

## EE 515: SYNCHROPHASOR TECHNOLOGY (3-0-0: 3)

### Introduction

Basic architecture; basic principles for wide area monitoring and control in real-time; dynamic modeling of synchronous generator; transient stability monitoring and control; small signal monitoring and control

### Characterization of Phasor

Fourier concepts and applications; sampling data and aliasing; phasor estimation of nominal frequency inputs; phasor estimation of off-nominal frequency inputs, single phase, multiphase, unbalanced systems, sequence components estimation

### Frequency Estimation

Historical overview; balanced three phase inputs; unbalanced inputs; non-linear frequency estimators; advanced frequency measurement techniques

### Phasor Measurement Units (PMU) and Phasor Data Concentrators

Generic PMU, global positioning system, phasor measurement systems, communication system for PMU's, functional requirements for PMU's and PDC's

### Phasor Measurement Applications

Synchrophasor applications in power system protection and emergency control; optimal placement of phasor measurement units; Real-time monitoring and control of voltage stability

### Suggested List of experiments:

1. Study of open source PMU
2. Study of open source PDC
3. Study of synchronized phasor format according to standards
4. Implementation of DFT based phasor estimator to estimate phasor of a given signal
5. Implementation of DFT based phasor estimator to estimate frequency of a given signal
6. Implementation of recursive phasor estimator based on DFT method
7. Implementation of an algorithm for Optimal placement of PMU
8. Study of TMS 6678 digital signal processor kit
9. Development of generic PMU using DSP kit
10. Testing of generic PMU using DSP kit under fault environment

### Text Books & References:

1. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer.
  2. M. Shadidehpour and Y. Wang, "Communication and Control in Electric Power System", Wiley.
  3. P. Kundur, "Power System Stability and Control", Tata McGraw Hill.
  4. P. M. Anderson and A. A. Fouad, "Power System Control and Stability", Wiley.
  5. H. D. Chiang, "Direct Methods for Stability Analysis of Electric Power Systems: Theoretical Foundation, BCU Methodologies, and Applications", Wiley.
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