

UWIG/NREL Industry-University Workshop on Power Engineering Needs for the Wind Industry

Session III – New Power Engineers: Prognosis and Needs

May 7, 2008

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Meteorology and Atmospheric Physics

- Planetary boundary layer theory and applications.
- Turbulence characterization.
- Performance prediction, forecasting and atmospheric modeling.
- Meso scale and synoptic scale modeling.
- Micrositing, wake analysis and propagation.
- Meteorological sensors and operation in ongoing atmospheric conditions.

Aerodynamic Design

- Knowledge of aerodynamics of airfoils and airfoil design.
- Knowledge of rotary wing aerodynamics, specifically blade element momentum theory, vortex theory, and unsteady aerodynamics.
- Knowledge of tools such as XFOIL, blade element momentum theory codes. Examples of such tools are PropID, WT_Perf.
- Courses in computational fluid dynamics (CFD) and exposure to the use of CFD tools.

Loads and Dynamics Analysis

- Knowledge of wind turbine aerodynamics and dynamics of rotating wing systems.
- Coursework in vibration and aeroelasticity.
- Practical coursework with loads analysis software tools such as ADAMS, BLADED, SIMPACK and DADS.
- Knowledge of latest multi-body dynamics modeling.

Control System

- Coursework in control system design with basic knowledge of PID controller, open and closed loop control system, and stability of controls system.
- Practical knowledge of using tools such as MATLAB and Simulink.
- Capability to develop turbine simulation models.
- Knowledge of Modern Control Theory: State Space Control, State Machine Development, Estimation Theory.
- Wind plant control and supervisory controls and data acquisition systems.
- Condition-based monitoring systems and reliability and quality control.

Electronics Engineers

- Wide range of Analog and Digital Circuit Design.
- Microprocessor and Microcontroller design for industrial control systems.
- Circuit board layout knowledge and experience including high-speed layout techniques, controlled-impedance layout techniques and EMI/EMC reduction.
- Programmable Logic Controller design and experience for use in industrial controls.
- Industrial control system design including ladder-logic language knowledge, motor starter design and protection.
- Good knowledge of grounding, bonding, and transient over voltage techniques including optical isolation.
- Wide range of communication theory knowledge including fiber optic hardware. Applications include serial communication including RS-232, RS-485, RS-422, Ethernet and Fiber serial communication techniques.

Software Engineers

- Knowledge of both Intel and Motorola type microcontroller and microprocessor styles.
- Knowledge of Algorithm development and translation to a machine code level including Laplace transforms.
- Programming language knowledge including Ladder Logic, Basic, C, and assembly language.
- Good knowledge of communication theory and application including Serial, ProFi bus, CAN bus, Fiber, TCP-IP, Ethernet and other standard protocols.

Blade Design and Composites

- Coursework in statics, dynamics and strength of materials.
- Finite element analysis courses with projects in tools such as NASTRAN, Ansys and Cosmos.
- Courses on composite materials and analysis of composite materials using finite element tools.
- Knowledge of material testing and verification of composite material properties.

Mechanical Design

- Design of drivetrain including analysis of static and fatigue analysis of gears.
- Design and analysis of bearings for pitch and yaw bearing design.
- Coursework in strength of materials and analysis of structures in finite element tools such as NASTRAN and Ansys.
- Thermal management, cooling and heating utilizing CFD and FEA techniques.

Power Systems

- Electric machine development synchronous, asynchronous, DFIG, etc.
- Traditional power system issues such as transmission, distribution and Balance of Plant.
- Power electronics, conversion design and controls including: 6,12 and 24 pulse rectification using IGBTs, SCRs, IGCTs, and other switching devices.
- Understand electrical codes and requirements for US and international applications.
- High power and current XFMR and indicator designs.
- Low, medium and high voltage equipment.

Civil Structure

- Soil testing and foundation designs.
- Larger tower systems, development and optimization.
- Concrete structures and foundation.