## ME 343-003 Mechanical Laboratory I Spring 2025; ME 214 Lab

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**Textbook:** J. P. Holman, Experimental Methods for Engineers, 8<sup>th</sup> Edition, McGraw Hill, 2011

## **Course Content**

Topic	Reading Assignment	Key concepts	
Introduction;	2.7, 3.2-3.9, 3.11-3.14, Notes	Random and precision errors; Least square method;	
Data analysis	1, 4	Uncertainty analysis	
Linear and Rotation Speed	Note 3	Cross-correlation theory; Oscilloscope applications	
Measurements		Lab abstract writing	
Signal Conditioning	4.12, 14.3	RC filtration; Power spectrum; Digital filtration	
Temperature measurements	8.5,8.6, 8.8, 8.9, 2.7	Thermocouple; thermo-resistance; pyrometers	
	Notes 3; 5	Full lab report writing	
Force and Torque	10.3-10.8	Strain-stress relationship; strain gage; Wheatstone bridge;	
Measurements (Strain gage)	Notes 6-7; supplements	Force and deformation of elastic collisions	
Programmable Logic Control	Note 9; supplements	PLC, Ladder logic diagram	
Flowrate & Velocity	7.3, 7.4, 7.6, 7.13	Venturi, orifice & rotameter; Pitot tube, LDV and PIV; Flow	
Measurements	Note 8; supplements	visualization	
Acoustics	11.5; Note 10	Sound pressure level (dB); Attenuation	

