King Saud University
College of Applied Medical Sciences
Biomedical Technology Department

BMT225: Measurements in Biomedical Instruments 2 (1-1-0)

Current Instructor: Eng. Emad Ameen and Dr. Mohammed Al-Mijalli
Course Coordinator: Dr. Mohammed Al-Mijalli
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Textbook(s) and/or Other Required Materials: Measurement and Instrumentation Principles, Alan S. Morris

Course Description (catalog): this course covers an introductory material to electrical measurements including measurement units, measurement system applications, elements of a measurement system, instrument types and performance characteristics ,accuracy and inaccuracy (measurement uncertainty), precision/repeatability/reproducibility, tolerance, sensitivity of measurement, threshold, resolution, statistical analysis of measurements subject to random errors, and graphical data analysis techniques – frequency distributions.

Prerequisites: BMT 211
Co-requisite: None
Course Type: Mandatory

Course Learning Outcomes: The global content of the course will help student:
- Understand the field of electrical measurements and how is this affect the biomedical equipment's measurements
- Understand the related measurements terms
- Develop a capability of investigate the instrument characteristics.

Student Outcomes Covered by Course:
a. an ability to select and apply the knowledge, techniques, skills, and modern tools of biomedical technology to include the application of circuit analysis, analog and digital electronics, microcomputers, biomechanics, biomedical instrumentation systems, and safety in the building, testing, operation, and maintenance of biomedical equipment.
Students apply knowledge and skills of measurement system applications, elements of a measurement system, instrument types and performance characteristics.

b. an ability to select and apply a knowledge of mathematics, chemistry, physics, and biological sciences, engineering, and technology to building, testing, operation, and maintenance of biomedical equipment and the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of biomedical systems.
Students apply knowledge and skills of mathematics for different problem solving regarding finding the response and performance characteristics of a measurement system with application to biomedical equipment

c. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.
In laboratory, students develop capabilities in conducting various measurement experiments that will enable them to understand the theory concepts regarding different measuring technique

d. an ability to analyze, design, and implement biomedical systems, components or processes for broadly-defined engineering technology problems appropriate to program educational objective.
e. an ability to function effectively as a member or leader on a technical team.

f. an ability to identify, analyze, and solve broadly-defined biomedical technology problems.

g. an ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature.
h. an understanding of the need for and an ability to engage in self-directed continuing professional development.
i. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.

j. a knowledge of the impact of engineering technology solutions in a societal and global context and an understanding of the clinical application of biomedical equipment.

k. a commitment to quality, timeliness, and continuous improvement.

Major Topics covered and schedule in weeks:

- Introduction to measurement, Measurement units, Measurement system applications, Elements of a measurement system, Choosing appropriate measuring instruments
- Instrument types and performance Characteristics, Review of instrument types, Null-type and deflection-type instruments, Analogue and digital instruments, Indicating instruments and instruments with a Signal output
- Accuracy and inaccuracy (measurement uncertainty), Precision/repeatability/reproducibility, Tolerance, Sensitivity of measurement, Threshold, Resolution, Errors during the measurement process, Sources of systematic error
- System disturbance due to measurement, Errors due to environmental inputs, Wear in instrument components, Reduction of systematic errors, Careful instrument design, Calibration, Random errors, Statistical analysis of measurements subject to random errors
- Graphical data analysis techniques – frequency distributions, Calibration of measuring sensors and Instruments, Principles of calibration, Control of calibration environment, Calibration records
- Analogue meters, Moving-coil meters, Moving-iron meter, Electro-dynamic meters
- Bridge circuits, Null-type, D.C. bridge (Wheatstone bridge), Deflection-type DC. Bridge, A.C bridges, Resistance measurement, D.C bridge circuit
- Voltmeter–ammeter method, Resistance-substitution method, Use of the digital voltmeter to measure resistance, ohmmeter
- Codes for resistor values, Inductance measurement, Capacitance measurement, The Wien Bridge
- Sensor technologies, Capacitive and resistive sensors, Magnetic sensors, Hall-effect sensors, Piezoelectric transducers, Strain gauges, Piezo-resistive sensors, Temperature measurement, Pressure measurement