**Session1**

Class 1 on CT & PTs

Laboratory practice on CTs (Current Transformers) and PTs (Potential Transformers) typically involves testing and calibration to ensure their accuracy and performance. Here's an overview of the general procedures involved in the lab practice for CTs and PTs:

Visual Inspection: Begin by visually inspecting the CTs and PTs for any physical damage, loose connections, or signs of wear. Ensure that the primary and secondary terminals are clean and securely connected.

Wiring and Connections: Verify that the wiring connections between the CTs/PTs and the test equipment or relays are correct. Use appropriate safety precautions while handling high-voltage equipment.

Ratio Measurement: Determine the transformation ratio of the CT or PT. For CTs, this involves injecting a known current through the primary winding and measuring the output on the secondary side. For PTs, apply a known voltage to the primary winding and measure the output on the secondary side. Compare the measured ratio with the nameplate specifications.

Polarity Check: Verify the polarity of the CT or PT by injecting a unidirectional current or voltage and checking if the output is in the expected direction. Polarity is essential for correct phasing and directionality of the measured quantities.

Burden Measurement: Measure the burden (load) of the CT or PT by connecting an appropriate load resistor or instrument. Ensure that the burden does not exceed the rated limits specified by the manufacturer.

Excitation Curve Test: Perform an excitation curve test to determine the magnetizing characteristics of the CT or PT. This involves progressively increasing the primary current or voltage and measuring the corresponding secondary output. Plot the excitation curve to assess linearity and saturation characteristics.

Accuracy Test: Conduct an accuracy test by injecting known primary currents or voltages of different magnitudes and comparing the measured secondary values with the expected values. Calculate the accuracy class or accuracy percentage based on the deviation from the reference values.

Phase Shift Measurement: Measure the phase shift between the primary and secondary currents or voltages. This can be done using a phase-angle meter or a vector analyzer. Compare the measured phase shift with the specified values.

Saturation Test: Determine the saturation characteristics of the CT or PT by gradually increasing the primary current or voltage until the output reaches a saturation point. Measure the corresponding secondary output and note the saturation limits.

Insulation Test: Perform insulation resistance tests to ensure the integrity of the insulation between windings and terminals. Use a megger or insulation resistance tester to measure insulation resistance and verify it against the specified limits.

Report and Documentation: Document all test results, including measured values, deviations, and any abnormalities observed during the tests. Prepare a comprehensive report that summarizes the overall performance and condition of the CTs and PTs.

It's important to note that the specific procedures may vary based on the standards, equipment, and specific requirements of the laboratory or testing facility. Always follow the manufacturer's instructions and adhere to safety guidelines while performing any tests on CTs and PTs.

Class2 on Local &p; Back-up Protection

A lab session on Local and Back-up Protection typically involves practical exercises to understand and demonstrate the functioning and coordination of local and back-up protection schemes in electrical power systems. Here's an outline of the key aspects you can cover during the lab session:

Introduction: Begin the session with a brief overview of local and back-up protection principles and their significance in power system protection. Explain the concept of primary and secondary protection and their roles in detecting and isolating faults.

Lab Setup: Set up a simplified power system model using simulation software or hardware equipment. The model should include generators, transformers, transmission lines, and distribution feeders.

Local Protection Exercise: Start by implementing local protection schemes for different components of the power system, such as generators, transformers, and transmission lines. Configure appropriate relays and protective devices based on the characteristics and requirements of each component.

Fault Injection: Introduce various fault scenarios, such as short circuits, line-to-ground faults, phase-to-phase faults, and overcurrent conditions, at different locations within the power system model. Simulate faults using the software or apply fault currents using hardware setups.

Local Protection Verification: Observe and analyze the response of the local protection devices to the injected faults. Verify if the relays correctly detect and isolate the faults by initiating appropriate tripping actions. Discuss the operating principles and settings of the relays and ensure their coordination within the local protection scheme.

Coordination Analysis: Evaluate the coordination between local protection devices in the system. Analyze the time-current characteristic curves of the protective relays to ensure proper discrimination and selectivity. Identify any instances of miscoordination or false tripping and propose adjustments to relay settings to improve coordination.