**Course Arrangement** 

Introduction; Chap 3   Random data statistics; regression method   Random data statistics; regression method   Rotation speed;   HW#1   Random error, least square regression	Week	Lecture/Lab: Tuesday: 6:00 PM – 100 PM in MEC 214					
Random data statistics; regression method  Linear and rotation speed measurements; Lab abstract requirement of rotation speed  Measurement of rotation speed  Measurement of Temperature and Characteristics of Sensor  Mid-term  Stress & strain; strain gage: Chap 10  Spring Break  Measurement of Mechanical Stress using Boned Strain Gages  Measurement of Visualization of Flow  Plow rate: Chap 7 Measurement of Visualization of Flow  Plow rate: Chap 7 Measurement of Visualization of Flow  Plow rate: Chap 7 Measurement of Visualization of Flow  Lab 7  Measurement of Visualization of Flow  Lab 8  Rotation speed;  HW#1  Rotation speed;  HW#2  RC Filtration  Lab 1  HW#2  RC Filtration  Lab 2  RC Filtration  HW#3  Temperature  Lab 2 RC Filtration  HW#3  Flowrater  HW#3  Lab 3 Temperature  Lab 3 Temperature  HW#4  Flow rate  Lab 4 Strain gage & Dynamic force  HW#4  HW#4  Lab 4 Strain gage & dynamic force  HW#4  Lab 4 Strain gage & dynamic force  HW#5  Flow rate  Lab 4 Strain gage & dynamic force  HW#5  Flow rate  Lab 5 Flowrate  HW # 5  Flowrate  Lab 5 Flowrate  Lab 5 Flowrate  Lab 5 Flowrate  Lab 5 Flowrate  Lab 5 Flowrate  Lab 5 Flowrate  Lab 6 Flow accounting of PLC Controllers and Applications  Acoustics: Chap 11; Measurement of Acoustic Response		Topic	HW/Lab	Topic	Due (Thursday class)		
abstract requirement of rotation speed  3 Uncertainty analysis; Chap 3 HW#2 RC Filtration  4 Signal Conditioning by RC Filter and Characteristics Analysis  5 Thermometry: Chap 8, Chap 2 HW#3 Temperature  6 Measurement of Temperature and Characteristics of Sensor  7 Mid-term  8 Stress & strain; strain gage: Chap 10 HW#4  9 Spring Break  10 Measurement of Mechanical Stress using Boned Strain Gages  11 Wellness Day  12 Flow rate: Chap 7 Measurement of Visualization of Flow  13 Flow rate: Chap 7 Measurement of Visualization of Flow  14 Control Theory (PLC) Understanding of PLC Controllers and Applications  15 Acoustics: Chap 11; Measurement of Acoustic Response  16 Review  8 RC Filtration  Lab 1 HW#2  RC Filtration  Lab 2 Temperature  Lab 2 RC Filtration  HW#3  Temperature  HW#3  Temperature  HW#3  Temperature  HW#3  Temperature  HW#4  Flow attain Gage & Dynamic force  HW#4  Flow rate  Lab 3 Temperature  HW#4  HW#4  Flow rate  Lab 4 Strain gage & dynamic force  HW#5  Flow rate  Lab 4 Strain gage & dynamic force  HW#5  Flow rate  Lab 5 Flowrate  HW # 5  HW# 6 and  Applications  Flow  HW# 6 Flow  HW# 6 PLC Controller	1		HW#1	, , , , , , , , , , , , , , , , , , ,	-		
4 Signal Conditioning by RC Filter and Characteristics Analysis  5 Thermometry: Chap 8, Chap 2 HW#3 Temperature  6 Measurement of Temperature and Characteristics of Sensor  7 Mid-term  8 Stress & strain; strain gage: Chap 10 HW#4  9 Spring Break  10 Measurement of Mechanical Stress using Boned Strain Gages  11 Wellness Day  12 Flow rate: Chap 7 Measurement of Visualization of Flow  13 Flow rate: Chap 7 Measurement of Visualization of Flow  14 Control Theory (PLC) Understanding of PLC Controllers and Applications  15 Acoustics: Chap 11; Measurement of Acoustic Response  16 Review  HW#2  HW#3  Temperature  HW#3  Temperature  HW#3  Strain gage & Dynamic force  HW#4  Strain gage & Dynamic force  HW#4  Flow rate  Lab 4 Strain gage & dynamic force  HW#5  Flow rate  Lab-5 Flowrate  HW# 6 and Lab #6  Applications  Flow  HW# 6 and Lab #6  Acoustics: Chap 11; Measurement of Acoustic Response	2	•	Lab-1	Rotation speed;	HW#1		
