

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-2019 | 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 | <input checked="" type="checkbox"/> Core course | | | | |
| Syllabus (approved in BoS) | | | | | |
| <p>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</p> | | | | | |
| COURSE OBJECTIVES | | | | | |
| <p>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.</p> | | | | | |
| COURSE OUTCOMES (CO) | | | | | |
| Course Outcomes | Aligned Programme Outcomes (PO) | | | | |
| 1. To be able to explain the working of various power converters | COs/ POS | CO1 | CO2 | CO3 | CO4 |
| 2. To analyze and derive the mathematical relations for typical power converters | 1 | H | M | H | M |
| | 2 | M | H | M | H |
| | 3 | L | L | L | L |
| | 4 | L | L | L | L |
| 3. To be able to design basic power converter circuits as per specifications | 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 | | | |
| <p>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.</p> | | | |
| 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 Review of power factor, harmonic distortion with non-sinusoidal waveforms | Lecture/Discussions/ C&T/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/ C&T/PPT |
| 3. | Weeks 4, 5 and 6 (8 contact hours) | 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/ C&T/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/ C&T/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/ C&T/PPT |
| | | Assessment -2 | Written test |
| 6. | Weeks 13 - 15 (7 contact hours) | Loss calculations and thermal management: Device models for loss calculations, ratings, | Lecture/Discussions/ C&T/PPT |

| | 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 | |
| <ul style="list-style-type: none"> • Assessment 3 (assignments and seminar/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) | 7 th week | 60 minutes | 20 |
| 2 | Assessment – 2 (written examination covering units-3&4) | 12 th week | 60 minutes | 20 |
| 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) | 15 th week | 60 minutes | 20 |
| 4 | Assessment - 4 Final Assessment (written examination covering entire syllabus) | 16 th week | 120 minutes | 40 |
| *mandatory; refer to guidelines on page 4 | | | | |
| ESSENTIAL READINGS | | | | |
| Reference Books: | | | | |
| <ol style="list-style-type: none"> 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 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

Nepawan
Course/Faculty 20/8/19 CC-Chairperson 20/08/19 HOD S. Sndly

Date: