Engineering Program

Specialty	**Instrumentation and Process Control**
Course Number	**20306221**
Course Title	**Flow and Temperature Measurements**
Credit Hours	**3**
Theoretical Hours	**3**
Practical Hours	**0**

Brief Course Description:

- The course includes the study of differential pressure and variable area method flow meter. Different types of flow meters. Basic concepts of temperature scales units, measuring methods and devices like TC, RTD, Bimetallic, thermocouple, semiconductor and filled system thermometers.

Course Objectives:

Upon the completion of the course, the student will be able to:

1. Select the most appropriate flow meter for the given task.
2. Connect and commission the selected flow meter.
3. Troubleshoot and maintain the flow meter.
4. Carry out the required simple calculations.
5. Identify different temperature scales and carry out the necessary conversion between them.
6. Distinguish between the different temperature measurement principles and different temperature measurement equipment.

Detailed Course Description:

Unit Number	Unit Name	Unit Content	Time Needed
1.	**Basic theory of flow**	▪ Basic units and definitions ▪ Flow rate equation for incompressible fluids ▪ Flow rate equation for compressible fluids ▪ Applications of Bernoulli equation ▪ Classification of flow measurement methods	
2.	**Differential pressure methods of flow measurement**	▪ Practical hints for the measurement of fluid flow rate by differential pressure flow meters ▪ Flow measurement by differential pressure device installed outside the pipeline ▪ Flow measurement for dirt-laden fluids	
3.	**Variable area flow meters**	▪ General ▪ Basic theory of the ratemeters ▪ Construction of the ratemeters and their applications	
4.	**Volume flowmeters Magnetic flow meters**	▪ Rotary meters for liquids ▪ Rotary rate meters for liquids ▪ Magnetic flow meters	
5.	**Anemometers and anubars**	▪ Introduction ▪ Mechanical anemometers. ▪ Hot wire and hot-film anemometers ▪ Anubars	

6.	**Thermometry**	▪ Introduction ▪ Temperature and temperature scales ▪ Practical temperature scales ▪ Classification of temperature measurement methods contacts methods, non contact methods, electrical and non-electrical methods, and radiation methods	
7.		▪ Liquid-in-glass and filled-system thermometers. Liquid in glass thermometers. Liquids used in thermometers. Laboratory and industrial thermometers. Thermometers that include an electrical contact. Filled system thermometers. Gas filled and vapour filled thermometers. Correction for changes in bulb volume	
8.		▪ Solid-expansion and bimetal thermometers – solid-expansion thermometers. The coefficient of linear expansion of the solid materials. Bimetallic thermometers in control system. Bimetallic thermostats	
9.	**Resistance and semiconductor thermometers**	▪ Introduction. Platinum and copper resistance thermometers ▪ Semiconductor resistance thermometers ▪ Thermister, its characteristics, and its applications in temperature measurement and	

		control ▪ Electrical circuit for detection temperature	
10.	**Thermoelectric thermometry**	▪ Connection of a measuring instrument in a thermocouple circuit ▪ Basic Principle of thermocouple (peltier, seebic and Thomson effects) ▪ Intermediate metals and compensating leads ▪ Intermediate temperature ▪ Measuring of the differential temperature using thermocouples ▪ Measurement of the average temperature using the thermocouple	
11.	**Pyrometry**	▪ Principles of radiation ▪ The optical pyrometers ▪ The infrared pyrometers ▪ Photon detector temperature instruments	

Evaluation Strategies:

Exams		Percentage	Date
Exams	First Exam	20%	--/--/----
	Second Exam	20%	--/--/----
	Final Exam	50%	--/--/----
Homework and Projects		10%	
Discussions and lecture Presentations			

Teaching Methodology:

❖ Lectures

❖ **تطبق هذه الخطة الدراسية اعتباراً من بداية العام الجامعي 2009/2008**

Text Books & References:

1. Instrumentation for Engineering Measurement, James W. Dally, William F. Rilcy, Kenneth Gmacnnell, 2nd edition John willy and sons. Inc 1993.
2. Measurements and Instrumentation in Heat Engineering Volume. Mir. Publishers. Moscow 1980.
3. Fundamentals of Temperature, Pressure and Flow measurements by Rebert, p. Ben dict, Jul 1984, amazon.com sealer.

Program Engineering

Specialty	**Instrumentation and Process Control**
Course Number	**20306222**
Course Title	**Flow and Temperature Measurements Lab**
Credit Hours	**1**
Theoretical Hours	**0**
Practical Hours	**3**

Brief Course Description:

- The practical activity includes the study of different methods to measure flow and temperature such as RTD, Thermocouple, Thermistor, Rotameters, Vinturi tubes, Orifice plates and optical sensing propeller flow meter.

Course Objectives:

Upon the completion of the course, the student will be able to:

1. Troubleshoot flow meters and carry out the necessary repair or maintenance.
2. Carry out the necessary calibration using the available standard flow meters.
3. Troubleshoot temperature measurement and temperature control circuits and devices.
4. Carry out the required calibrations of the measuring devices.

Detailed Course Description:

Unit Number	Unit Name	Unit Content	Time Needed
1.	**Flow rate through the vinturi tubes**	▪ The student shall assemble the network with the necessary measuring equipment to measure the defferented pressure and the recovery ratio of the pressure	
2.	**Flow rate through the orifice plates**	▪ The student shall fix the different types of orifice plates and realize the differential pressure up stream and down stream	
3.	**Optical Sensing Propeller flow meter**	▪ An impeller placed in the flow stream will be rotated with a velocity proportional to the flow rate. Using optical transducer the impeller shall be calibrated directly for flow rate	
4.	**Rotameters**	▪ Study the construction of different rotemeters. Connect the Rotameter in a pipe network. Carry the necessary check and cleaning for the Rotameter needle valve	
5.	**Capillary bulb Thermostatic Controller**	▪ The experiment illustrates the use of capillary bulb thermostat to control temperature	
6.		▪ Adjustable bi-metallic strip thermostatic controller with anticipatory	
7.	**Thermocouple**	▪ A practical study of the principles of thermocouples and practical study of a two-metal	

		junction as a temperature indicator	
8.	**Thermistor**	▪ The experiment includes the study of the behavior of negative temperature coefficient resistor and its application in the design of practical measurement systems	
9.	**The RTDs**	▪ The experiment includes the practical study of the behaviour of a positive temperature coefficient resistance as a temperature measuring device	
10.	**On-off Temperature Control (Hall-Effect).**	▪ The experiment illustrates the use of hall-effect thermostatic type in the control of temperature	

Evaluation Strategies:

Exams		Percentage	Date
Exams	Reports	30%	--/--/----
	Midterm Exam	20%	--/--/----
	Final Exam	50%	--/--/----

Teaching Methodology:

- ❖ Laboratory

Text Books & References:

1. Systems Laboratory manuals of experiments, JJ instruments SL 40, SL 20. England
2. Teknikit technology tutor, Feed back instruments Kit 3.