Characteristics Analysis  Thermometry: Chap 8, Chap 2  HW#3  Temperature  Lab 2 RC Filtration  Measurement of Temperature and Characteristics of Sensor  Mid-term  Stress & strain; strain gage: Chap 10  Spring Break  Measurement of Mechanical Stress using Boned Strain Gages  Wellness Day  Flow rate: Chap 7 Measurement of Visualization of Flow  HW#5  Flow rate: Chap 7 Measurement of Visualization of Flow  Measurement of Visualization of Flow  HW#6 and Lab 5  Control Theory (PLC) Understanding of PLC Controllers and Applications  Acoustics: Chap 11; Measurement of Acoustic Response  Review  Backup  - Lab 2 RC Filtration  HW#3  Temperature  HW#3  Lab 3 Temperature  Lab 4 Strain gage & Dynamic force  HW#4  Lab 4 Strain gage & dynamic force  HW#5  Flow rate Lab 4 Strain gage & Lab 4 Strain gage & Lab 4 Strain gage & dynamic force  Lab 5 Flowrate  HW # 5  HW#6 and Lab #6  Applications  Flow  HW#6 PLC Controller  HW 6 PLC Controller	3	Uncertainty analysis; Chap 3	HW#2	RC Filtration	Lab 1		
6 Measurement of Temperature and Characteristics of Sensor  7 Mid-term  8 Stress & strain; strain gage: Chap 10 HW#4  9 Spring Break  10 Measurement of Mechanical Stress using Boned Strain Gages  11 Wellness Day  12 Flow rate: Chap 7 HW#5 Flow rate  13 Flow rate: Chap 7 Lab-5 Flowrate  14 Control Theory (PLC)  Understanding of PLC Controllers and Applications  15 Acoustics: Chap 11; Measurement of Acoustic Response  16 Review  Mid-term  Mid-term  Mid-term  Lab-3 Strain gage & Lab 3 Temperature  Dynamic force  HW#4  Lab-4 Flow rate  Lab 4 Strain gage & dynamic force  Lab 5 Flow rate  Lab 4 Strain gage & dynamic force  Lab-5 Flowrate  HW # 5  HW # 6 and PLC  Lab 5 Flowrate  HW 6 PLC Controller  HW 6 PLC Controller	4		Lab-2		HW#2		
Characteristics of Sensor  Mid-term  Stress & strain; strain gage: Chap 10  Spring Break  Measurement of Mechanical Stress using Boned Strain Gages  HW#4  Strain gage & Dynamic force  HW#4  Wellness Day  Flow rate: Chap 7 HW#5  Measurement of Visualization of Flow  Flow rate: Chap 7 HW#5  Measurement of Visualization of Flow  HW#5  Flow rate  Lab 4 Strain gage & dynamic force  Lab 4 Strain gage & dynamic force  HW#5  Flow rate  Lab 5 Flowrate  HW # 5  HW # 5  Flowrate  Lab 5 Flowrate  HW # 5  Flowrate  Lab 5 Flowrate  Lab 6  Applications  Flow  HW 6 PLC Controller  HW 6 PLC Controller  Flow  HW 6 PLC Controller  Lab # 7	5	Thermometry: Chap 8, Chap 2	HW#3	Temperature	Lab 2 RC Filtration		
8 Stress & strain; strain gage: Chap 10 HW#4 9 Spring Break 10 Measurement of Mechanical Stress using Boned Strain Gages 11 Wellness Day 12 Flow rate: Chap 7 HW#5 Flow rate Lab 4 Strain gage & dynamic force 13 Flow rate: Chap 7 HW#5 Flow rate 14 Control Theory (PLC) HW# 6 and Applications 15 Acoustics: Chap 11; Measurement of Acoustic Response 16 Review Backup - Lab 3 Temperature  Strain gage & Lab 3 Temperature  HW#4  Strain gage & Dynamic force  HW#4  HW#4  Lab 4 Strain gage & dynamic force  HW#5 Flow rate  Lab 4 Strain gage & dynamic force  HW# 5  HW# 6 and PLC  Lab 5 Flowrate  HW# 6 PLC Controller	6	*	Lab-3	Temperature	HW#3		
