**ECET 590 Special Topics in Electrical and Computer Engineering Technology**

**(Electrical Systems, Electronics, Signal Processing, Sensors, and Instrumentation for Medical, Clinical and Healthcare Applications)**

**Spring 2012**

**Activities & Assessment**

* Weekly Study Report and briefing, 40%
* Research proposal , mid-term, 20%
* Final research report with possibly for Conference Paper presentation at, 40%
	+ IEEE Medicine and Biology Society, <http://embs.org/>
	+ Others

**Study and Research Topics**

1. Power Systems for Medical Applications and Related Electrical Safety

* Distribution of Electric Power
	+ NEC code
	+ UL
	+ IEC 60601-1
	+ Bed (NEMA 5-15P, NEMA 5-20P, medical grade; movable, transport patient), COT (ambulance testing, automotive testing, medical testing: vibration test, with person, crash test): (automation, testing, EMC testing – person interference, absorbing cell phone)
	+ Wireless power
		- Standards
		- Wireless power consortium: QI Interface (wirelesspowerconsortium.com)
			* AC => DC => Power electronic (switching) => RF => transmit
			* 5 – 30 mW
				+ => Rectified => saved on Cap => Battery => Inverter => AC
			* QI 5W to 120W wireless power
		- Max power
		- FCC
		- Medical Apps
			* UL
			* New, no standard?
			* IEC ?
* Macro-shock Hazards
	+ Current I = X mA?
	+ UL dictated, uA
		- Patient contact
		- User contact
		- Surface
		- Invasive
	+ Pace maker?
	+ Insulation of wires, material, dielectric, leakage current
	+ Human body resistance couple to ground
* Micro-shock Hazards
	+ Combined with Macro, different types of devices
	+ IEC60601 - diagrams
* Electrical Safety Codes and Standards
* Best Practices to Protect Against Shock
	+ Warning signs – user manuals
	+ System built-in?
	+ Excellent grounding
	+ Sensor => High Impedance
		- Body mass (measure from left feet => right foot): signal monitoring
* Power Distribution Subsystem Protection
	+ Circuit breaker
	+ Medical equipment
	+ Power monitoring (current limit; over load, over current protection)
	+ Switching mode power system (resist brown-out, overvoltage): 80 v – 260 v, 50 Hz to 60 Hz
* Equipment Design and Protection
	+ IEC60601
* Electrical Safety Analyzers
	+ Insulation (Mega Ohm meter)
	+ Dielectric Meter
	+ Grounding Z meter
	+ Functional test
	+ EMC test
	+ Radiated and conducted emission testing
* Testing Electrical System
* Tests of Electrical Appliances
* Power supply system reliability
	+ Standard?
	+ 60601
	+ Medical grade power supply
	+ Hospital backup power
		- UPS
		- Modified sine wave (power transformer, Harmonics)
		- Generator – pure sine wave

Risk analysis of ? all parts of medical equipment

* Instruction
* Components
* Functions
* Standard for Risk Analysis
* ISO 14971 – Application of Risk Management to Medical Devices
* Risk Assessment Technique – ISO 31010
1. Power Electronics for Medical Applications
* Diode
* Transistor
* FET
* IGBT
* Others
1. Analog Electronics and Analog Signal Processing for Medical Applications
	* Systems (1st, 2nd order systems)
	* Amplifiers (Inverting, Noninverting, Differential amplifiers, comparators)
	* Frequency Responses
	* Filters (Low pass, high pass, others)
	* Timers
	* A/D
	* D/A
	* Computer Hardware/Software
	* Display devices
	* Record devices
2. Sensors for Medical Applications
3. Bio and Medical Instrumentation

EMC Compatability

Tera Hetz => Human body (full image scanner, see bones and internal organs)

References

* **IEEE spectrum**
* **IEEE transactions on information technology in biomedicine**
* **IEEE engineering in medicine and biology magazine**
* **IEEE instrumentation & measurement magazine**
* **IEEE power & energy magazine**
* **IEEE signal processing magazine**
* **IEEE transactions on biomedical circuits and systems**
* **IEEE transactions on biomedical engineering**
* **IEEE transactions on neural systems and rehabilitation engineering**
* **IEEE transactions on dielectrics and electrical insulation**
* **IEEE transactions on energy conversion**
* **IEEE transactions on instrumentation and measurement**
* **IEEE transactions on man-machine systems**
* **IEEE transactions on medical imaging**
* **IEEE transactions on visualization and computer graphics**
* **IEEE transactions on multimedia**
* **IEEE transactions on nanobioscience**
* **IEEE transactions on nanotechnology**
* **IEEE transactions on power delivery**
* **IEEE wireless communications**
* **IEEE transactions on ultrasonics, ferroelectrics, and frequency control**