Subject: **Biosignals and Bioinstrumentation**

Summary: This exam will evaluate the student's undergraduate and junior graduate knowledge of modeling and analysis of biological signals, and concepts and principles of biomedical measurement and instrumentation. The ability to model neuromuscular biological signals is expected, as is fundamental knowledge of signal processing (time/frequency domain analysis, adaptive filtering, and denoising) as it relates to biosignals. This exam also covers the measurement of biopotentials, fluid flow, and pressure, as well as clinical laboratory analysis methods. Fundamental knowledge of human anatomy and physiology and electrical safety as they relate to instrumentation will also be covered.

Keywords

- Biopotentials (resting membrane potentials, action potentials, ENG, EMG, ECG, EEG, MEG)
- Time domain, frequency domain, and time-frequency analysis
- Denoising methods, including filtering and adaptive systems
- Modelling of biological signals including subthreshold phenomena, active behavior of cell membranes, and innervation processes
- Measurement of biological signals, including electrode effects
- Cardiovascular and pulmonary system: basic anatomy and physiology
- Biopotential amplifiers
- Blood pressure and sound
- Measurement of flow and volume of blood
- Measurement of respiratory system
- Thermal measurements (thermocouples, thermistors)
- Electrical safety
- Noise and artifacts (e.g., electromagnetic interference, motion artifact)