DIGITAL PROTECTION OF POWER SYSTEM

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INTENDED AUDIENCE : Post graduate students of all IITs, NITs, State Colleges, deemed universities and affiliated colleges.

INDUSTRIES APPLICABLE TO : L&T, ABB, Siemens, SEL, etc

COURSE OUTLINE :

It aims to give a comprehensive up to date presentation of the fundamentals of digital relays, concept of digital signal processing used in digital relays and various algorithms utilized in digital/numerical relays. It begins with a state of the art survey of theories and methods of digital/numeric relays and phasor measurement units (PMUs) along with IEC 61850 substation and automation protocols. This course bridges the gap between the theoretical advances, experimental validations and practical engineering in real life. Aim of this course is to educate the reader and help the student to realize that many of the problems that will be faced in practice will require careful analysis, consideration and some approximations.

ABOUT INSTRUCTOR :

Prof. Bhaveshkumar R. Bhalja is working as a Professor, Department of Electrical Engineering, Indian Institute of Technology (IIT) Roorkee, Roorkee, India. He has a teaching experience of more than 20 years. He has published more than 150 papers in journals at international and national levels. He received Fulbright Nehru Academic and Professional Excellence Fellowships and worked as a visiting scholar at the Department of Electrical and Computer Engineering, Texas A & M University, College Station, Texas, US for a period of 9 months in 2018 19 in the area of “Fault Detection using Synchrophasor.

COURSE PLAN :

Week 1: Introduction of digital relays; Fundamentals of digital relays.

Week 2: Estimation of phasors using Full cycle Discrete Fourier Transform (DFT); Estimation of phasors using Half cycle DFT and introduction of Discrete Cosine Transform; Estimation of phasors using Walsh function technique and Least Error Square technique; Estimation of frequency in digital relays and practical considerations for selection of various algorithms; Digital Differential Protection of Generator, Induction motors and Busbar.

Week 3: Digital Differential Protection of Transformers; Digital Directional/Non directional Overcurrent and Earth fault relays; Overcurrent relay coordination in an interconnected power system network: LINKNET structure and determination of primary/backup relay pairs; Overcurrent relay coordination in an interconnected power system network: Example; Problems faced by digital distance relays.

Week 4: Computation of direction and impedance for digital distance relays; Power swing detection and blocking technique in digital distance Relays; Protection of double circuit transmission line using digital distance relays; Protection of multi terminal transmission line using digital distance relays; Protection of series compensated transmission line using digital distance relays: Basic components.

Week 5: Protection of Series compensated transmission line using digital distance relays: Voltage/current inversion and sub synchronous oscillations and additional transients; Load shedding and Frequency relaying: Various load shedding techniques and frequency relays; Load shedding and Frequency relaying: Factors to be considered and rate of frequency decline; Islanding phenomena: Hazards and risk of islanding and methods of islanding; Loss of existing protection coordination among protective devices: Recloser Fuse coordination for DG interfaced Distribution network.

Week 6: Hardware in loop testing of an islanding detection technique; Protection of dc microgrid: Review and challenges; AC microgrid protection;Insight in to hybrid ac dc microgrid protection; Application of travelling wave (TW) and wavelet transform (WT) based algorithm.

Week 7: Application of artificial intelligence (AI) in digital relaying.

Week 8: Introduction to IEC 61850 standard for substation automation and relay interoperabilit.