DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE OUTLINE TEMPLATE			
Course Title	**POWER CONVERTERS**		
Course Code	**EE651**	**No. of Credits**	**03**
Department	**EEE**	**Faculty**	**N. Ammasai Gounden**
Pre-requisites	**Knowledge on the power semiconductor devices, electronic circuits, circuit theory and mathematics, such as Fourier series analysis and Laplace transform and differential equations, are essential.**		
Course Coordinator(s) (if, applicable)	**---**		
Other Course Teacher(s)/Tutor(s) E-mail	**---**	**Telephone No.**	**0431-2503253**
Course Type	[√] **Core course**	[ ] **Elective course**	

COURSE OVERVIEW

Power electronics can be considered as the technology associated with the conversion, control and conditioning of electric power from its available form to the desired electrical form, by the application of power semiconductor devices. Power Electronics is one of the fastest developing technologies today, having gone through dynamic changes in the last several decades.

Application of Power Electronics ranges from power supplies to motion control, factory automation, transportation, energy storage, multi-megawatt industrial drives, power quality and electric power transmission / distribution. Further it is expected to evolve in several directions such as integrated systems for electronic power processing, intelligent control and energy management, distributed generation, automotive applications, electric traction, emerging applications in commercial / residential areas. Power Electronics will play a dominant role in the 21st century in industrial and utility applications with increased emphasis on energy saving and efficient control of industrial processes thereby helping to preserve the environment.

Aim of this course is to give the exposure to the students on the analysis, operation and control of typical power converters, namely, dc-dc, dc-ac, ac-dc and ac-ac converters. This course also aims to apply the mathematical skills to a number of practical / design problems. Practical application of typical converters will be presented to the students as case study.

COURSE OBJECTIVES

The aim of this course to present the concepts of typical power electronic circuits - topologies and control. Converter analysis, modeling, design and control of converters will be presented as relevant to different applications. This course also aims to apply the mathematical skills to a number of practical problems.

COURSE OUTCOMES (CO)	
Course Outcomes	**Aligned Programme Outcomes (PO)**
At the end of the course students will be able to 1. study and analyze transient response of basic power electronic circuits 2. understand the working of commonly used power converters 3. analyze and design various power converter systems	

COs / POs		Course outcomes(COs) 1	2	3
Programme Outcomes (POs)	1	M	H	H
	2	H	H	H
	3	H	H	H
	4	L	M	H
	5	NA	L	L
	6	NA	L	M
	7	H	H	H
	8	L	H	H
	9	L	M	M
	10	H	H	H
	11	H	H	H
	12	H	H	H
	13	L	L	L
	14	NA	NA	H

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1	1st week of August 16 (1 to 5) **(3 Contact Hours)**	Introduction to power converters & selection of switching devices: features of SCR & its requirements for firing – ZCD and pulse amplifier circuits; Features of power BJT	Lecture C&T / PPT
2	2nd week of August 16 (8 to 12) **(3 Contact Hours)**	Linear switched circuits with R, RL and RC loads for ac and dc inputs; Diode circuit with R, RL and battery loads; Tutorial problems	
3	3rd week of August 16 (16 to19) **(2 Contact Hours)**	SCR circuit (half wave) with R, RL and battery loads; Tutorial problem; SCR full converter with RL load (single – phase)	
4	4th week of August 16 (22 to 26) **(3 Contact Hours)**	Control scheme for single – phase full converter, Effect of source inductance, tutorial problem on overlap angle calculation Inverter operation of single- phase full converter	
5	5th week of August to 1st week of Sep. 16 (29.08.16 to 02.09.16) **(3 Contact Hours)**	Averaged circuit modeling Introduction to inverters Single-phase VSI	
6	2nd week of Sep. 16 (6 to 9) **(3 Contact Hours)**	Three-phase VSI Voltage control and harmonic reduction in inverters-standard PWM techniques	
7	3rd week of Sep. 16 (12 to 16) **(3 Contact Hours)**	Voltage control and harmonic reduction in inverters-standard PWM techniques – contd. and Single-phase and Three-phase CSI	

