Course code	Course Name	L-T-P - Credits	Year of Introduction
EE465	Power Quality	3-0-0-3	2016

Prerequisite: Nil

Course Objectives:

- To discuss various power quality issues and different methods to control them.

Syllabus:

Power quality issues in distribution systems, Need for power quality monitoring, IEEE guides, standards and recommended practices, Modelling of networks and components under non sinusoidal conditions, Harmonic Analysis, Effects of Power System harmonics on Power System equipment and loads, Harmonic elimination, Power Quality Management in Smart Grid, Electromagnetic Interference.

Expected Outcome:

- The students will be able to identify the power quality problems, causes and suggest suitable mitigating techniques.

References:

1. Angelo Baggini (Ed.) *Handbook of Power Quality,* Wiley, 2008
2. C. Sankaran, *'Power Quality',* CRC Press, 2002
3. G. T. Heydt, *'Power Quality',* Stars in circle publication, Indiana, 1991
4. Jose Arillaga, Neville R. Watson, *'Power System Harmonics',* Wiley, 1997
5. Math H. Bollen, *'Understanding Power Quality Problems'* Wiley-IEEE Press, 1999
6. R. C. Durgan, M. F. Me Granaghen, H. W. Beaty, *'Electrical Power System Quality',* McGraw-Hill

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Power quality phenomenon - Sources and Effects of power quality problems, types of power quality disturbances - Voltage sag (or dip), Swell, Transients, short duration voltage variation, Long duration voltage variation, voltage imbalance, waveform distortion, and voltage flicker	6	15%
II	IEEE guide lines, standards and recommended practices. Harmonics -mechanism of harmonic generation-harmonic indices (THD, TIF, DIN, C – message weights - Power Quality Costs Evaluation -. Harmonic sources – Switching devices, arcing devices, saturable devices. Effects of Power System harmonics on Power System equipment and loads.	7	15%
FIRST INTERNAL EXAMINATION			
III	Harmonic Analysis - Fourier series and coefficients, the Fourier transforms, discrete Fourier transform, fast Fourier transform, Window function- numerical problems. .	5	15%
IV	Power quality Monitoring considerations: Power line disturbance analyzer, power quality measurement equipment, harmonic spectrum analyzer, flicker meters, disturbance analyzer	7	15%
SECOND INTERNAL EXAMINATION			

V	Harmonic elimination - Design and analysis of filters to reduce harmonic distortion – Power conditioners ,passive filter, active filter - shunt , series, hybrid filters,	7	20%
VI	Power Quality Management in Smart Grid: Power Quality in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid. Electromagnetic Interference (EMI -introduction - Frequency Classification - Electrical fields-Magnetic Fields - EMI Terminology - Power frequency fields - High frequency	10	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.