

ME 632 Mechanical Engineering Measurements

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Textbook: J. P. Holman, Experimental Methods for Engineers, 7th Ed., McGraw Hill, 2001

References: R. J. Goldstein, Fluid Mechanics Measurements, Hemisphere Pub., 1983

Course Description:

Mechanical Engineering Measurements is aimed to enhance the graduate education with extensive mechanical engineering lab experience, including the learning of basic measurement principles, conducting basic lab experiments, performing data analysis, and writing professional engineering reports. The topics cover basic measurement theories and technologies in major mechanical engineering areas including thermodynamics, thermofluids, and control. Some specialized experiments with significant industrial application background will also be included. Comparison of various measurement techniques for the measurement objective and comparison of experimental results against theoretical predictions or computational results are also required.

Course Prerequisite: first-degree in engineering or physics; or consent of course lecturers

1. Experiment Arrangement

Group 1 (thermofluids)	Flow Measurements in Pipe Flows and Jets	
	Temperature Measurements in Jet Cooling and Heat Exchangers	
Group 2 (thermodynamics)	System Performance of Engine Cycle (Gasoline Engine or Diesel Engine)	
	System Performance of Vapor-compression Cycle (A/C)	
Group 3 (control)	Pneumatic Actuator Control by PLC (Programmable Logic Control)	
	Feedback Control by PIDC (Proportional, Integral, Differential Control)	
Group 4 (special topics)	Fluidization/Dynamic stresses by collision	Self-defined Lab Project
	Turbine Characteristics (Pump systems)	

2. Lecture Arrangement

- 1) Introduction to ME Measurement
 - Course structure & requirement
 - Lab report format
 - Sensor characteristics
 - Uncertainty analysis of a (ME) system
- 2) Basic Flow Measurement
 - Flow visualization
 - Flow-rate measurement
 - Flow velocity measurement
 - Flow friction measurement

- 3) Heat Exchanger Characteristics
 - Temperature measurement
 - Co-axial tubular heat exchanger
- 4) Data Analysis & Lab Report Requirements of Group-1 Experiments
 - Flow Measurements in Pipe Flows & Jets
 - Temperature Measurements in Jet Cooling and Heat Exchangers
- 5) Thermodynamic Cycles
 - Engine cycle (Otto-cycle: gasoline engine & Diesel-cycle: diesel engine)
 - Vapor-compression cycle (A/C)
- 6) Data Analysis & Lab Report Requirements of Group-2 Experiments
 - System Performance of Engine Cycle (Gasoline Engine or Diesel Engine)
 - System Performance of Vapor-compression Cycle (A/C)
- 7) PLC
 - System configuration
 - Ladder Logic Diagram
- 8) Feed-back Control (PID)
 - Transfer function and block diagram
 - Controller design
- 9) Data Analysis & Lab Report Requirements of Group-3 Experiments
- 10) Gas-Solid Fluidization
 - Geldart classification
 - Fluidization characteristics
- 11) Turbine Characteristics (Pumps)
 - Single pump
 - Pumps in series or parallel
 - Operation with flow systems
- 12) Data Analysis & Lab Report Requirements of Group-4 Experiments
 - Fluidization
 - Characteristics of Pumps

3. Weekly Arrangement

Week	Content	
1-3	Lectures of Group 1	Group-1
4	Labs of Group-1	
5-6	Lectures of Group 2	Group-2
7	Labs of Group-2	
8	Midterm	
9-10	Lectures of Group 3	Group-3

11	Lab Group-3	
12	Lecture of Group 4	Group-4
13	Labs of Group-4	
14	Review for Final	

Grading Policy

(1) Grade Calculations

50% Lab Reports (3; 10% each) and Lab abstracts (4; 5% each)

- Lab attendance is a must for each lab experiment! More than 1-hour delay is considered as absence.
- Makeup may be allowed, with TA's supervision (\$20/hour for TA's supervision as personal tutorship).

10% Class Attendance (14)

- Class attendance is required. More than 30-min delay will be considered as absence.

10% Homework (4; 2.5% each)

15% Mid-term Examination (1)

15% Final Examination (1)

Final Grade is based on the total grade.

In general, above 90% guarantees an "A" grade and below 60% will result in an "F" grade.

(2) Lab Report Requirement

All reports should be individually completed and submitted in time. Group discussion is encouraged but not for "Group Report". For identical reports or very similar reports, the grade is divided by the number of students involved. Resubmitted Lab report is accepted (final grade will be averaged with the original grade).

(3) Homework Requirement

- (a) Four Assignments will be given, with 4-6 problems per assignment,
- (b) Late & revised submission will be accepted, with a 50% grade deduction.
- (c) Homework grade is based on "efforts".

(4) Mid-term/Final Exam Requirement

- (a) A 1.5 hour mid-term exam will be given, mainly covering topics on Data Analysis Methods & Group 1.
- (b) A 2.5-hour final exam will be given, mainly covering topics of Data Analysis Methods & Groups 2&3.