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-2021**	**Section (if, applicable)**	**M.Tech-Power Systems**
Name of Faculty	**Dr.C.Nagamani**	**Department**	**EEE**
Email	**cnmani@nitt.edu**	**Telephone No.**	**04312503254/ 04312504555**
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 understand and explain the operation of power converter circuits**	
2. **be able to derive the mathematical relations for typical power converter circuits**	
3. **identify the devices, their arrangements, and switching patterns, required in a given input-output scenario**	

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. be able to analyse/ compare suitable control methods for a given the power electronic circuit	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
5. be able to use modern computer simulation tools for power converter circuits	

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)	Introduction to power electronics, power devices, and converter topologies. Review of terminologies used power conversion techniques	On line mode
2.	Week 1, 2 & 3 & 4 (8 contact hours)	DC-DC converters; Buck converter, boost converter; buck - boost converter analysis; ripple calculations, filter design	On line mode
3.	Weeks 4, 5 and 6 (8 contact hours)	DC-AC inverters - Review of power factor, harmonic distortion with non-sinusoidal waveforms; Single phase and three phase VSI, single phase and three phase CSI, voltage control and harmonic reduction in inverters-standard PWM techniques, numerical problems	On line mode
		Assessment -1 (week 7)	Written test (on line)
4.	Week 7, 8, 9 and 10 (9 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	On line mode
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	On line mode
		Assessment -2	Written test (on line)
6.	Weeks 13 - 15 (8 contact	Loss calculations and thermal management: Device models for loss calculations, ratings,	On line

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

- **Assessment 3** (assignments and seminars/ term paper) 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	60 minutes	25
2	**Assessment – 2** *(written examination covering units-3&4)*	12th week	60 minutes	25
3	**Assessment - 3** *(Assignment/Seminar/term paper)*	Work will be carried out along with the course		20
CPA*	**Compensation Assessment** (*written examination covering units-1 to 4)*	15th week	60 minutes	25
4	**Assessment - 4 Final Assessment** *(written examination covering entire syllabus)*	16th week	120 minutes	30

***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. Umanand L., 'Power Electronics: Essentials & Applications', Wiley India Pvt. Ltd., 2009.
5. 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 (preferred mode of correspondence with students, policy on a attendance, compensation assessment, academic honesty and plagiarism etc.)

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.

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 25% weightage (25 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 S. Kayalvizhi

Course Faculty _____ **CC-Chairperson** Dr. S. Kayalvizhi **HOD** Approved by HoD

Date: 23.9.2021