GANPAT UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

Programme	Master of Technology			Branch/Spec.	Electrical (Electrical Power System) / (Renewable Energy)
Semester	II			Version	1.0.0.0
Effective from Academic Year		2025-2026		Effective for the batch Admitted in	July 2025
Course Code	3EE2101	Course Name		Power Quality & FACTS	

Teaching scheme						Examination scheme (Marks)			
(Per week)	Lecture(DT)		Practical(Lab.)		Total		CE	SEE	Total
	L	TU	P	TW					
Credit	3	0	1	0	4	Theory	40	60	100
Hours	3	0	2	0	5	Practical	30	20	50

Pre-requisites:

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Course Outcomes

On successful completion of the subject, students should be able to:

CO1	Understand power quality issues and working principle of FACTS devices.
CO2	Analyze the behavior and comparative performance of shunt and series compensators under varying system conditions.
CO3	Apply and Design solutions for power quality Enhancement using FACTS
CO4	Evaluate and select appropriate mitigation techniques including active, passive, and hybrid filters.

Theory syllabus

Unit	Content	Hrs
1	**Introduction to Power Quality:** Overview of power quality phenomena, Classification of power quality issues, Power quality measures and standards, THD-TIF-DIN-C message weights, Flicker factor, Transients, Transient system model, Examples of models & response, Types and causes of transients, Power acceptability curves, IEEE guides, Standards and recommended practices.	**09**
2	**Harmonics:** Definition, Harmonic number, Odd and even harmonics, Cause of voltage and current harmonics, Individual and total harmonic distortion, RMS value of a harmonic waveform, Triplex harmonics-important harmonic introducing devices, SMPS, Three phase power converters, Arcing devices, Saturable devices, Harmonic distortion of fluorescent, Lamps, Effect of power system harmonics on power system equipment and loads.	**10**
3	**Static Shunt and Series Compensators:** Shunt compensation: Objectives of shunt compensation, Methods of controllable VAR generation, Static VAR compensators, SVC, STATCOM, SVC and STATCOM comparison. Series compensation: Objectives of series compensation, Thyristor switched series capacitors (TCSC), Static series synchronous compensator (SSSC), Power angle characteristics and basic operating control schemes.	**10**
4	**Combined Compensator:** Unified Power Flow Controller, Circuit Arrangement, Operation and control of UPFC, Basic Principle of P and Q control, Independent real and reactive power flow control, Applications of UPFC, Introduction to interline power flow controller (IPFC), Application of IPFC, Modelling and analysis of FACTS Controllers.	**09**
5	**Application of FACTS in Power Quality improvement:** MATLAB/Simulink models of FACTS for PQ enhancement, Practical examples from utilities/industries, Integration of FACTS with renewable energy systems, IEEE and IEC standards related to power quality and FACTS.	**07**

Practical content

Practicals, assignments, and tutorials are based on the above syllabus.

Text Books

1.	N. G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems," IEEE Press Book, Standard Publishers and Distributors, Delhi.
2.	C. Sankaran, "Power quality," CRC publication.

Reference Books	
1.	K R Padiyar, “FACTS Controllers in Power Transmission and Distribution,” New Age International Publishers.
2.	X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, Springer Verlag, Berlin.
3.	Y. H. Song, “Flexible AC Transmission Systems (FACTS),” IEEE Series.
4.	G. T.Heydt, “Power Quality,” McGraw-Hill Professional.
5.	T. J. E. Miller, “Static Reactive Power Compensation,” John Wiley and Sons, Newyork.
6.	Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez, César Angeles Camacho, “FACTS: Modelling and Simulation in Power Networks” John Wiley & Sons, Ltd.
7.	R.Mathur & P.K Verme, “Thyristor Based FACTS Controller for Electrical Transmission Systems,” IEEE Press(Wiley).
8.	Roger C. Dugan, “Electrical Power Systems Quality” TMH publication.
ICT/MOOCs	
1.	https://nptel.ac.in/courses/108/107/108107114/
2.	https://nptel.ac.in/courses/108/102/108102179/
3.	https://nptel.ac.in/courses/108/107/108107157/
4.	https://nptel.ac.in/courses/108/106/108106025/

Mapping of CO with PO and PSO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	0	0	1	0	1	3	2	3	2
CO2	3	3	1	2	1	1	1	0	1	0	1	2	2	1	1
CO3	3	3	3	3	2	1	1	0	1	0	2	2	3	2	1
CO4	3	3	3	3	2	1	1	0	1	0	2	2	3	3	1