

## POWER QUALITY

PEC-IV: EPS																																									
Course Code	Category	Hours / Week			Credits	Maximum Marks																																			
BPSB17	Elective	L	T	P	C	CIA	SEE	Total																																	
		3	-	-	3	30	70	100																																	
Contact Classes: 45		Tutorial Classes: Nil		Practical Classes: Nil		Total Classes: 45																																			
<p><b>I. COURSEOVERVIEW:</b>            This course deals with the basic concepts power quality problems, mitigation techniques used to improve power quality in distribution system. This course is designed to construct study of characterization of voltage sag magnitude and three phase unbalanced voltage sag. This course also concludes with the behavior of power electronics loads, induction motors and synchronous motors.</p> <p><b>II. COURSE OBJECTIVES:</b>  <b>This course should enable the students to:</b>            I. Understand different terms of powerquality.            II. Illustrate power quality issues for short and long interruptions.            III. Construct study of characterization of voltage sag magnitude and three phase unbalanced voltagesag.            IV. Learn the behavior of power electronics loads, induction motors, synchronous motor etc. by the power quality issues.            V. Explain mitigation of power quality problems by using VSIconverters.</p> <p><b>III. COURSEOUTCOMES:</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3">After successful completion of the course, students will be able to:</th> </tr> </thead> <tbody> <tr> <td style="width: 10%;">CO 1</td> <td style="width: 70%;">Identify the Power Quality problem by applying the techniques to mitigate them.</td> <td style="width: 20%;">Apply</td> </tr> <tr> <td>CO 2</td> <td>Analyze the methodology to improve the power quality for sensitive loads by various custom power devices.</td> <td>Analyze</td> </tr> <tr> <td>CO 3</td> <td>Analyze the difference between failure, outage and Interruptions for reliability evaluation to power quality</td> <td>Analyze</td> </tr> <tr> <td>CO 4</td> <td>Analyze the voltage sag and swell based power quality problem in Single phase and three phase system for deenergization of large load.</td> <td>Analyze</td> </tr> <tr> <td>CO 5</td> <td>Identify the Power Quality problems in Industry power systems for harmonic distortions in the nonlinear loads.</td> <td>Apply</td> </tr> <tr> <td>CO 6</td> <td>Evaluate power quality monitoring and classification mitigating techniques for the quality of voltage and current produced by a power plant.</td> <td>Evaluate</td> </tr> </tbody> </table> <p><b>IV.SYLLABUS:</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">UNIT-I</th> <th style="width: 65%;">INTRODUCTION</th> <th style="width: 20%;">Classes: 09</th> </tr> </thead> <tbody> <tr> <td colspan="3">Introduction of the power quality (PQ): Problem, terms used in PQ voltage, sag, swell, surges, harmonics, over voltages, spikes, voltage fluctuations, transients, interruption, overview of power quality phenomenon, remedies to improve power quality, power quality monitoring.</td> </tr> <tr> <th>UNIT-II</th> <th>LONG AND SHORT INTERRUPTIONS</th> <th>Classes:10</th> </tr> <tr> <td colspan="3">Interruptions: Definition, difference between failures, outage, interruptions, causes of long interruptions , origin of</td> </tr> </tbody> </table>									After successful completion of the course, students will be able to:			CO 1	Identify the Power Quality problem by applying the techniques to mitigate them.	Apply	CO 2	Analyze the methodology to improve the power quality for sensitive loads by various custom power devices.	Analyze	CO 3	Analyze the difference between failure, outage and Interruptions for reliability evaluation to power quality	Analyze	CO 4	Analyze the voltage sag and swell based power quality problem in Single phase and three phase system for deenergization of large load.	Analyze	CO 5	Identify the Power Quality problems in Industry power systems for harmonic distortions in the nonlinear loads.	Apply	CO 6	Evaluate power quality monitoring and classification mitigating techniques for the quality of voltage and current produced by a power plant.	Evaluate	UNIT-I	INTRODUCTION	Classes: 09	Introduction of the power quality (PQ): Problem, terms used in PQ voltage, sag, swell, surges, harmonics, over voltages, spikes, voltage fluctuations, transients, interruption, overview of power quality phenomenon, remedies to improve power quality, power quality monitoring.			UNIT-II	LONG AND SHORT INTERRUPTIONS	Classes:10	Interruptions: Definition, difference between failures, outage, interruptions, causes of long interruptions , origin of		
After successful completion of the course, students will be able to:																																									
CO 1	Identify the Power Quality problem by applying the techniques to mitigate them.	Apply																																							
CO 2	Analyze the methodology to improve the power quality for sensitive loads by various custom power devices.	Analyze																																							
CO 3	Analyze the difference between failure, outage and Interruptions for reliability evaluation to power quality	Analyze																																							
CO 4	Analyze the voltage sag and swell based power quality problem in Single phase and three phase system for deenergization of large load.	Analyze																																							
CO 5	Identify the Power Quality problems in Industry power systems for harmonic distortions in the nonlinear loads.	Apply																																							
CO 6	Evaluate power quality monitoring and classification mitigating techniques for the quality of voltage and current produced by a power plant.	Evaluate																																							
UNIT-I	INTRODUCTION	Classes: 09																																							
Introduction of the power quality (PQ): Problem, terms used in PQ voltage, sag, swell, surges, harmonics, over voltages, spikes, voltage fluctuations, transients, interruption, overview of power quality phenomenon, remedies to improve power quality, power quality monitoring.																																									
UNIT-II	LONG AND SHORT INTERRUPTIONS	Classes:10																																							
Interruptions: Definition, difference between failures, outage, interruptions, causes of long interruptions , origin of																																									

