NPTEL Syllabus Template

Course Title	Modeling and Control of Grid Connected Power Converters
Discipline	Electrical Engineering
Duration of course 4/8/12 weeks (10/20/30 hours @2.5 hrs/week)	12 Weeks
Number of times you have taught this course totally and in the last 5 years (2-3 times is preferable, if not more)	4 Times
Is this course syllabus approved by AICTE or by Senate in your/any institute? If yes, please give the course name and institute under which this is approved.	The contents covered are a part of the course EE6230 Modeling and Control of Electric Drives offered at IIT Hyderabad
The time frame of when you would want to offer the course: (Jan 2024/July 2024)	July 2024
Will it map to any course in the AICTE model curriculum? LINK to AICTE Curriculum LINK 1 LINK 2 LINK 3 LINK 4	The contents covered in this course will be useful for the following courses in AICTE Curriculum. 1) PEC-EE01: Wind and Solar Energy Systems 2) PCC-EE11: Power Electronics
Will it map onto any of the NPTEL domain? LINK to Domain page: https://nptel.ac.in/noc/Domain/	Power Systems and Power Electronics Domain under Electrical Engineering

Name of the Instructor(s)	Dr. V. Seshadri Sravan Kumar	
Department	Electrical Engineering	
Institute	Indian Institute of Technology Hyderabad	
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Mobile Phone Number	+91-9632239688	
Website of Instructor	https://people.iith.ac.in/seshadri	

Intended audience	Final Year UG students in Electrical/Electrical and Electronics Engineering, PG and PhD Students who (wish to) specialize in Power Electronics and Power Systems
Is it a core/elective course?	Elective
Is it a UG/PG/PhD level course?	PG and PhD
Is this course relevant for GATE exam preparation?	Some part of the contents covered in the course is useful for GATE
Which degrees would it apply to? (BE/ME/MS/BSc/MSc/PhD etc)	BE, ME and PhD
What are the next set of courses that can be taken by students who complete this?	Advanced Courses related to Power Electronics and Electric Vehicles
Pre-requisites in terms of educational qualification of participants, or if any other courses should be done before this course can be taken	Anyone who has done some UG level courses related to circuit analysis, basic control systems and introductory power electronics can opt for this course.
Industry recognition of this course – List of companies/industry that will recognize/value this online course	People working in industries related to renewable energy systems, electric vehicles and power systems will find the course to be useful.
Will the final certification exam be– paper/pen type or computer based - both are proctored	Computer Based
Will the course require use of any software such as MATLAB or any programming language, etc. or any other tool? If yes, does it have a Linux based compiler available or if licensed, can we get the educational license for the same?	The course will involve a bit of programming in Python and simulation using tools such as Spice (both of which are available in Linux)
Names of 2 reviewers for the course (can be from other institutes – will be used if we need any additional inputs on the course) – Name, Dept, email id, Institute	Name : Prof. Vinod John Dept. : Electrical Engineering Institute : Indian Institute of Science, Bangalore Email : vjohn@iisc.ac.in Name : Prof. Amit Kumar Jain Dept. : Electrical Engineering Institute : Indian Institute of Technology, Delhi Email : amitjain@ee.iitd.ac.in

List of reference materials/books	1) B Wu, Y Lang, N Zargari and S Kouro, “Power Conversion and Control of Wind Energy Systems”, John Wiley & Sons 2) A Yazdani and R. Iravani, “ Voltage-Sourced Converters in Power Systems: Modeling, Control and Applications”, John Wiley & Sons 3) Robert Erickson and D Maksimovic, “Fundamentals of Power Elecronics”, Springer 4) Review Papers from Technical Literature

FOR GETTING THE INTRODUCTORY COURSE PAGE READY – TO OPEN FOR ENROLLMENTS

1. Introduce the course in about 4-5 lines

Power electronic converters are crucial in integrating Renewable Energy Systems into the Power Grid. This course focuses on modeling, analysis, and control of power electronic converters that are used for interfacing renewable energy sources to the grid. This course begins by covering aspects related to commonly used power electronic converters (for grid integration). Subsequently, aspects related to the control of grid-connected power converters are introduced. Finally, aspects related to the operation of power electronic converters in low voltages (commonly referred to as low voltage ride-through) are introduced. In addition, this course also covers digital filter design aspects, which play a crucial role in Phase Locked Loops (essential for grid integration).

2. Photograph of instructor(s)

3. About the instructor(s)

V. Seshadri Sravan Kumar received the M.Sc. (Engg.) and Ph.D. degrees in Electrical Engineering from Indian Institute of Science (IISc), Bangalore in 2011 and 2016, respectively. He is currently an associate professor in the Department of Electrical Engineering at Indian Institute of Technology (IIT), Hyderabad. Prior to joining IIT, he was a Postdoctoral Research Associate with the Department of Electrical and Computer Engineering at Texas A&M university, college station, TX, USA. His research interests include modeling and grid integration of renewable energy systems, Time and Frequency Domain modeling of Power System and Power Electronic Components and Electromagnetic Transients.

4. An introductory video about the course (2-5 minutes’ duration)

Weekly Course Plan

Weeks		Lecture Names	Assignments
Week 1	:	Overview of Grid Connected Renewable Energy Systems and Role of Power Electronic Converters	Online
Week 2	:	Grid Codes and Standards for Grid Integration – Broad classification of Grid Code Requirements, steady state requirements (voltage and frequency regulation), transient requirements and protection issues.	Online
Week 3	:	Singe Phase Converters – Introduction to Switching Pole, Switching States and Switching Sequences, Introduction to Pulse Width Modulation, Sine Triangle PWM, Unipolar and Bipolar PWM	Online
Week 4	:	Three Phase DC-AC Converters – Sine Triangle PWM, Space Vector Pulse Width Modulation, 120 Degrees Space Vector Pulse Width Modulation	Online
Week 5	:	Design of Passive Filters – Overview of Filters, Approaches for Design of LCL Filter, significance of grid parameters/specifications in the design of filters.	Online
Week 6	:	Modeling and Control of Power Electronic Converters – Reference Frame Transformation, Transfer Function modeling of Power Electronic Converters.	Online
Week 7	:	Phase Locked Loop – Overview of Phase Locked Loop, Design of Phase Locked Loop Design of Digital Filters for Phase Locked Loop Applications – Design and analysis of Low Pass, Band Pass, Delayed Signal Cancellation and Moving Average Digital Filters, transfer function modeling of phase locked loops with various digital filters.	Online
Week 8	:	Control of Power Electronic Converters and Phase Locked Loops – Introduction to Various Control Strategies of grid connected power electronic converter (PQ and PV modes), Controller Design in Time and Frequency Domains, controller design considering grid specifications, controller Design for Phase Locked Loops	Online
Week 9	:	Vector and Direct Power Control of Grid Connected Power Electronic Converter – Introduction to Vector Control and Direct Power Control, Case Studies (specific to Wind and PV based Renewable Energy Systems)	Online
Week 10	:	Steady State and Transient Modeling of Power Converters for Grid Studies – Equivalent circuit models, PQ Characteristics, Impact of PV and PQ mode controls on steady state behavior of power networks	Online
Week 11	:	Low Voltage Ride Through of Grid Connected Power Converters – Challenges in Low Voltage Ride Through, Low Voltage Ride Through Strategies	Online
Week 12	:	Fault Ride Through of Grid Connected Power Converters – Challenges in Fault Ride Through, Fault Ride Through Strategies	Online

TA Details

	:	Teaching Assistant 1	Teaching Assistant 2
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