GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02000721

Course / Subject Name: Custom Power Devices for Power Quality

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisit	Knowledge of Fundamentals of Power System and Power Electronics
Rationale:	This curriculum on "Custom Power Devices for Power Quality" is designed to equip students with in-depth knowledge and practical skills to address power quality issues. It covers fundamental concepts, harmonics, the impact on electrical apparatus, distributed generation, voltage quality controllers, and harmonic filters. The comprehensive approach ensures that graduates can effectively design, implement, and manage power electronic systems, enhancing the reliability and efficiency of modern power networks.

Course Outcome:

After Completion of the Course, the student will be able to:

No	Course Outcomes
01	Understand power quality problems and application of custom power devices used for mitigating power quality problems in electrical systems
02	Analyze and design various types of electric drives.
03	Design of custom power devices used for improving power quality in electrical systems.
04	Apply advanced control strategies and techniques for custom power devices to enhance power quality in various industrial applications.
05	Explore emerging technologies and innovations in custom power devices for future power quality solutions.

Teaching and Examination Scheme:

Teaching Scheme (in			Total Credits (L+T+	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Power Quality:** Definitions and Importance, Power Quality Standards (IEEE, IEC), Power Quality Issues (Voltage Sag, Swell, Harmonics, Flicker), Economic Impacts of Poor Power Quality	4	5
2.	**Fundamentals of Custom Power Devices:** Definition and Classification of Custom Power Devices, Role of Custom Power Devices in Power Quality, Improvement Comparison with Traditional Power Quality Solutions, Basic Operation Principles	4	10
3.	**Active Power Filters:** Types of Active Power Filters (Shunt, Series,	12	30

	Hybrid) Design and Control Strategies, Applications and Performance Evaluation, Case Studies		
4.	**Voltage Quality Controllers:** Series Controllers, Dynamic Voltage Restorers (DVRs): Operating Principles of DVRs, Design Considerations, Control Techniques, Practical Applications and Case Studies Shunt controllers: D-SVC, D-STATCOM– operation & control, Comparative analysis of different voltage quality controllers	12	30
5.	**Unified Power Quality Conditioners (UPQCs):** Concept and Configuration, Control Strategies for Voltage and Current Compensation, Integration and Performance Analysis, Industrial Applications	9	20
6.	**Emerging Custom Power Devices and Technologies: Recent** Advancements in Power Electronics for Power Quality, Smart Grid and Power Quality, Future Trends and Research Directions	4	05
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	20	20	20	10	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Power Quality Enhancement Using Custom Power Devices by Arindam Ghosh and Gerard Ledwich, Springer-Verlag New York Inc., 2nd edition (2002).
2. Power Quality: Problems and Solutions by Bimal K. Bose, John Wiley & Sons, 2nd edition (2002).
3. Power System Harmonics: A Practical Guide for Power Engineers by J. C. Smith, John Wiley & Sons, 1st edition (1992).
4. Power Quality in Electrical Power Systems by R. J. Kerkman and J. A. Tylavsky, McGraw-Hill, 1st edition (1994).
5. Power Quality and Harmonics in Power Systems by J. S. Rao, John Wiley & Sons, 1st edition (2004).
6. Power Quality: Principles, Measurement, and Improvement by R. H. Dugan, M. F. McGranaghan, and H. W. Beaty, McGraw-Hill, 1st edition (2000).
7. Power Quality and Control of Electromagnetic Interference by J. S. Rao, John Wiley & Sons, 1st edition (2004).

(b) Open-source software and website:

Power Quality - By Prof. Bhim Singh, IIT Delhi

1. This course covers various power quality issues, compensation techniques, and power quality improvement methods.
2. Power Quality - Course

Electrical Engineering - NOC: Power Quality - Coordinated by IIT Delhi

1. This course includes lectures on improved power quality converters, power quality improvement in renewable energy systems, and distributed generation sources.
2. NPTEL :: Electrical Engineering - NOC:Power Quality

Power Quality in Power Distribution Systems - By Dr. Mahesh Kumar, IIT Madras

1. This course focuses on custom power devices such as DSTATCOM and DVR, and their applications in mitigating power quality problems.
2. 108106025.pdf

Suggested Course Practical List:

This is a suggestive list only.

1. Design and Simulation of Shunt Active Power Filters (APFs)
2. Design and Simulation of Series Active Power Filters (APFs)
3. Design and Simulation of Hybrid Active Power Filters
4. Dynamic Voltage Restorer (DVR) Design and Simulation
5. Unified Power Quality Conditioner (UPQC) Design and Simulation
6. Simulation of Power Quality Improvement using Distributed Power Flow Controller (DPFC)
7. Case Study on Power Quality Improvement using Shunt APF in an Industrial Zone
8. Case Study on Harmonic Mitigation using Active Filters
9. Simulation of Power Quality Improvement using STATCOM
10. Case Study on Voltage Sag and Swell Mitigation using DVR
11. Design and Simulation of Solid-State Transfer Switch (SSTS)
12. Case Study on Power Quality Improvement using FACTS Devices

List of Laboratory/Learning Resources Required:

PC/Laptop with installed MATLAB/ similar software, power converter hardware etc.
E-materials available at the website of NPTEL- http://nptel.ac.in/

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