GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (07)
POWER QUALITY ISSUES AND THEIR MITIGATION TECHNIQUES IN POWER SYSTEMS
SUBJECT CODE: 2730707
M.E. SEM-III

Type of course: Engineering Science (Electrical)

Prerequisite: None

Rationale: NA

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)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Power quality terminologies** Categories & characteristics of power system electomagnetic phenomena for power quality, transients – impulsive & oscillatory, long duration & short duration voltage variations, voltage imbalance, waveform distortion, power frequency variations, power quality terms	5	10
2	**Harmonics & power electronic converters** Calculation of harmonic currents – effects of source unbalance, circuit reactance, dc filter inductance Current harmonics in converter with inductor input filter & capacitor input filter Single phase power conversion – effects of circuit resistance, source reactance, 3rd harmonics currents, reduction of harmonics Harmonic issues for phase controlled thyristors	8	20
3	**Effect of harmonics on electrical apparatus** Effect of harmonic on Transformer - Harmonics in No-Load Exciting Current, Harmonics due to Inrush Current, DC Magnetization Effect on Capacitor, Induction Motor, protection devices Harmonics in arc furnace loads & thyristor controlled reactor	7	15
4	**Power Quality in Distributed Generation** DG technologies, Interface to the utility system, Impact of distributed generation on power quality, Operating conflicts, DG on distribution networks, Interconnection standards.	5	10
5	**Voltage quality controllers** Shunt controllers: D-SVC, D-STATCOM – operation & control Series controllers: DVR – operation & control	5	10
6	**Passive harmonic filters**	7	15

	Types, Ac network impedance, Design of filters – single tuned, double tuned & damped filter, filter component ratings		
7	**Active Power filters** Advantages, Types – shunt, series & hybrid, current control techniques – instantaneous reactive power theory, synchronous reference frame theory, current controllers for active power filters – hysteresis, space vector pulse width modulation (SVPWM)	8	20

Reference Books:

1. R. Sastry Vedam & Mulukutla S. Sarma, "Power Quality : VAR Compensation in power systems" , CRC press 2009
2. Moreno-Munoz, "Power Quality: Mitigation techniques in a distributed environment"
3. Roger C. Dugan , "Electrical Power Systems Quality" , 2nd Edition, Tata Mcgraw Hill Publication
4. Derek A. Paice, "Power Electronic converter harmonics : Multipulse methods for clean power", IEEE press, 1995
5. Hirofumi Akagi, Edson Hirokazu Watanabe, Mauricio Aredes, "Instantaneous Power Theory and Applications to Power Conditioning", John Wiley & Sons, 2007
6. C. Sankaran, "Power quality" , CRC Press, 2002
7. M. H. J. Bollen, "Understanding Power Quality Problems: Voltage sags and Interruptions", Wiley-IEEE Press, 1999

Course Outcome:

After learning the course the students should be able to:

1. Comprehend concept of Power Quality & it's issues for various electrical systems
2. Understand effects of power qulaity on electrical apparatus
3. Know different power quality improvement tecniques and devices

List of Experiments:
Practical based on above topics

Design based Problems (DP)/Open Ended Problem:
Course coordinator can assign the design based problem/open ended problem.

List of Open Source Software/learning website:

- E-materials available at the website of NPTEL- http://nptel.ac.in/
- MATLAB (Trial version): Software is useful for simulation and analysis of electrical systems

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.