GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS (29)
POWER QUALITY (POWER ELECTRONICS)
SUBJECT CODE: 2742903
M.E. 4TH SEMESTER

Type of course: Major Elective-V

Prerequisite: Fundamental knowledge of Power System & harmonics, and the basic concept of Power Electronics devices and interface parameters essential to safe limit.

Rationale: This course provides the basic concepts about the major role of power electronics in various engineering systems. It explains the basic concept about power electronics circuits introduces harmonics and also provides the solution to the power system, harmonics related problems and different techniques for the mitigation of harmonics etc.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA(M)	ESE (V)		PA(I)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	%Weightage
1.	**INTRODUCTION TO POWER QUALITY:** Terms and definitions: Linear & Non Linear Loads, Power Quality Indices, Overloading - under voltage - over voltage, Concepts of transients – short duration variations such as interruption - long duration variation such as sustained interruption, Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations, International standards of power quality, Computer Business Equipment Manufacturers Associations (CBEMA) curve, Fundaments of Power Losses in Harmonic Environments.	**6**	**10**
2.	**VOLTAGE EVENTS:** Voltage Events, Monitoring of Voltage Events, Sources of voltage events, Methods for the Detection & Evaluation of Voltage Events, Thevenin's equivalent source - analysis and calculation of various faulted condition, Effects of Voltage Events on Equipment, Voltage sag due to induction motor starting, Estimation of the sag severity - mitigation of voltage sags, Mitigation of voltage swells, active series compensators. Static transfer switches and fast transfer switches, protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.	**8**	**15**

3.	**HARMONICS:** Harmonic sources from commercial and industrial loads, Power system response characteristics - Harmonics Vs transients, Effect of harmonics - harmonic distortion - voltage and current distortion - harmonic indices - inter harmonics, resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters, IEEE and IEC standards, Effects of harmonics on capacitors, Transformers, Rotating machines, Lighting Devices, cables, relays etc.	**8**	**15**
4.	**HARMONIC ANALYSIS AND MEASUREMENT**: Harmonic source representation, Harmonic Propagation facts, flux of harmonic currents, Interrelation between AC system and Load Parameters Analysis methods, Necessity of harmonic measurement, Measurement procedure, and power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer - flicker meters – disturbance analyzer, Applications of expert systems for power quality monitoring.	**6**	**15**
5.	**DISTRIBUTED GENERATION AND POWER QUALITY:** Resurgence of DG, DG Technologies, Impact of DG, Interface to the Utility System, Power Quality Issues, Operating Conflicts, DG on Distribution Networks, Siting DG Distributed Generation, Interconnection Standards, Protection issues.	**6**	**15**
6.	**PASSIVE FILTERS:** Introduction, State of the Art on Passive Power Filters, Classification of Passive Filters, Principle of Operation of Passive Power Filters, Analysis and Design of Passive Power Filters, Modeling, Simulation, and Performance of Passive Power Filters, Limitations of Passive Filters, Parallel Resonance of Passive Filters with the Supply System and Its Mitigation.	**6**	**15**
7.	**Active Power line filters:** General description of Shunt Active filters, 3-phase, 3-wire shunt active filters, Active filters for current minimization, Active filters for harmonic damping, 3-phase, 4-wire shunt active filters, Hybrid and series active filters, comparison with pure active filters, Combined series and shunt power conditioners, Unified Power Flow Controller (UPFC), Unified Power Quality Controller (UPQC)- basic concepts	**6**	**15**

Reference Books:

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H. Wayne Beaty, "Electrical Power Systems Quality", McGraw Hill, 2003.
2. G.T. Heydt, "Electric Power Quality", 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994).
3. M.H.J Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", (New York: IEEE Press, 1999).
4. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment" , (New York: Wiley, 1999).
5. C. Shankran, "Power quality", CRC Press, 2001.

Course Objectives:

After learning the course, the students should be able to:

1. Understand various issues related to power quality in power distribution systems.
2. Understand the basic definition and terms used in power quality.
3. Understand how to analyze power quality issues.
4. Understand how common power disturbances can affect circuits, devices and equipments etc.
5. Understand use of passive and active filters for mitigation of harmonics.

Website:

http://nptel.iitm.ac.in

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.