S.No.	Week	Topic	Mode of Delivery
8	4th week of Sep. 16 (19 to 23) **(2 Contact Hours + 1 hour Cycle Test)**	Analysis of single- phase semi converter; Tutorial problems **Assessment – 1**	Lecture C&T / PPT **I Cycle Test**
9	5th week of Sep.16 (26 to 30) **(3 Contact Hours)**	Three – phase full converter: analysis & design; micro controller based control scheme	Lecture C&T / PPT
10	1st week of October 16 (3 to 7) **(3 Contact Hours)**	Plotting of waveforms, tutorial problems and case study for application of three – phase full converter in renewable energy systems	
11	2nd week of October 16 (10 to 14) **(2 Contact Hours)**	Three – phase semi converter – working and waveforms; analysis and design; Case study for application of single – phase VSI in renewable energy systems	
12	3rd week of October 16 (17 to 21) **(3 Contact Hours)**	Single – phase ac voltage controller (phase angle control) with R and RL loads, PWM ac voltage controller(single – phase) with single pulse, multiple pulses; Three – phase ac voltage controller & analysis	
13	4th week of October 16 (24 to 28) **(3 Contact Hours)**	Case study for the application of three – phase ac voltage controller in SS circuit breaker. Analysis of buck, buck boost and SEPIC converters	Lecture C&T / PPT Seminars
14	1st week of Nov. 16 (31.10.16 to 4.11.2016) **(2 Contact Hours + 1 hour Cycle Test)**	Design and analysis of boost converter, Integrated cascaded boost converter **Assessment – 2**	Seminars **II Cycle Test**
15	2nd week of Nov. 16 (7 to 11) **(3 Contact Hours)**	Cuk converter Control of DC – DC converter; Case study for application of DC – DC converter in renewable energy applications. Tutorial problems	Seminar Lecture C&T / PPT
16	3rd week of Nov. 16 (14 to 18) **(2 Contact Hours)**	Doubts Clarification	-
17	4th week of Nov. 16 (21 to 25)	**Compensation Assessment (CPA)**	**Written test**
18	1st week of Dec. 16 or date decided by Class committee / Dean office **(3 Hours written test)**	**End Semester Examination**	**Written test**

C & T : Chalk and Talk and PPT : Power Point

COURSE ASSESSMENT METHODS				
S.No.	**Mode of Assessment**	**Week/Date**	**Duration**	**% Weightage**
1	I Cycle test (Written examination) (Units 1 & 4)	4th week of September 2016	1 Hour	20
2	II Cycle Test (Written examination) (Units 2 & 5)	1st week of November 2016	1 Hour	20
3	Seminar / case study / design examples	During the contact hours		10
CPA	Compensation Assessment (Written Test)	3rd week of Nov. 2016	1 Hour	Please refer course policy for more details
4	End Semester Examination (Written test)	1st week of December 2016	3 Hours	50

Note:

1. **Attending all the assessments (except CPA) are MANDATORY for every student.**
2. **If any student is not able to attend I and / or II Cycle test(s) due to genuine reasons, student is permitted to attend the compensation assessment (CPA) with 20 % weightage (20 marks).**
3. **At any case, CPA will not be considered as an improvement test.**
4. **Relative grading will be based on the clusters (range) of the total marks (cycle tests, assignment and semester examination etc. put together for each student) scored for grading by adopting Gap theory / Normalized curve. Letter grades and the corresponding grade points will be as per institute norms.**
5. **Every student is expected to score minimum 40% (i.e., 40 marks) to pass the course. Otherwise the student would be declared fail and 'F' grade will be awarded. Supplementary examination will be conducted with 100 % weightage for 'F' grade students.**
6. **Suggestion (if any) from Class Committee / Office of the Dean (Academic) on the assessment / grading will be honoured with intimation to the students.**

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc
1. Ned Mohan, Undeland and Robbin, 'Power Electronics: converters, Application and design', John Wiley and sons. Inc, 3rd Edition, 2002.
2. Rashid M.H., 'Power Electronics Circuits, Devices and Applications', Pearson, 3rd Edition, Twelth impression, 2013.
3. P.C. Sen., 'Modern Power Electronics', Wheeler publishing Company, 1st Edition, New Delhi, 2005.
4. Singh M.D., Khanchandani K. B., 'Power Electronics', Tata McGraw-Hill, 2nd Ediition, 2008.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

Feedback from the students during class committee meetings
Anonymous feedback through questionnaire

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

CORRESPONDENCE

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through their webmail.
2. Queries (if required) may be emailed to me / contact me during 4.00 pm to 5.00 pm on Wednesday and Thursday with prior intimation for any clarifications.

ATTENDANCE

1. Attendance will be taken by the faculty in all the contact hours. Every student should maintain minimum 75 % physical attendance in these contact hours to attend the end semester examination.

2. Any student, who fails to maintain 75% attendance needs to appear for the compensation assessemnt (CPA). Student who scores more than 60 % marks in the CPA will be eligible for attending the end semester examination.

3. Students not having 75% minimum attendance at the end of the semester and also fail in CPA (scoring less than 60%) will have to RE DO the course.

ACADEMIC HONESTY & PLAGIARISM

1. All the students are expected to be genuine during the course work. Taking of information by means of copying simulations, assignments, looking or attempting to look at another student's paper or bringing and using study material in any form for copying during any assessments is considered dishonest.
2. Tendering of information such as giving one's program, simulation work, assignments to another student to use or copy is also considered dishonest.
3. Preventing or hampering other students from pursuing their academic activities is also considered as academic dishonesty.
4. Any evidence of such academic dishonesty will result in the loss of marks on that assessment. Additionally, the names of those students so penalized will be reported to the class committee chairperson and HoD for necessary action.
5. Students who honestly producing ORIGINAL and OUTSTANDING WORK will be REWARDED.

FOR APPROVAL

Course Faculty _____ **CC-Chairperson** _____ **HOD** _____