GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3172423
Semester – VII

Subject Name: Power Quality

Type of course: Professional Elective Course VI

Prerequisite:

Rationale: Quality of power can have direct impact on many industrial consumers. There has recently been a great emphasis on revitalizing industry with more automation and more modern equipment. This usually means electronically controlled, energy-efficient equipment that is often much more sensitive to deviations in the supply voltage. This worsens the quality of power. The electric utility is concerned about power quality issues as well. This course would make the students aware about the various issues affecting the power quality as well as techniques available to improve the quality of power.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Course Content	Total Hrs.
1	**Introduction:** Definition of power Quality, power quality terminology, power quality issues, Susceptibility Criteria, Responsibility of supplier and users of elect power, Standards, Linear and nonlinear load and their effects.	4
2	**Power Frequency Disturbance:** Common power frequency disturbances, voltage sags, cures of low frequency disturbances, voltage tolerance Electrical Transients: Transient system model, Examples of models & response, Types and causes of transients, Examples of transient wave forms	8
3	**Harmonics:** Definition, number, odd and even harmonics, causes of harmonics, Individual & total distortion, Harmonics signatures, Effect of harmonics, Guidelines for harmonic voltage & current limitation, Harmonic current mitigation	6
4	**Grounding & Bonding:** Introduction, National electric code grounding requirements, Essentials of grounding system, Ground electrodes, Earth resistance tests, Earth ground grid system, Power Ground system, Signal reference ground, Signal reference ground methods, Single and multi-point grounding, Ground loops	6
5	**Power Factor:** Introduction, Active and Reactive power, Displacement and true power factor, power factor improvement, correction, penalty, voltage rise due to capacitance, application of synchronous condensers and static VAR compensators	3
6	**Electromagnetic Interference:** Electric and magnetic fields, Electromagnetic interference terminology, Power frequency fields, High frequency interference, EMI Mitigation, Cable shielding to minimize EMI, Health concerns of EMI	6
7	**Power Quality Measurement:** Power quality measurement devices, power quality measurements, Number of test locations, Test duration, Instrument set-up, Instrument set up guidelines.	6
8	**Distributed Generation and Power Quality:** Resurgence of DG, DG technologies, Interface to the utility system, Power quality issues, Operating conflicts,	6

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Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**40**	**30**	**10**	**10**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Power Quality by Sankaran, CRC publication
2. Electrical Power Systems Quality by Roger C. Dugan, TMH publication
3. Harmonics and Power Systems by Francisco C. De La Rosa, CRC Publication

Course Outcome:

Sr. No.	CO statement After learning this course, the students should be able to	Marks % weightage
CO1	understand the major power quality problems.	25
CO2	understand the grounding and ground loops.	25
CO3	use equipment that are required to measure the quality of power	25
CO4	apply techniques available to mitigate power quality problems	25

List of Experiments:

Suggested list of experiments
1) Study and calculation of THD and IHD of various types of non-linear loads
2) Power factor improvement using static VAR compensators
3) Measurement of current harmonics using current probe
4) Measurement of high frequency noise with oscilloscopes having high sampling rates
5) Measurement of true RMS value of voltage and current using true RMS meters
6) Measurement of magnetic and electric field using low frequency electromagnetic field meter
7) Study of harmonic distortion limits in agreement with IEEE 519
8) Study of power quality monitoring standards such as IEEE 1159 and IEC 61000-4-30

List of Equipment/Software:

1) Current probe for measuring current harmonics
2) True RMS meter
3) Spectrum analyser
4) Oscilloscope with high sampling rate
5) Data loggers and chart recorders
6) Low frequency electromagnetic field meter
7) MATLAB for simulation of harmonics generated by non-linear loads

List of Open-Source Software/learning website:

https://nptel.ac.in/courses/108/106/108106025/