DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Course Title	Power Conversion Techniques		
Course Code	EE603	No. of Credits	3
Course Code of Pre-requisite subject(s)	-		
Session	July 2022	Section (if, applicable)	M.Tech-Power Systems
Name of Faculty	Dr.C.Nagamani	Department	EEE
Email	cnmani@nitt.edu	Telephone No.	04312503254
Name of Course Coordinator(s) (if, applicable)	NA		
Course Type	√ Core course		

Syllabus (approved in BoS)

DC-DC converters - Buck converter, boost converter, buck - boost converter, averaged circuit modeling, input-output equations, ripple calculations, filter design, case studies DC-AC inverters -Single phase VSI, Three phase VSI, Single phase CSI, Three phase CSI, voltage control and harmonic reduction in inverters-standard PWM techniques, case studies AC-DC converters- Uncontrolled rectifiers, single and three phase fully controlled and semi controlled converters, continuous current conduction, discontinuous current conduction, Reactive compensation, Harmonic compensation techniques, case studies AC-AC converters-single phase and three phase circuits employing Phase angle control, on-off control. AC choppers, case studies Loss calculations and thermal management: Device models for loss calculations, ratings, safe operating areas, data sheets, forward conduction loss, switching losses, heat sink design, snubber design drive and protection circuits, commutation circuits, Soft switching

COURSE OBJECTIVES

To present the concepts of typical power converter circuit topologies, operation and control. Anaysis, mathematical modeling, design and control aspects will be discussed. Applications of power converters will be introduced. Strong mathematics background and circuit analysis techniques are essential.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
1. To be able to explain the working of various power converters	
2. To analyze and derive the mathematical relations for typical power converters	
3. To be able to design basic power converter circuits as per specifications	

COs/ POS	CO1	CO2	CO3	CO4
1	H	M	H	M
2	M	H	M	H
3	L	L	L	L
4	L	L	L	L
5	M	M	M	M
6	M	M	M	M
7	L	L	L	L

4. to be able to select suitable control and other associated circuits for the operation of power converters	8	M	M	M	M
	9	L	L	L	L
	10	M	M	M	M
	11	M	M	M	M
	12	H	M	H	M
	13	H	H	H	H
	14	M	H	M	H

COURSE PLAN – PART II

COURSE OVERVIEW

The aim of this course is 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. Knowledge on the power semiconductor devices, electronic circuits, circuit theory and mathematics, such as Fourier series analysis and differential equations is essential.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1.	Week 1 (2 contact hours)	Course plan-discussion Introduction to power electronics, power devices, and converter topologies. Review of terminologies used power conversion techniques	Lecture/Discussions/ PPT
2.	Week 2,3 & 4 (7 contact hours)	DC-DC converters; Buck converter, boost converter ; buck - boost converter analysis; ripple calculations, filter design	Lecture/Discussions/ PPT
3.	Weeks 4, 5 and 6 (8 contact hours)	Review of power factor, harmonic distortion with non-sinusoidal waveforms DC-AC inverters - Single phase and three phase VSI, single phase and three phase CSI, voltage control and harmonic reduction in inverters- standard PWM techniques, numerical problems	Lecture/Discussions/ PPT
		Assessment -1	Written test
4.	Week 7, 8 and 9 (8 contact hours)	AC-DC converters- Uncontrolled rectifiers, single and three phase fully controlled and semi controlled converters, continuous current conduction, discontinuous current conduction, Reactive compensation, Harmonic compensation techniques, case studies	Lecture/Discussions/ PPT
5.	Weeks 10 - 12 (8 contact hours)	AC-AC converters-single phase and three phase circuits employing Phase angle control, on-off control. AC choppers, case studies	Lecture/Discussions/ PPT
		Assessment -2	Written test
6.	Weeks 13 - 15	Loss calculations and thermal management:	Lecture/Discussions/

	(7 contact hours)	Device models for loss calculations, ratings, safe operating areas, data sheets, forward conduction loss, switching losses, heat sink design, snubber design drive and protection circuits, commutation circuits, Soft switching	PPT
7.	Week 16	**Assessment - 4 (Final assessment)**	Written test

- **Assessment 3** (assignment and seminar/term paper/miniproject) will be carried out during the semester (in parallel with class work)

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	**Assessment – 1** *(written examination covering units-1&2)*	7th week	90 minutes	20
2	**Assessment – 2** *(written examination covering units-3&4)*	12th week	90 minutes	20
3	**Assessment - 3** *(Assignment and Seminar/ term paper/miniproject)*	Work carried out along the course		20 (Assignment - 10% Seminar/term paper/ miniproject – 10%)
CPA*	**Compensation Assessment** *(written examination covering units-1 to 4)*	15th week	90 minutes	20
4	**Assessment - 4 Final Assessment** *(written examination covering entire syllabus)*	16th week	180 minutes	40

*mandatory; refer to guidelines on page 4

ESSENTIAL READINGS

Reference Books:

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', Prentice Hall India, 3rd Edition 2004.
3. Singh M.D., Khanchandani K. B., 'Power Electronics', Tata McGraw-Hill, 2nd Edition, 2008.
4. Issa Batarseh, "Power Electronic circuits", Wiley India Pvt Ltd, 2014

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed) – Apart from the formal feedback (arranged by academic office) at the end of the course, informal and objective feedback is encouraged along the course work for improving the teaching – learning process.

COURSE POLICY

MODE OF CORRESPONDENCE (email/ phone)

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 through webmail or teephone.

ATTENDANCE

As per the uniform policy specified by the Academic office, NIT, Tiruchirappalli

COMPENSATION ASSESSMENT

1. Attending all the assessments (Assessment 1, 2, 3 and 4) is MANDATORY for every student.
2. If any student is not able to attend Assessment-1 or Assessment-2 due to genuine reasons, he/ she can seek permission to write the Compensation Assessment (CPA) with 20% weightage (20 marks).
3. In any case, Compensation Assessment will not be offered as an improvement test.

ACADEMIC HONESTY & PLAGIARISM

. As per the policy specified by the Academic office, NIT, Tiruchirappalli

ADDITIONAL INFORMATION

FOR APPROVAL

C Nagamani

Course Faculty _____ CC-Chairperson _____ HOD _____

(Dr C. NAGAMANI)

Date: 9/9/2022