NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**B.Tech. in Electrical Engineering**
Semester:	**VII**
Course Code:	**2EEDE62**
Course Title:	**Power Quality and Custom Power Devices**
Course Type:	(□ Core/ □ Value Added Course / √ **Department Elective**/ □ Institute Elective/ □ University Elective/ □ Open Elective/ □ Any other)
Year of Introduction:	**2021 – 22**

Credit Scheme

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

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

1. interpret power quality terms and analyse related issues
2. implement appropriate power quality improvement solutions
3. analyse operation of FACTS controllers
4. implement control scheme for various FACTS controllers

Syllabus: **Total Teaching hours: 30**

Unit	Syllabus	Teaching hours
Unit-I	**Power Quality Issues** Significance of power quality in power system, classification of linear and nonlinear loads, causes and effects of power quality disturbances, origin of power quality variation & events, power quality indices, characterization of power quality events & event classification, harmonics, power quality measuring instruments, harmonics mitigation techniques, understanding of IEEE harmonic standard 519-2014.	**06**
Unit-II	**Power Factor Correction and Harmonic Mitigation** DC-DC converters for power factor correction, front-end converters, passive filters – tuned and de-tuned filters, active power filters.	**10**
Unit-III	**Shunt FACTS Controllers** Objectives of shunt compensation, methods of controllable VAR generation, use of VSI (Voltage Source Inverter) as a VAR generator, role and technical understanding of SVC (Static VAR Compensator) and STATCOM, D-STATCOM (Static Synchronous Shunt Compensator).	**06**
Unit-IV	**Series and Unified FACTS Controllers** Objectives of series compensation, variable impedance type series compensators – TCSC (Thyristor Controlled Series Capacitor), role of SSSC (Static Synchronous Series Compensator), Dynamic Voltage Restorer (DVR), Basic operating principle of UPFC	**08**

(Unified Power Flow Controller) and IPFC (Interline Power Flow Controller) with their control capabilities.

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 10 laboratory experiments / simulations based on the syllabus.

Suggested Readings/ References:

1. N. G. Hingorani, Understanding FACTS: Concepts And Technology of Flexible AC Transmission Systems, IEEE Computer Society Press
2. T.J.E. Miller, Reactive Power Control in Electric Power Systems, John Wiley & Sons, New York
3. R. Mohan Mathur and Rajiv K. Varma, Thyristror based FACTS Controllers for Electrical Transmission Systems, IEEE Press, Wiley Interscience
4. K. R. Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International
5. R. Sastry Vedam and M. S. Sarma, Power Quality VAR Compensation in Power Systems, CRC Press
6. Wakileh George J., Power System Harmonics: Fundamentals, analysis and filter Design, Springer, (first Indian reprint).
7. Fuchs E.F., Masoum Mohammad A.S, Power Quality in Power Systems and Electrical Machines, Elsevier Academic Press.
8. M. H. J. Bollen, Understanding Power quality Problems: Voltage Sags and Interruptions, IEEE Press (Standard Publishers Distributors).
9. B. Singh, A. Chandra, Kamal Al-Haddad, Power quality: Problems and Mitigation Techniques, Wiley
10. IEEE Std. 519-2014 - IEEE Recommended Practice Requirements for Harmonic Control in Electric Power Systems, IEEE SA
11. Recent Journal Papers and literature available in various industry documents

Suggested List of Experiments:
1. Simulation and analysis three phase active front end converter.
2. Simulation and analysis of static var compensator (thyristor-controlled reactor).
3. Simulation and analysis of power network with and without static var compensators (fixed capacitor TCR).
4. Simulation and analysis of static synchronous shunt compensator (STATCOM).
5. Simulation and analysis of thyristor-controlled series capacitor compensated line (TCSC).
6. Simulation and analysis of Dynamic Voltage Restorer (DVR).
7. Simulation and analysis of static synchronous series compensator (SSSC).
8. Simulation and analysis of active power filter based on instantaneous reactive power theory.
9. Simulation and analysis of active power filter based on synchronous reference frame theory.
10. Simulation and analysis of active power filter based on generalized Fryze control theory.

L = Lecture, T = Tutorial, P = Practical, C = Credit