



**NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**  
**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

<b>COURSE PLAN – PART I</b>			
<b>Name of the programme and specialization</b>	M.Tech. Power Systems		
<b>Course Title</b>	Power Quality		
<b>Course Code</b>	EE 676	<b>No. of Credits</b>	3
<b>Course Code of Pre-requisite subject(s)</b>	Power Systems, Signals and Systems		
<b>Session</b>	January 2022	<b>Section</b>	NA
<b>Name of Faculty</b>	Dr. Karthik Thirumala	<b>Department</b>	Electrical and Electronics Engineering
<b>Official Email</b>	<a href="mailto:thirumala@nitt.edu">thirumala@nitt.edu</a>	<b>Telephone No.</b>	+91 9848626021
<b>Name of Course Coordinator (if applicable)</b>	--		
<b>Course Type</b>	<input type="checkbox"/> Core course	<input checked="" type="checkbox"/> Elective course	<input type="checkbox"/> Laboratory course
<b>SYLLABUS (approved in BoS)</b>			
<p>Electric Power Quality phenomenon – IEC and IEEE definitions – power quality disturbances – voltage fluctuations – transients – unbalance – waveform distortion – power frequency variations.</p> <p>Voltage variations – Voltage sags and short interruptions – flicker – longer duration variations – sources – range and impact on sensitive circuits – standards – solutions and mitigations – equipment and techniques.</p> <p>Transients – origin and classification – capacitor switching transient – lightning – load switching – impact on users – protection – mitigation.</p> <p>Harmonics – Sources – definitions &amp; standards – impacts – calculation and simulation – harmonic power flow – mitigation and control techniques – filtering – passive and active</p> <p>Power Quality conditioners – shunt and series compensators – Dstatcom – Dynamic Voltage Restorer – Unified Power Quality Conditioners – Case studies</p> <p><i>Essential Readings / Reference:</i></p> <ol style="list-style-type: none"> <li>Heydt, G.T., ‘Electric Power Quality’, Stars in a Circle Publications, Indiana, 2nd edition 1996.</li> <li>Bollen, M. H. J., ‘Understanding Power Quality Problems; Voltage sags and interruptions’, IEEE Press, New York, 2000.</li> <li>Arrillaga, J., Watson, N. R., Chen, S., ‘Power System Quality Assessment’, Wiley, New York, 2000.</li> <li>R. C. Dugan, M. F. McGranaghan and et al, ‘Electrical Power Systems Quality’, New York, USA: McGraw-Hill Education, 2012.</li> </ol>			

<b>COURSE OBJECTIVES</b>	
Understand the various power quality phenomenon, their origin and monitoring and mitigation methods, understand the effects of various power quality phenomenon in various equipment.	
<b>COURSE OUTCOMES (CO)</b>	
<b>Course Outcomes</b> Upon completion of the course, the students will be able to:	<b>Aligned Programme Outcomes (PO)</b>
1. Understand different types of power quality problems with their source of generation.	1, 2, 5, 6, 8, 11, 12, 14
2. Design different methodologies for detection, classification and mitigation of power quality problems.	2, 5, 6, 8, 10,11, 13, 14
3. Expected to practically design active & passive filters for harmonic elimination.	1, 2, 5, 6, 7, 8, 10, 11, 12, 13, 14

## Course Plan – Part II

### COURSE OVERVIEW

The aims of the electric power system can be summarized as "to transport electrical energy from the generator units to the terminals of electrical equipment" and "to maintain the voltage at the equipment terminals within certain limits." For decades, research and education have been concentrated on the first aim. The term power quality has become one of the most prolific buzzwords in the power industry since the late 1980s. Both electric utilities and end users of electric power are becoming increasingly concerned about the quality of electric power. Much of the equipment in use today is susceptible to damage or service interruption during poor power-quality events. Also, poor power quality also affects the efficiency and operation of electric devices and other equipment in factories and offices. Manufacturers want faster, more productive, more efficient machinery. Utilities encourage this effort because it helps their customers become more profitable and can use more efficient load equipment.

This course concentrates on the power quality phenomena and standards. Covers Origin, effect on equipment, monitoring, prediction and mitigation of various power quality problems such as harmonics, interruptions, voltage sags, transients and so on. Lastly, it introduces few important power quality conditioners for mitigation and control of disturbances.