Back-up Protection Exercise: Introduce the concept of back-up protection and its role in providing secondary protection to clear faults that are not detected or isolated by local protection schemes. Configure and install appropriate back-up protection relays and devices in the power system model.

Fault Simulation and Analysis: Repeat the fault injection process for different fault scenarios, including faults that were not successfully cleared by the local protection schemes. Observe and analyze the response of the back-up protection devices to these faults. Verify if the back-up protection operates within the appropriate time and clears the fault effectively.

Coordination Analysis: Perform a coordination study between the local and back-up protection devices. Ensure that the back-up protection only operates if the local protection fails to clear the fault. Adjust the settings of the back-up relays, if necessary, to improve coordination and minimize false tripping.

Documentation and Analysis: Document the observed results, fault responses, coordination analysis, and any necessary adjustments made to the protection settings. Discuss the implications of the findings and the importance of maintaining coordinated and reliable protection schemes in power systems.

Q&A and Discussion: Conclude the lab session with a question-and-answer session and open discussion to address any queries or concerns raised by the participants. Encourage participants to share their experiences and insights related to local and back-up protection.

Remember to prioritize safety during the lab session by following appropriate protocols and guidelines for working with electrical systems and equipment.

Class 3 on Protection Schemes

A lab session on Protection Schemes aims to provide practical experience and understanding of different protection schemes used in electrical power systems. Here's a step-by-step guide for conducting a lab session on protection schemes:

Introduction: Begin by explaining the importance of protection schemes in power systems and their role in detecting and isolating faults to ensure system reliability. Discuss the various types of protection schemes commonly used, such as overcurrent protection, differential protection, distance protection, and others.

Lab Setup: Set up a simplified power system model using simulation software or hardware equipment. The model should include generators, transformers, transmission lines, and distribution feeders. Ensure that the protective relays and devices are properly configured and connected to the system.

Overcurrent Protection Scheme: Start with the implementation of an overcurrent protection scheme for feeders or distribution lines. Configure appropriate overcurrent relays and set their current pickup and time delay settings. Test the protection scheme by injecting fault currents at different locations and observing the response of the relays.

Differential Protection Scheme: Move on to the implementation of a differential protection scheme for transformers or generators. Configure differential relays and connect current transformers or voltage transformers appropriately. Verify the proper operation of the differential protection scheme by injecting fault currents or simulating internal faults.

Distance Protection Scheme: Proceed with the implementation of a distance protection scheme for transmission lines. Configure distance relays and set their reach and impedance settings. Test the distance protection scheme by injecting faults at different distances from the relays and analyzing the relay response.

Directional Protection Scheme: Introduce directional protection schemes, such as directional overcurrent or directional power protection. Configure appropriate relays and set the directional elements. Verify the proper operation of the directional protection scheme by injecting faults in different directions and observing the relay response.

Pilot Protection Scheme: Implement a pilot protection scheme, such as a line differential protection scheme or a pilot wire protection scheme. Configure the relays and ensure proper communication between the relays using pilot wires or communication channels. Test the pilot protection scheme by simulating faults and analyzing the relay responses and coordination.

Fault Analysis and Coordination: Analyze the response of the different protection schemes during fault conditions. Evaluate the coordination between various protection schemes to ensure proper discrimination and selectivity. Make necessary adjustments to relay settings, time delays, or reach settings to improve coordination if required.

Documentation and Analysis: Document the observed results, fault responses, coordination analysis, and any necessary adjustments made to the protection settings. Discuss the findings and the importance of proper protection coordination and scheme selection for reliable system operation.

Q&A and Discussion: Conclude the lab session with a question-and-answer session and open discussion to address any queries or concerns raised by the participants. Encourage participants to share their experiences and insights related to protection schemes.

Throughout the lab session, prioritize safety by following appropriate protocols and guidelines for working with electrical systems and equipment. Emphasize the importance of correctly configuring and testing the protective relays to ensure the safety and reliability of power systems.