9 Spring Break 10 Measurement of Mechanical Stress using Boned Strain Gages 11 Wellness Day 12 Flow rate: Chap 7 HW#5 Flow rate 13 Flow rate: Chap 7 Lab-5 Flowrate 14 Control Theory (PLC) HW# 6 and Applications 15 Acoustics: Chap 11; Lab7 Flow 16 Review 17 Strain gage & Dynamic force 18 Dynamic force 19 HW#4  HW#4  HW#4  HW#4  HW#4  HW#4  Lab 4 Strain gage & dynamic force  HW#5 Flow rate  Lab 4 Strain gage & dynamic force  HW#5  HW#5 Flow rate  Lab 4 Strain gage & Dynamic force  HW#4  HW#5  Flow rate  Lab 4 Strain gage & Dynamic force  HW#4  HW#4  HW#4  HW#4  Lab 4 Strain gage & Dynamic force  HW#4  HW#4  HW#4  Lab 4 Strain gage & Dynamic force  HW#4  HW#4  Lab 4 Strain gage & Dynamic force  HW#4  HW#4  Lab 4 Strain gage & Dynamic force  HW#4  HW#4  Lab 4 Strain gage & Dynamic force  HW#4  HW#4  Lab 4 Strain gage & Dynamic force  HW#4  HW#4  Lab 4 Strain gage & Dynamic force  HW#5  HW#5  Flow rate Lab 4 Strain gage & Dynamic force  HW#5  HW#6  Advantage & Dynamic force  HW#5  Flow rate Lab 4 Strain gage & Dynamic force  HW#5  HW#6  HW#6	7	Mid-term		Mid-term			
9 Spring Break 10 Measurement of Mechanical Stress using Boned Strain Gages 11 Wellness Day 12 Flow rate: Chap 7 HW#5 Flow rate Lab 4 Strain gage & dynamic force 13 Flow rate: Chap 7 Lab-5 Flowrate HW # 5  14 Control Theory (PLC) HW# 6 and Applications 15 Acoustics: Chap 11; Lab 7 Flow HW 6 PLC Controllers and Applications 16 Review Backup - Lab # 7	8	Stress & strain; strain gage: Chap 10	HW#4	Strain gaga fr	Lab 3 Temperature		
Measurement of Mechanical Stress using Boned Strain Gages   Lab-4   HW#4	9	Spring Break					
11 Wellness Day  12 Flow rate: Chap 7 Measurement of Visualization of Flow  13 Flow rate: Chap 7 Measurement of Visualization of Flow  14 Control Theory (PLC) Understanding of PLC Controllers and Applications  15 Acoustics: Chap 11; Measurement of Acoustic Response  16 Review  HW#5 Flow rate Lab 4 Strain gage & dynamic force  HW# 5  HW# 6 and PLC Lab 5 Flowrate  Lab 4 Flow HW# 5  HW# 6 and Lab #6  Lab #6  HW# 6 PLC Controller  Lab 7  Lab 7  Lab 7  Lab 7  Lab # 7	10		Lab-4	Dynamic force	HW#4		
Measurement of Visualization of Flow  Flow rate: Chap 7  Measurement of Visualization of Flow  Lab-5  Flowrate  HW # 5  Measurement of Visualization of Flow  14  Control Theory (PLC)  Understanding of PLC Controllers and Applications  15  Acoustics: Chap 11;  Measurement of Acoustic Response  16  Review  Review  Measurement of Acoustic Response  Measurement of Acoustic Response  Lab # 7  Measurement of Acoustic Response	11	Wellness Day					
Measurement of Visualization of Flow  14 Control Theory (PLC) Understanding of PLC Controllers and Applications  15 Acoustics: Chap 11; Measurement of Acoustic Response  16 Review  HW# 6 and PLC Lab 5 Flowrate  Lab #6  HW 6 PLC Controller  Flow HW 6 PLC Controller  Lab # 7	12	•	HW#5	Flow rate			
Understanding of PLC Controllers and Applications  Lab #6  Acoustics: Chap 11; Lab7 Flow HW 6 PLC Controller Measurement of Acoustic Response  Review Backup - Lab # 7	13	-	Lab-5	Flowrate	HW # 5		
Measurement of Acoustic Response  16 Review Backup - Lab # 7	14	Understanding of PLC Controllers and		PLC	Lab 5 Flowrate		
	15	Acoustics: Chap 11;	Lab7	Flow	HW 6 PLC Controller		
	16	Review	_	-	Lab # 7		

## **Tentative Schedule of ME 343 Spring 2025 Semester**

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Week	Tuesday	Due	
1	01/23 1st Lecture		
2	1/30 (lab-1)	HW-1	
3	$02/06 - 2^{\text{nd}}$ Lecture	Lab-1	
4	02/13- (lab-2)	HW-2	
5	02/20 3rd Lecture	Lab-2	
6	02/27 (lab-3)	HW-3	
7	03/06 (Mid Term)	-	
8	03/13 4 <sup>th</sup> Lecture	Lab-3	
9	03/20 Spring Break		
10	03/27 Lab 4	HW-4	
11	04/03 Wellness Day	-	
12	04/10 5 <sup>th</sup> Lecture	Lab-4	
13	04/17 5 <sup>th</sup> Lab	HW -5	
14	04/24 6 <sup>th</sup> lecture &	Lab-5	
	Lab 6		
15	05/01 7 <sup>th</sup> lecture &	HW 6 and Lab 6	
	Lab 7		
16	05/06 (backup)	Lab-7 & all re-sub	
17	05/15 (Final Exam)		