### COURSE TEACHING AND LEARNING ACTIVITIES

S. No.	Week/ Contact Hour	Topic	Mode of Delivery
1.	17 – 21 January 2022 (2 hours)	Introduction to Power Quality and its importance Electric Power Quality phenomenon – IEC and IEEE definitions	Online lecture mode

2.	24 – 28 January 2022 (3 hours)	Power Quality disturbances: voltage fluctuations, transients, waveform distortion, power frequency variations and unbalance		
3.	1 – 4 February 2022 (3 hours)	Voltage sags and swell – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.	Online lecture mode	
4.	7 – 11 February 2022 (3 hours)	Short interruptions and flicker – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques. Longer duration variations – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.		
5.	14 - 18 February 2022 (3 hours)	Flicker – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.		
<b>ASSESSMENT – I</b>				
6.	21 - 25 February 2022 (3 hours)	Introduction to transients, their origin and classification	Online lecture mode	
7.	28 Feb, 1 – 4 March 2022 (3 hours)	Capacitor switching transient, lighting – impact on users, protection		
8.	7 – 11 March 2022 (3 hours)	Load switching – impact on users – protection – mitigation		
<b>ASSESSMENT – II</b>				
9.	14 – 18 March 2022 (2 hours)	Harmonics – Sources, definitions & standards	Online lecture mode	
10.	21 March 2022 (1 hour)	Impacts on equipments, calculation and simulation, harmonic power flow		
11.	28 March – 1 April 2022 (3 hours)	Harmonic Mitigation and control techniques, passive and active filters		
<b>ASSESSMENT – III</b>				
12.	4 - 8 April 2022 (3 hours)	Introductory to Power Quality conditioners, shunt and series compensators	Online lecture mode	
13.	11 – 15 April 2022 (1 hour)	Dstatcom, Dynamic Voltage Restorer and Unified Power Quality Conditioners		
14.	18 – 22 April 2022 (3 hours)	Case studies of the conditioners		
15.	25 – 27 April 2022 (3 hours)	<b>ASSESSMENT – IV &amp; Compensation Assessment</b>		
16.	5 – 18 May 2022 (2 hours)	<b>ASSESSMENT V - End Semester Examination</b>		
<b><u>COURSE ASSESSMENT METHODS (Shall Range from 4 to 6)</u></b>				
S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Assessment I (1 <sup>st</sup> & 2 <sup>nd</sup> unit)	14 - 18 February 2022	1 hour	20%

2.	Assessment II Quiz/viva - 3 <sup>rd</sup> unit	14 – 18 March 2022	20 minutes	10%
3.	Assessment III Quiz/viva - 4 <sup>th</sup> unit	4 - 8 April 2022	20 minutes	10%
4.	Miniproject/Seminar	18 – 26 April 2022	-	30%
CPA	Compensation test (entire syllabus)	3 – 7 May 2022	1 hour	80% of the weightage of the A1 or A2 or A3
5.	End Semester Exam (entire syllabus)	5 – 18 May 2022	2 hours	30%

### **COURSE EXIT SURVEY**

1. Students' feedback through class committee meetings
2. Feedback questionnaire from students – twice during the semester
3. Feedback from students on course outcomes shall be collected at the end of the semester

### **COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, academic honesty and plagiarism etc.)**

#### **Mode of Correspondence**

1. The faculty is available for consultation during the time intimated to the students then and there.
2. All correspondence will be sent to the NITT webmail of the students or MS Teams, if required.
3. The students can contact me in my office or through the email *thirumala@nitt.edu* for any academic related issues with respect to this course.

#### **Compensation Assessment Policy**

1. Flexibility is given to the students to fix the date for each assessment convenient to majority of the students.
2. Only one instance of absence in internal assessment is permitted. Only one compensation assessment for absentees in internal assessments will be conducted.
3. The compensation assessment (CPA) is for entire syllabus and the weightage is 80% of the weightage of the internal assessments A1 or A2. In any case, CPA is not considered as an improvement test.

#### **Attendance Policy**

1. All the students are expected to attend all the contact hours. Students should maintain 75% minimum physical attendance by the end of the course to attend the end semester examination.
2. Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' Grade. Student have to REDO the course.
3. A maximum of 10% attendance shall be allowed under On Duty (OD) category. OD is allowed only for the students having minimum attendance of 65%.

#### **Academic Honesty & Plagiarism**


1. Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
2. The answer sheet of the student will not be evaluated and ZERO mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
3. The departmental disciplinary committee including the course faculty member, PAC chairperson and

the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.


**ADDITIONAL INFORMATION**

The minimum marks for passing this course and grading pattern will adhere to the regulations of the institute.

**FOR APPROVAL**

  
20-Jan-22  
**Dr. Karthik Thirumala, AP/EEE**  
Course Faculty

  
Pinkymol K.P.  
**CC-Chairperson**

  
**HoD, Dept. of EEE**

**Guidelines:**

- a) The number of assessments for a course shall range from 4 to 6.
- b) Every course shall have a final assessment on the entire syllabus with at least 30% weightage.
- c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.
- d) The passing minimum shall be as per the current regulations.

<b>B.Tech. Admitted in</b>	<b>P.G.</b>
35% or class average/2 whichever is greater.	35% or class average/2 whichever is greater.

- e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.
- f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.
- g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.