DAY 1

Principals and Types of Corrosion

- Introduction to Principles of Corrosion
- Corrosion Cycle
- Kinetics of the Corrosion Reaction
- Electrochemical Reactions
- Anodic and Cathodic Reactions
- Galvanic Series
- Corrosion Rates
- Materials of Construction, Types and Properties of Steel

- Forms of Corrosion
  - Uniform Corrosion
  - Bimetallic Corrosion
  - Pitting Corrosion
  - Concentration Cell Corrosion
  - Stress Corrosion Cracking
  - Erosion Corrosion
  - Corrosion and Fatigue

DAY 2

Types of Cathodic Protection

- Pipe-to-soil potentials: electrodes, electrode placement, pipe line connection, surface potential survey for corrosion, pipe-to-soil potential as a criterion of Cathodic Protection

- Resistivity of Soils
  - Resistivity units, types of soil, area surveys, two-terminal and four-terminal resistivity determination

- Potential Surveys
  - Pipe-to-soil potentials: electrodes, electrode placement, pipe line connection, surface potential survey for corrosion, pipe-to-soil potential as a criterion of Cathodic Protection

- Line Currents
    - Measurement of line current in test section, current requirements, stray-current studies, long-line currents, Cathodic Protection tests, IR tests, current distribution and attenuation

DAY 3

Concrete Corrosion

- Defects in Concrete Structures
- Corrosion Process in Concrete Structures
- Concrete System Corrosion Timeline
- Influence of the Environment
- Macro-cell Corrosion of Steel Reinforcement
- pH Levels and Alkalinity of Concrete
- Influence of Hydroxides
- Influence of Aggressive Agents and Solutions, Carbon Dioxide, Sea Water, etc.
- Carbonation
- Chloride Contamination
- Chloride Limits for Various Types of Concrete Systems, Reinforced, Pre-stressed, etc.
- Penetration of Concrete Structures
- Porosity and Permeability
- Corrosion Induced Cracking of Concrete

DAY 4

Principals of Cathodic Protection

- Cathodic Protection Systems, Ground Beds and Installation
    - Types, Permanent and Temporary Ground Beds, Design, Installation and Applications, Galvanic (Sacrificial) Anode and Impressed Current Cathodic Protection Systems, Ground beds and Installation, Galvanic Anodes Connection to Structure, Galvanic Anode Test Station Location and Function

    - Types of Impressed Current Anode Beds, Impressed Current Cathodic Protection Systems, Distributed Impressed Current Cathodic Protection Systems, Impressed Current Rectifier Installation, Impressed Current Test Station

    - Connecting Cables

- Cathodic Protection Problems, Hazards, safety and Control
    - Detecting and Control of Interference, Anode Bed Location, Direct Bonding, Resistive Bonding, Non-Conductive Barrier, Stray currents, Interference of Foreign Lines with Insulating Joints
- Cathodic Protection of Port Infrastructures, Pipelines, Storage Tanks, Concrete, etc.
- Anode Types and Beds
- Pipe Coatings
    - Types of Coatings, Metallic Coatings, Polymer Coatings, Fusion Bonded Epoxy, Coating Efficiency
- Coating Inspection and Testing
    - Construction Inspection, Coating or Leakage Conductance, Coating Tests, Pipe Coating Holiday (loss of coating) Inspection Methods
- Cathodic Protection Interference
    - Stray-current, Sources and Detection of Stray Currents, Crossing Bonds, Auxiliary Drainage, Foreign Lines, Secondary Exposure, Basic Solutions

DAY 5

Rehabilitation and Cathodic Protection of Concrete Structures

- Rehabilitation and Cathodic Protection of Concrete Structures
    - Sacrificial Concrete Anode Systems and Anode Mesh Systems
    - Thermal Spray Anodes
    - Reinforced Steel Coatings
    - Repair and Rehabilitation of Concrete
    - Identify Rehabilitation Alternatives
    - Relevant Standards
- Concrete Survey Methods
    - Determining Possible causes of Failure
    - Preliminary and Detailed Inspections
    - Delamination Survey

    - Core Extraction and Testing
    - Nondestructive Testing of to Determine Concrete Cracks
    - Crack Survey
    - Pachometer (Cover) Survey
    - Chloride Content Determination
    - Moisture Content Determination
    - Half-cell Potential
- CATHODIC PROTECTION Maintenance and Monitoring Techniques
    - Pipe and Coating Monitoring, Pearson Surveys, Close Interval Potential Survey (CIPS) technique, Direct Current Voltage Gradient (DCVG) Technique, Signal Attenuation Coating (SAC) Survey

- Equations and Mathematical Calculations of Cathodic Protection
    - Group exercises and worked example for the determination and mathematical calculation of, current required, circuit resistance, rectifier voltage, type and number of anodes, life cycle cost and expectancy