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

COURSE PLAN – PART I			
Name of the programme and specialization	M.Tech. Power Systems		
Course Title	Power Quality		
Course Code	EE 676	**No. of Credits**	3
Course Code of Pre-requisite subject(s)	Power Systems, Signals and Systems		
Session	January 2021	**Section**	NA
Name of Faculty	Dr. Karthik Thirumala	**Department**	Electrical and Electronics Engineering
Official Email	thirumala@nitt.edu	**Telephone No.**	+91 9848626021
Name of Course Coordinator (if applicable)	- -		
Course Type	☐ **Core course**	☑ **Elective course**	☐ **Laboratory course**

SYLLABUS (approved in BoS)

Electric Power Quality phenomenon – IEC and IEEE definitions – power quality disturbances – voltage fluctuations – transients – unbalance – waveform distotion – power frequency variations.

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.

Transients – origin and classification – capacitor switching trnasient – lighting – load switching – impact on users – protection – mitigation.

Harmonics – Sources –definitions & standards – impacts – calculation and simulation – harmonic power flow-mitigation and control techniques – filtering – passive and active

Power Quality conditioners – shunt and series compensators – Dstatcom – Dynamic Voltage Restorer – Unified Power Quality Conditioners – Case studies

Essential Readings / Reference:

1. Heydt, G.T., 'Electric Power Quality', Stars in a Circle Publications, Indiana, 2nd edition 1996.
2. Bollen, M. H. J., 'Understanding Power Quality Problems; Voltage sags and interruptions', IEEE Press, New York, 2000.
3. Arrillaga, J., Watson, N. R., Chen, S., 'Power System Quality Assessment', Wiley, New York, 2000.
4. R. C. Dugan, M. F. McGranaghan and et al, 'Electrical Power Systems Quality', New York, USA: McGraw-Hill Education, 2012.

COURSE OBJECTIVES

Understand the various power quality phenomenon, their origin and monitoring and mitigation methods, understand the effects of various power quality phenomenon in various equipment.

COURSE OUTCOMES (CO)

Course Outcomes Upon completion of the course, the students will be able to:	**Aligned Programme Outcomes (PO)**
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.	18 – 22 January 2021 (2 hours)	Introduction to Power Quality and its importance Electric Power Quality phenomenon – IEC and IEEE definitions	Online lecture mode

2.	25 – 29 January 2021 (3 hours)	Power Quality disturbances: voltage fluctuations, transients, waveform distotion, power frequency variations and unbalance	
3.	1 – 5 February 2021 (3 hours)	Voltage sags and swell – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.	Online lecture mode
4.	8 – 12 February 2021 (3 hours)	Short interruptions and flicker – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.	
5.	15 - 19 February 2021 (3 hours)	Longer duration variations – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.	
6.	22 - 26 February 2021 (3 hours)	Flicker – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.	
		ASSESSMENT – I	
7.	1 – 5 March 2021 (3 hours)	Introduction to transients, their origin and classification	Online lecture mode
8.	8 – 12 March 2021 (3 hours)	Capacitor switching trnasient, lighting – impact on users, protection	
9.	15 – 19 March 2021 (3 hours)	Load switching – impact on users – protection – mitigation	
10.	22 – 26 March 2021 (3 hours)	Harmonics – Sources, definitions & standards	Online lecture mode
11.	30 Mar – 2 April 2021 (3 hours)	Impacts on equipments, calculation and simulation, harmonic power flow	
12.	5 – 9 April 2021 (3 hours)	Harmonic Mitigation and control techniques, passive and active filters	
		ASSESSMENT – II	
13.	12 – 16 April 2021 (3 hours)	Introductio to Power Quality conditioners, shunt and series compensators	Online lecture mode
14.	19 – 23 April 2021 (3 hours)	Dstatcom, Dynamic Voltage Restorer and Unified Power Quality Conditioners	
15.	26 – 30 April 2021 (3 hours)	Case studies of the conditioners	
16.	3 – 7 May 2021 (3 hours)	***ASSESSMENT – III & Compensation Assessment***	
17.	10 – 28 May 2021 (150 minutes)	***ASSESSMENT IV - End Semester Examination***	

<u>COURSE ASSESSMENT METHODS (Shall Range from 4 to 6)</u>

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Assessment I (1^{st} & 2^{nd} unit)	22 - 26 February 2021	1 hour	20%

2.	Assessment II (3^{rd} & 4^{th} units)	5 – 9 April 2021	1 hour	20%
3.	Miniproject/Seminar	26 – 30 April 2021	-	30%
CPA	Compensation test (entire syllabus)	3 – 7 May 2021	1 hour	80% of the weightage of the A1 or A2
4.	End Semester Exam (entire syllabus)	10 – 28 May 2021	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, 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		
18 January 2021 **Dr. Karthik Thirumala, AP/EEE** **Course Faculty**	**CC-Chairperson**	Approved by Mail **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 regulations.

B.Tech. Admitted in					P.G.
2019	2018	2017	2016	2015	
35% or class average/2 whichever is greater.			Peak/3 or class average/2 whichever is lower		40%

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.