SEMESTER S7

POWER QUALITY

Course Code	PEEET751	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	PE - Theory

Course Objectives:

1. To introduce the fundamental concepts of power quality, different power quality issues and its mitigation methods.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Power quality phenomenon** - Sources and effects of power quality problems, Need for concern of Power quality **Types of power quality disturbances** –Transients – classification and origin, Short duration voltage variation – interruption, sag, swell, Long duration voltage variation, voltage unbalance, waveform distortion - notching, harmonics and voltage flicker **Power Quality issues of Grid connected Renewable Energy Systems** – operating conflicts	9
2	**Harmonics** - mechanism of harmonic generation, Triplen harmonics, **Harmonic sources** – switching devices, arcing devices and saturable devices, Effects of harmonics on power system equipment and loads – transformers, capacitor banks, motors and telecommunication systems, Effect of triplen harmonics on neutral current, line and phase voltages. **Harmonic analysis using Fourier series and Fourier transforms** – simple numerical problems	9
3	**Harmonic indices** (CF, DF, THD, TDD, TIF, DIN, C – message weights), Displacement and total power factor **Overview of power quality standards**: IEEE 519, IEEE 1433 and IEC 61000 **Power quality Monitoring:** Objectives and measurement issues, different monitoring instruments – Power quality analyzer, harmonic spectrum analyzer, flicker meters	9

KTU SPECIAL

4	**Mitigation of Power quality problems** - Harmonic elimination - Design simple problems and analysis of passive filters to reduce harmonic distortion – demerits of passive filters – description of active filters - shunt, series, hybrid filters, sag and swell correction using DVR Power quality conditioners - DSTATCOM and UPQC - Configuration and working **Power factor correction** – Single phase active power factor converter – circuit schematic and control block diagram **Grounding and wiring**– reasons for grounding – wiring and grounding problems - solutions to these problems	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

KTU SPECIAL

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the sources and effects of power quality problems.	**K2**
CO2	Apply Fourier concepts for harmonic analysis.	**K3**
CO3	Explain the important aspects of power quality monitoring.	**K2**
CO4	Examine power quality mitigation techniques.	**K2**
CO5	Discuss power quality issues in grid connected renewable energy systems.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2				2		1				2
CO2	3	3										2
CO3	3	3			3							2
CO4	3	3	2					1				2
CO5	3	2										2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

KTU SPECIAL

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electrical Power System Quality	R. C. Dugan, M. F. Me Granaghen, H. W. Beaty	McGraw-Hill	2012
2	Power Quality	C. Sankaran	CRC Press	2002
3	Understanding Power Quality Problems	Math H. Bollen	Wiley-IEEE Press	1999
4	Power Quality problems and mitigation techniques	Bhim Singh, Ambrish Chandra and Kamal Al-Haddad	John Wiley and Sons Ltd	2015