EPE 900- Signal Processing for Modern Power Systems

Course Code EPE 900	Credit Hours (Th-Pr) 3.0-0	**Signal Processing for Modern Power Systems**	Contact Hrs/Week (Th-Pr) 3.0-0	Total Contact Hrs (Th-Pr) 45-0

Background

1. Give brief rundown of the existing programme:
   a. Having a special relation to modern power systems and emerging smart grids, this course provides clear and comprehensive explanation of how Digital Signal Processing (DSP) and Computational Intelligence (CI) techniques can be applied to solve problems in the power system. Its unique coverage bridges the gap between DSP, electrical power and energy engineering systems, showing many different techniques applied to typical and expected system conditions with practical power system examples. Surveying all recent advances on DSP for power systems, this course enables engineers and researchers to understand the current state of the art and to develop new tools. It presents:
      (1) an overview on the power system and electric signals, with description of the basic concepts of DSP commonly found in power system problems
      (2) the application of several signal processing tools to problems, looking at power signal estimation and decomposition, pattern recognition techniques, detection of the power system signal variations
      (3) description of DSP in relation to measurements, power quality, monitoring, protection and control, and wide area monitoring.

Rationale

2. Rationale for offering/launching the new course.
   a. With rapid transformation of existing grid into modern one, signal processing has become an integral component of modern power systems. With this aim, this course will allow the learners to become aware and skillful of practical signal processing knowledge in order to enhance their abilities as a researcher. The course directly focuses on:
      (1) Providing a broader view of signal processing in power system applications
      (2) Challenges to implement processing into conventional grids.
      (3) Smart monitoring and metering

(4) Signal processing for net metering applications

Educational Objectives

3. Objectives of the programme under which the proposed course will be conducted

   a. The objectives of “Signal Processing for Modern Power Systems” course are:

      (1) To impart the advance understanding of signal processing in electric power system

      (2) To discuss the nature of recorded faults in a power system

      (3) To discuss different types of steady state and transient power signals

      (4) To introduce role of DSP to provide measurement, monitoring and protection solutions

Input Obtained from Industry/Corporate Sector/Subject Specialists/Academia

4. Relevant input will be obtained in CRC from subject/Academia specialist from Industry.

International Practice

5. Specify the universities of repute where the proposed course is being conducted.

   a. Colorado State University
   b. Tampere University of Technology
   c. University of Electronic Science and Technology of China

Proposed Timeframe of Commencement

6. Specifying semester with year.

   Fall-2018

Course Contents

7. Give details of the course, on the following lines:

   a. Course Code: EEE 900
   b. Title: Signal Processing for Modern Power Systems
   c. Credit Hours: 03
   d. Objectives (Repetition: Same as educational objectives)

   The objectives of “Signal Processing for Modern Power Systems” course are:

(1) To impart the advance understanding of signal processing in electric power system
(2) To discuss the nature of recorded faults in a power system
(3) To discuss different types of power signals
(4) To introduce role of DSP to provide measurement, monitoring and protection solutions

e. Outcomes

By the end of this course students will be able :

(1) To comprehend the advanced understanding of signal processing in electric power system
(2) To exercise and work on the nature of recorded faults in a power system
(3) To apply DSP to provide measurement, monitoring and protection solutions
(4) To understand the nature of recorded faults in a power system
(5) To comprehend various types of power signals
(6) To utilize DSP methods to provide measurement, monitoring and protection solutions

f. Contents with suggested contact hours

No.	Topics	Book	Contact Hours
1.	**Introduction to Signal processing for Power grid** • The Future Grid • Motivation and Objectives • Signal Processing Framework • **Power Systems and Signal Processing** o Dynamic Overvoltage o Fault Current and DC Component o Voltage Fluctuations o Transients in Transformers	PF	8
2.	**Transducers and Acquisition Systems** • Voltage Transformers (VTs) • Capacitor Voltage Transformers • Current Transformers	PF	6

	• Non-Conventional Transducers • Analog-to-Digital Conversion Processing • Supervision and Control • Mathematical Model for Noise • Sampling for Power System Application • Smart-Grid Context		
3.	**Basic Power Systems Signal Processing** • Fourier transform, DFT and z-Transform • Linear and Time-Invariant Systems • Frequency Response of LTI System • Linear Phase FIR Filter • Basic Digital System and Power System Applications • Parametric Filters in Power System Applications • Parametric Notch FIR Filters • Filter Design using MATLAB1 (FIR and IIR) • Sine and Cosine FIR Filters	PF	12
4.	**Estimation of Electrical Parameters** • Estimation Theory • Least-Squares Estimator (LSE) • Frequency Estimation • Phasor Estimation • Phasor Estimation in Presence of DC Component	PF	8
5.	**Spectral Estimation and Time-Frequency Signal Decomposition** • Windows • Interpolation in Frequency Domain: Multitone Signal • Interharmonics • Interharmonic Detection and Estimation Based on IEC Standard • Parametric Methods for Spectral Estimation	PF	6

	• Short-Time Fourier Transform • Sliding Window DFT • Filter Banks • Wavelet • Application of Wavelets for Time-Varying Generation and Load Profiles		
6.	**Detection** • Why Signal Detection for Electric Power Systems? • Typical Experimental Setup • Detection of Disturbances in Power Systems • Examples	PF	5
	Total		45

g. Details of lab work, workshops practice (if applicable).

Lab work assignments and small projects will complement the course work.

h. Recommended Reading (including Textbooks and Reference books).