Nirma University

Institute:	**Institute of Technology, School of Engineering**
Name of Programme:	**B. Tech. in Electrical Engineering**
Semester:	**VII**
Course Code:	4EE304ME25
Course Title:	**Power Quality and Custom Power Devices**
Course Type:	**Department Elective-IV**
Year of Introduction:	**2025 –26**

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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to -

1. analyse the effects of poor power quality (BL4)
2. investigate the current and voltage harmonics with required solution (BL5)
3. select a suitable custom power device for enhancing power quality (BL4)
4. design appropriate power quality improvement device based on need of application (BL6)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Introduction** Overview of power quality – concern about the power quality – general classes of power quality and voltage quality problems – transients – long–duration voltage variations – short–duration voltage variations – voltage unbalance – Waveform distortion – voltage fluctuation – power frequency variations	06
Unit-II	**Voltage Imperfections in Power Systems** Power quality terms – voltage sags – voltage swells and interruptions – sources of voltage sag, swell and interruptions – nonlinear loads – IEEE and IEC standards, source of transient over voltages – principles of over voltage protection – devices for over voltage protection – utility capacitor switching transients	08

Unit-III	**Harmonic Distortion and Solutions** Voltage distortion vs. current distortion – harmonics vs. transients – harmonic indices – sources of harmonics – effect of harmonic distortion – impact of capacitors, transformers, motors and meters – point of common coupling – passive and active filtering – numerical problems	09
Unit-IV	**Passive Power Compensators** Principle of operation of passive shunt and series compensators, analysis and design of passive shunt compensators simulation and performance of passive power filters- limitations of passive filters, parallel resonance of passive filters with the Supply System and Its mitigation, fundamentals of load compensation – voltage regulation & power factor correction	09
Unit-V	**FACTS** Introduction, need of FACTS devices in power system, types of compensation techniques, various FACTS controllers, different FACTS devices like TCSC, TCSR, SVC etc., advantages & disadvantages, SSSC, The UPFC, comparative evaluation of different FACTS controllers, future direction of FACTS technology	07
Unit-VI	**Custom Power Devices** Active filters, DSTATCOM – DVR Structure – rectifier supported DVR – DC capacitor supported DVR -unified power quality conditioner	06

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10 % of the questions will be asked from self-study contents.

Laboratory Work:

This shall consist of at least 08 laboratory experiments / simulations based on the syllabus.

Suggested Reading:

1. R. C. Duggan, *Electric Power Systems Quality*, Tata MC Graw Hill Publishers
2. J. Arrillga, *Power System Harmonics*, John Wiley and Sons
3. Derek A. Paice, *Power Electronic Converter,* Harmonics IEEE Press
4. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, *Power Quality Problems & Mitigation Techniques*, Wiley
5. R. Sastry Vedam, Mulukulta S Sarma, *Power Quality VAR Compensation in Power Systems*, CRC Press
6. Narain G. Hingorani, *Understanding FACTS: Concepts & Technology of Flexible AC Transmission Systems*, Wiley India Pvt. Ltd.
7. C. Sankaran, *Power Quality*, CRC press
8. T. K. Nagsarkar and M. S. Sukhija, *Power System Analysis*, Oxford University Press
9. Francisco C. De La Rosa, *Harmonics and Power Systems*, CRC Press

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1.	Impact of sag and swell on source and load using ac programmable source/simulation	02
2.	Simulation and analysis of current harmonics and voltage harmonics generated by non-leaner load.	02
3.	Simulation of passive shunt and series compensators	04
4.	Design and simulation of passive tuned filter for 5^{th} and 7^{th} current harmonics elimination	04
5.	Design and simulation analysis of Thyristor-Controlled Series Capacitor (TCSC)	02
6.	Design and simulation analysis of Thyristor-Controlled Series Reactor (TCSR)	02
7.	Design and simulation shunt active filter	04
8.	Design and simulation of Dynamic Voltage Restorer (DVR)	04