Course-Plan

School: **Engineering**
Department: **Energy**
Course Code: **EN 530**
Course Title: **Instrumentation and Control for Energy Systems**

Instructor: P. K. Choudhury

1. Abstract:

This course presents the instrumentation and control techniques which are usually required in field of energy system studies. This course deals with the background knowledge of principles of measurements and errors in the context of energy systems. An overview of applications of electronics and microcontroller in control systems as well as software intervention is also presented. Some of the typical measuring and control instruments related to energy systems are discussed. The objective of this course is to provide the students from different discipline a better foundation in instrumentation as well as control system in the context of energy system studies.

2. Objective:

The primary objectives of this course are outlined as below.

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a) To give an overview of measurements principles as well as requirements and functioning of sensors, signal conditioning and data acquisition systems
b) To illustrate the basic control system principles, application of microcontroller in monitoring and control of process/ parameters and hardware and software interfacing
c) To explain the working of typical monitoring and control instruments/devices used in energy system studies

3. Course Outcomes:

CO1: Explain components of instrumentation and control systems
CO2: Analyse monitoring, signal conditioning and control circuits
CO3: Develop micro controller programmes for sensing and triggering events

4. Prerequisites of the course:

This course is an elective course and second semester students of MTech. in Energy Technology programme can opt to register for this course.

5. Course outline

Unit	Topic	Learning Objectives
Unit 1	Introduction	To understand the basics of instrumentation and control systems, types, components and characteristics
Unit 2	Sensor and transducers	To understand the types, characteristics and typical applications of sensors and transducers
Unit 3	Introduction to Control Systems	To understand the basics of control systems, Feedback and non-feedback systems and their applications Transfer function, block diagram representation and reduction techniques
Unit 4	Signal conditioning	To understand the features of operational amplifier typical application circuits- inverter, adder, substractor , multiplier and divider Analogue /digital/analogue conversion techniques
Unit 5	Data Acquisition Systems	To understand the working principles and applications of Single Channel and multi-channel A/D converter, Digital data processing and display
Unit 6	Microcontrollers and compilers	To understand the basics of microcontroller and use in energy conservation and management and programming, typical microcontroller applications for monitoring and control of electrical and non–electrical parameters/processes

6. (a)Time-Plan

Tentative Lectures	Topic to be covered	No. of classes
1-6	**Introduction** 1. Course overview 2. Principles of measurements and measurement errors 3. Classification of instruments 4. static and dynamic characteristics 5. Input output configurations of measurement system	**6**
7-12	**Sensor and transducers** 1. Types, characteristics and applications of Mechanical transducers 2. Types, characteristics and applications of electrical transducers 3. Principles of Modern sensors and typical applications	**6**
13-18	**Introduction to Control Systems** 1. Overview of control systems 2. Feedback and non-feedback systems and their applications 3. Transfer function 4. block diagram representation and reduction techniques	**6**
19-24	**Signal conditioning** 1. Operational amplifier types and characteristics 2. Application circuits- inverter, adder, substractor , multiplier and divider 3. Analog /digital/analog conversion techniques	**6**
25-30	**Data Acquisition Systems** 1. working principle and application of Single Channel A /D converter 2. Working principle and application of multi-channel A/D converter 3. Digital data processing and display	**6**
30-36	**Microcontrollers and compilers** 1. Overview of microcontroller, its use and programming 2. Use of compilers for data acquisition, processing and display 3. Typical microcontroller applications for monitoring and control of electrical and non–electrical parameters/processes	**6**
Total		**36**

(b) Evaluation plan

Tests	Type	Date*	Marks*	Time*
Test 1	Objective/ Quiz	6 – 9th April	25	45 min
Test 2 (Mid Term)	Descriptive/ Objective	6 – 12 May	40	2 hour
Test 3	Assignment/Seminar/Case study/ Objective/ Quiz	26 – 30th May	25	45 min
Test 4 (End Term)	Descriptive/ Objective	22 – 30th June	60	3 hour
Total Marks			**150**	

*** Exact Dates/Marks/Time will be as per Tezpur University academic calendar**

6. Pedagogy :

Apart from the theory classes students will also be given some practical oriented assignments. The objective of such assignments is to make the students familiar with the instrumentations/ control/ power electronics components related to integration of renewable energy systems.

Teaching-learning methods:

Teaching-learning methods to be used are

- Lecture and Discussion
- Assignment and Presentations
- Case studies
- Problem Solving

7. Expected outcome:

Towards the end of the course the student would be able to explain components of instrumentation and control systems, and develop micro controller programmes for sensing and triggering events in order to facilitate energy conservation and management.

8. Text Book

1. Morris A. S. (1998); Principles of Measurements and Instrumentation, Prentice Hall of India
2. Sawhney A. K. (2011); A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai

References

1. Bentley J. P. (2005); Principles of Measurement Systems, Fourth Edition, Pearson Prentice Hall
2. Jain R. P. (1998); Modern Digital Electronics, McGraw Hill
3. Gaonkar R. (2012); Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing
4. Raman C. S., Sharma G. R., and Mani V. S. V. (1983); Instrumentation Devices and systems, Tata McGraw Hill
5. Babu J. C. and Xavier S. E. (2004); Principles of Control Systems, S Chand and Co Ltd.

Program Outcomes, Course Outcomes and Assessment Criteria

EN 530 Instrumentation and Control for Energy Systems

CO1	Explain components of instrumentation and control systems
CO2	Analyse monitoring, signal conditioning and control circuits
CO3	Develop micro controller programmes for sensing and triggering events

Mapping	**PO1**	**CO1**		
	PO2		**CO2**	
	PO3			**CO3**

Course Outcomes	**Weightage (%)**	**Test I (25)**	**Mid Term Test (40)**	**Test II (25)**	**Sem End Exam (60)**	**Total (150)**
CO1	30	14	10		21	45
CO2	40	11	27		22	60
CO3	30		3	25	17	45
TOTAL	100	25	40	25	60	150

Assessment Criteria		**Marks distribution**					
Bloom Taxonomy	**Level**	**Marks Weightage (%)**	**Test I (25)**	**Mid Term Test (40)**	**Test II (25)**	**Semester End (60)**	**Total (150)**
Knowledge	Easy	10	4	6		5	15
Understanding	Easy	16.67	6	13		6	25
Application	Average	20	5	3		22	30
Analysis	Above average	18.67	5	13		10	28
Synthesis	Difficult	28	3	5	25	9	42
Evaluation	Difficult	6.67	2			8	10
TOTAL		**100**	**25**	**40**	**25**	**60**	**150**

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