King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 452: Measurements and Lab Project

Catalogue Description: (0-3-1)
Basic instrumentation and measurements in conducting the experiments -such as force, displacement, pressure, temperature, humidity, fluid level, fluid velocity, and flow rate, etc. Output signals, computerized data acquisition systems. Last 5 lab sessions will be devoted to group projects to integrate the knowledge in developing experimental system and experimental strategy (in ME 451 and ME452) in any of the following area: vibration analysis and condition monitoring, thermo-fluid, manufacturing processes, materials testing, and characterization, or industry. Projects will be planned by course instructors a head of time (semester prior to teaching) in collaboration with other (Guest) faculty member or specialist from industry). The projects will be assigned at the beginning of the course.

Status in Curriculum (Required or Elective): Required (offered Fall & Spring)

Prerequisites: None

Co-requisites: ME 451

Textbook: **None**

References:

1. **Measurement and Instrumentation: Theory and Application, Alan S. Morris and Reza Langari, Elsevier, 2012.**
2. **Theory and Design for Mechanical Measurements**, 5th Edition, Richard S. Figliola and Donald E. Beasley, John Wiley & Sons, Inc. 2011.
3. **Experimental Methods for Engineers, by Holman, J. P., McGraw Hill, 2011.**

Coordinator: **Dr. Atia E. Khalifa,** AssistantProfessor of Mechanical Engineering

Goals: (general objectives)
The course introduces basics of experimental design and measurement techniques in different major areas related to mechanical engineering. The student will practice real experiments in order to improve his critical thinking and hands-on experience in experimental measurements and to enhance the students' skills in designing an experiment based on clear objectives, select the appropriate instrumentations, construct laboratory setups and installation of measuring devices, perform calibration of different sensors, use of data acquisition systems and labview software, data analysis and post-processing. The last three or four lab sessions will be devoted to student team work in course projects to integrate the knowledge in developing experimental design and measurements.

Course Outline (Lab Topics):
1-Introduction: Engineering Experimentation, Design of Experiment, Strategy of Experimentation, Planning, Conducting & Analyzing an Experiment (one week).
2- **Uncertainty Analysis:** Introduction to uncertainty and error analysis of experimental data: causes and types of experimental errors (one week).
3- **Calibration of measuring systems:** Calibration of different sensors and exercise using mechatronic boards (one week).
4- **Data acquisition and Labview Software:** Introduction and application to Data acquisition and labview software with exercises (two weeks)
5- **Lab sessions and exercises:** conducting different experimental techniques in different ME labs, Including vibration measurements, Strain measurements; Temperature measurements and heat transfer, Pressure measurements, and Flow measurements (sex weeks).
6- **Lab projects:** Course projects are announced early for students (at least 4 weeks before the end of the semester) . Last 2 to 3 weeks are reserved for students to apply the knowledge on a real measurement problem. The project includes the design of experiment, setup assembly and/or construction, and calibration of sensors, data acquisition using labview, data analysis, and reporting (three weeks).

Design Activities/Projects:
Design of experiments, setups, sensors selection, wiring, and calibration, data acquisition and analysis.

Computer Usage:

Data acquisition and analysis and related homework/case studies require the use of labview software Students are encouraged to use any of the major statistics and DOE packages.

Laboratory:

Different labs are used in the course including computer lab, vibration lab, dynamics lab, material science lab, heat transfer lab, pumping machinery lab, heat engine lab, and fluid mechanics lab.

Assessment Tools:

i- Attendance and Participation
ii- Lab Reports and assignments
iii- Midterm Exam
iv- Lab Project

Course Learning Outcomes:

I- The student should understand and apply the basic concepts related to design of experiments.
II- 2. The student should demonstrate the ability to select and match different components in measuring system for accurate measurements.
III- 3. The student should learn how to calibrate sensors and other related components.
IV- 4. The student should use Labview software to acquire, record, and analyze experimental data.
V- 5. Students should be able to perform uncertainty and error analysis with the validation of the results.
VI- 6. The students will be able to learn the team work, reports writing, and presentation skills

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
Course-to-Student outcome mapping	I, II, V, VI	I, II, III, IV, V, VI	VI	I, VI	VI	VI	VI	I, II		II, IV, VI	II, III, IV, VI
Emphasis*	**L**	S	**M**	S	**L**	L	L	L	L	L	S

* **L**: Little/None **M**: Moderate **S**: Strong

Status of Continuous Improvement review of this Course:

Prepared by: Dr. Atia Khalifa **Date prepared:** March 2015
Reviewed by: **Date reviewed:**