<p>interruptions, limits for the interruption frequency, limits for the interruption duration, costs of interruption, overview of reliability evaluation to power quality, comparison of observations and reliability evaluation; Short Interruptions: Definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems, multiple events, single phase tripping, voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.</p>		
<b>UNIT-III</b>	<b>SINGLE AND THREE-PHASE VOLTAGE SAG CHARACTERIZATION</b>	<b>Classes:08</b>
<p>Voltage sag: Definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration.</p> <p>Three phase faults: Phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.</p>		
<b>UNIT-IV</b>	<b>POWER QUALITY CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS</b>	<b>Classes: 09</b>
<p>Voltage sag; Equipment behavior of power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation, mitigation of ac drives, adjustable speed dc drives and its operation, mitigation methods of dc drives.</p>		
<b>UNIT-V</b>	<b>MITIGATION OF INTERRUPTIONS AND VOLTAGE SAG</b>	<b>Classes: 09</b>
<p>Overview of mitigation methods: From fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods; System equipment interface: Voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.</p>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. Math H J Bollen, "Understanding Power Quality Problems", IEEE Press, 1<sup>st</sup> Edition, 2007.</li> <li>2. Sastry Vedam Mulukutla Sarma, "Power Quality VAR Compensation in Power Systems", R, CRC Press, 1<sup>st</sup> Edition, 2004.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. G T Heydt, "Electric Power Quality", (West Lafayette, IN, Stars in a circle Publications, 1<sup>st</sup> Edition, 1994.</li> <li>2. R Sastry Vedam Mulukutla Sarma, "Power Quality VAR Compensation in Power Systems", CRC Press, 1<sup>st</sup> Edition, 2000.</li> <li>3. A Ghosh, G Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic, 1<sup>st</sup> Edition, 2002.</li> </ol>		
<b>Web References:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.researchgate.net">https://www.researchgate.net</a></li> <li>2. <a href="https://www.aar.faculty.asu.edu/classes">https://www.aar.faculty.asu.edu/classes</a></li> <li>3. <a href="https://www.facstaff.bucknell.edu/">https://www.facstaff.bucknell.edu/</a></li> <li>4. <a href="https://www.electrical4u.com">https://www.electrical4u.com</a></li> </ol>		
<b>E-Text Books:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.jntubook.com/">https://www.jntubook.com/</a></li> <li>2. <a href="https://www.freeengineeringbooks.com">https://www.freeengineeringbooks.com</a></li> </ol>		