control of High-frequency Switched-Mode Power Converters, IEEE press and Wiley, USA
6. Mohinder S. Grewal, Angus P. Andrews, Kalman Filtering: Theory and Practice Using MATLAB, Wiley
7. Research Papers on IEEE/IET/Science Direct etc.

Suggested List of Experiments (not restricted to the following):
(Only for Information)(04 hours each)

1. Simulation and analysis of State space based controller for dc-dc converter.
2. Simulation of Kalman filter based parameter estimation of converters for vehicular applications.
3. Modelling and simulation of average current mode control of dc-dc converter.
4. Modelling and simulation of peak current mode control of dc-dc converter.
5. Simulation of linear current control of inverter.
6. Simulation and analysis of hysteresis control of inverter.
7. Simulation and analysis of predictive control of inverter.
8. Simulation of inverter control using selective harmonic elimination technique.
9. Simulation of trapezoidal modulation technique for converter.
10. Simulation and analysis of space vector PWM control of inverter.
11. Design and implementation of IC based PWM control of converter.

L = Lecture, T = Tutorial, P = Practical, C = Credit

w.e.f. academic year 2022-23 and onwards