GUJARAT TECHNOLOGICAL UNIVERSITY

SUBJECT NAME: Modeling and Analysis of Power Converters
SUBJECT CODE: 3710722
M.E. 1st SEMESTER

Type of course: Program Elective

Prerequisite: Power Electronics Converters

Rationale: The courses in power electronics at undergraduate level generally introduce the preliminary circuits, their steady state analysis, operation and applications. Hence, the course is included to provide the exposure to modeling, analysis, control and design aspects of switched mode power electronic circuits.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sl. No	Content	Total Hrs	% Weightage
1	Review of the ideal switch; basic switch cell; basic topology rules; basic converter topologies; steady-state analysis; dc transformer model, construction of equivalent circuit model, Voltage gain and Efficiency	05	12 to 15
2	AC Equivalent circuit Modeling Basic AC modeling approach; State-space Averaging; Circuit Averaging and Average Switched Model; The Canonical Circuit Model; Modeling of PWM Modulator; Some examples	09	20
3	Converter Transfer Functions Review of Bode Plots; Analysis of converter transfer functions; Graphical construction of impedances and transfer functions; Graphical construction of Converter transfer functions, Measurement of AC transfer functions and impedances	09	20
4	Controller Design Introduction; Effect of negative feedback on the network transfer functions; Closed loop transfer functions; Stability; Regulator Design	09	20

	: PI, PD and PID compensators; Measurement of loop gains			
5	Input Filter Design EMI and filter design problem; Effect of input filter on converter transfer functions; Design of Damped input filter; Examples	05	12 to 15
6	AC and DC equivalent circuit modeling of the discontinuous conduction mode Analysis for DCM for basic DC-DC converters, DCM averaged switched model; Small-signal AC modeling of the DCM switch network; High frequency dynamics of converters in DCM	05	12 to 15
	Total	**42**	**100**

Reference Books:

1. Robert Ericksson and Dragan Maksimovic, "Fundamentals of Power Electronics", Springer (India) Pvt. Ltd., 2nd ed., 2005.
2. Middlebrook, R. D. (Robert David), and Slobodan Cuk, Advances in Switched-Mode Power Conversion, Volumes I and II, 2nd ed., TESLAco, 1983.
3. Daniel M. Mitchell, "DC-DC Switching Regulator Analysis", McGraw-Hill, New York, 1988.
4. Seddik Bacha, Lulian Munteanu, Antoneta Luliana Bratcu, "Power Electronic Converters Modeling and Control", Springer, 2014.
5. V. Ramanarayanan Course Material on Switched Mode Power Conversion,Department of Electrical Engineering, Indian Institute of Science, Bangalore 560012.
6. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
7. Recent Literature

Course Outcome:

After learning the course the student should be able to:

> Analyze switched mode power electronic converters.
> Model and simulate switched mode power electronic converters
> Design the control scheme for switched mode power converters.

List of Experiments:

Lab experiments shall target the modeling of various switched mode power electronic converters and hence, simulation of these converters using these models to study their steady state and dynamic response. Experiments related to design of filters and their effect on transfer function and response shall also be included.

Major Equipment:

Simulation software like MATLAB, PSIM or Scilab and Power Electronic Converters as demanded by the course.

List of Open Source Software/learning website:

1. MIT OPEN COURSEWARE by Massachusetts Institute of Technology
   - website: ocw.mit.edu
2. Material on Fundamental of Power Electronics by Robert Erickson
   - website: ecee.colorado.edu/copec/book/slides/slidedir.html
3. Courses available through NPTEL.
   - website : nptel.ac.in