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 2023	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. **be able to explain the working of various power electronic converters**	
2. **analyze and derive the mathematical relations for typical power converters**	
3. **have ability to design power converters with given specifications**	
4. able to use data sheet and suggest suitable control and other associated circuits for the operation of power converters	

POs/ COS	PO_1	PO_2	PO_3
CO_1	L	M	M
CO_2	M	M	H
CO_3	H	M	H
CO_4	L	M	H

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report /document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program.

The mastery should be at a level higher than the requirements in the appropriate bachelor program.

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 (6 contact hours)	DC-DC converters; Buck converter, boost converter ; buck - boost converter analysis; ripple calculations, filter design, non-idealities	Lecture/Discussions/PPT
3.	Week 4 & 5 (6 contact hours)	Modeling converters Unit II; Review of power factor, harmonic distortion with non-sinusoidal waveforms;	

		DC-AC inverters - Single phase VSI inverters – analysis, voltage control and harmonic reduction in inverters-	
4.	Weeks 6 & 7 (3 contact hours)	3-phase VSI, single phase and three phase CSI, numerical problems	Lecture/Discussions/PPT
	Week 7 (1 contact hour)	**Assessment -1**	Written test
5.	Weeks 8 & 9 (6 contact hours)	AC-DC converters- Uncontrolled rectifiers, single and three phase fully controlled and semi controlled converters, continuous current conduction, discontinuous current conduction,	Lecture/Discussions/PPT
6.	Week 10 (1 contact hour)	Reactive compensation, Harmonic compensation techniques, case studies	
7.	Week 10, 11 & 12 (6 contact hours)	Unit 4: AC to AC conversion; ON-OFF (integral cycle) control, Phase angle control; 1-phase controller with R and RL loads, 3-phase 3-wire star connected load,	Lecture/Discussions/PPT
8.	Week 12 (1 contact hour)	**Assessment -2**	Written test
9.	Weeks 13, 14 and 15 (8 contact hours	Unit 5; Losses and Thermal management; losses in switching device; without snubber ; inductive load, Data sheets, turn on snubber, turn off snubber,	Lecture/Discussions/ PPT
10.	Week 16 (3 contact hours)	Thermal aspects in switching devices, electrical analogy; pulsed power source, static and dynamic model	Lecture/Discussions/ PPT
11.	Week 17 (3 contact hours)	Seminars Compensation assessment	Lecture/Discussions/ PPT
12.	Week 18 (3 contact hours)	**Final assessment**	Written test

- **Assessment 3** (assignment and seminar/term paper/mini project) 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)*	17th week	90 minutes	20
4	**Assessment - 4 Final Assessment** *(written examination covering entire syllabus)*	18th 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.

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 telephone.

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 or both 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

FOR APPROVAL

C.Nagamani

Course Faculty (C.NAGAMANI) 30/8/23 **CC-Chairperson** 1/9/23 **HOD** 01/09/23

Date: