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	July 2019	**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 (s) (if applicable)	- -			
E-mail	- -	**Telephone No.**	- -	
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.	5 – 9 August 2019	Introduction to Power Quality and its importance	*Lecture*

	(3 hours)	Electric Power Quality phenomenon – IEC and IEEE definitions	*Chalk and Talk or PPT*
2.	12 – 16 August 2019 (2 hours)	Power Quality disturbances: voltage fluctuations, transients, waveform distotion, power frequency variations and unbalance	*Chalk and Talk or PPT*
3.	19 – 23 August 2019 (3 hours)	Voltage sags and swell – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.	*Chalk and Talk or PPT*
4.	26 – 30 August 2019 (3 hours)	Short interruptions and flicker – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.	*Chalk and Talk or PPT*
5.	2 – 6 September 2019 (2 hours)	Longer duration variations – sources, range, impact on sensitive circuits, standards, solutions and mitigations, equipment and techniques.	*Chalk and Talk or PPT*
6.	9 – 13 September 2019 (2 hours)	**Assessment – I**	*First cycle test*
		Introduction to transients, their origin and classification	*Chalk and Talk or PPT*
7.	16 – 20 September 2019 (3 hours)	Capacitor switching trnasient, lighting – impact on users, protection	*Chalk and Talk or PPT*
8.	23 – 27 September 2019 (3 hours)	Load switching – impact on users – protection – mitigation	*Chalk and Talk or PPT*
9.	7 – 11 October 2019 (3 hours)	Harmonics – Sources, definitions & standards	*Chalk and Talk or PPT*
10.	14 – 18 October 2019 (3 hours)	Impacts on equipments, calculation and simulation, harmonic power flow	*Chalk and Talk or PPT*
11.	21 – 25 October 2019 (3 hours)	Harmonic Mitigation and control techniques, passive and active filters	*Chalk and Talk or PPT*
12.	28 – 31 October 2019 (3 hours)	**Assessment – II**	*Second cycle test*
		Introductio to Power Quality conditioners, shunt and series compensators	*Chalk and Talk or PPT*
13.	4 – 8 November 2019 (3 hours)	Dstatcom, Dynamic Voltage Restorer and Unified Power Quality Conditioners	*Chalk and Talk or PPT*
14.	11 – 15 November 2019 (3 hours)	Case studies of the conditioners	*Discussion*
15.	25 November – 4 December 2019	**End Semester Exam**	*Descriptive*

COURSE ASSESSMENT METHODS

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1.	Assessment – I (First cycle test)	II week of September 2019	1 hour	20%
2.	Assessment – II (Second cycle test)	V week of October 2019	1 hour	20%
3.	Group Task	Submit in II week of November 2019	-	20%
CPA	Compensation test (First four units)	13 November 2019	1 hour	20%
4.	End Semester Exam	25 Nov – 4 Dec 2019	2 hours	40%

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 in the mentioned week. Attending all the assessments (1, 2, 3, 4) are mandatory for every student.
2. If any student fails to attend the assessment 1 or 2 or both due to genuine reason like medical emergency or on duty, the student may be permitted to appear the compensation assessment (CPA) on submission of appropriate documents as proof.
3. The syllabus for compensation assessment (CPA) is unit 1, 2, 3 and 4. 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

6/8/2019

Dr. Karthik Thirumala, AP,EEE
Course Faculty

6/8/19

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 regulations.

B.Tech. Admitted in				P.G.
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.