CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EET468	INDUSTRIAL INSTRUMENTATION AND AUTOMATION	PEC	2	1	0	3

Preamble: This course introduces basic terms and techniques applicable to instrumentation and various automation activities related to the industry and power sector. It also provides a basic idea of the recent developments in communication techniques and process control in industrial automation.

Prerequisite : Basics of Analog and digital electronics, control systems

Course Outcomes : After the completion of the course, the student will be able to:

CO 1	Identify the sensors/transducers suitable for industrial applications.
CO 2	Design the signal conditioning circuits for industrial instrumentation and automation.
CO 3	Analyze the concepts of data transmission and virtual instrumentation related to automation
CO 4	Develop the logic for the process control applications using PLC programming
CO 5	Describe the fundamental concepts of DCS and SCADA systems

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1										2
CO 2	3	1										2
CO 3	3	1										2
CO 4	3	1										2
CO 5	3	1										2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	20
Understand (K2)	30	30	60
Apply (K3)	10	10	20
Analyse (K4)			
Evaluate (K5)	-	-	-
Create (K6)	-	-	-

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer anyone. Each question can have a maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain different characteristics of transducers (K2)
2. Selection of transducers for various applications (K2, K3)

Course Outcome 2 (CO2):

1. Explain amplifier circuits used for signal conditioning in instrumentation systems (K2)
2. Explain different types of actuators used in instrumentation system (K2)

Course Outcome 3 (CO3):

1. Explain the protocols used in data transmission for instrumentation system (K2)
2. Describe the differences between traditional instruments and virtual instruments (K2)

Course Outcome 4 (CO4):

1. Describe the hardware details of programmable logic controllers (K2)
2. Implement logic gates and simple operations using PLC (K2, K3)

Course Outcome 5 (CO5):

1. Explain the architecture and protocols involved in SCADA systems (K2)
2. Describe the architecture of Distributed Control Systems (K2)

Model Question Paper

QP CODE:

PAGES:2

Reg. No:_____
Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY EIGHTH SEMESTER
B. TECH DEGREE EXAMINATION,
MONTH & YEAR
Course Code: EET468

Course Name: INDUSTRIAL INSTRUMENTATION AND AUTOMATION

Max. Marks: 100 Duration: 3 Hours

PART A
Answer all questions. Each Question Carries 3 mark

1. State the factors to be considered while selecting a transducer for a specific application.
2. Explain different modes of operation of hotwire anemometer.
3. How can a log amplifier be used for signal conditioning?
4. Describe the working of electrical actuators
5. Compare Profibus and Fieldbus used in data transmission
6. List the advantages of virtual instrumentation systems
7. Implement basic gate operations using PLC ladder logic
8. Write a PLC program to obtain a delay of 10ms for process control
9. List the main components associated with SCADA Systems.
10. Explain different protocols used in SCADA communication

PART B
Answer any one full question from each module. Each question carries 14 marks.

Module 1

11. a) With the help of a diagram explain the process control loop. (10)
    b) Explain second order time response of sensor. (4)

12. a) Explain the principal and operation of variable reluctance tachometer (7)
    b) Discuss the working principle of Capacitive differential pressure measurement (7)

Module 2

13. a) Explain different types of actuators. (10)
    b) Explain the working principle of charge amplifier. (4)

14. a) Explain the operation of Instrumentation amplifier (7)
    b) How phase sensitive detectors can be employed for phase measurement. (7)

Module 3

15. a) Explain the architecture of Virtual instrumentation system (10)
    b) Describe the concept of graphical programming (4)

16. a) Explain the different types of communication networks used for data collection and control in industrial applications (10)

    b) Explain Field bus. (4)

Module 4

17. Devise a ladder program to switch on a pump for 100 s. It is then to be switched off , and a heater switched on for 50 s. Then the heater is switched off, and another pump is used to empty the water. (14)

18. Draw a block diagram of a PLC showing the main functional items and how buses link them, explaining the functions of each block (14)

Module 5

19. a) With neat diagram explain the architecture of Distributed control system (7)
    b) Describe in detail protocols for SCADA communication (7)

20. a) Explain role of MTU in SCADA communication (4)
    b) With neat diagram explain the architecture of SCADA system (10)

Syllabus		
Module	**Contents**	**Hours**
I	**Sensors and Transducers** Introduction to Process Control - block diagram of the process control loop, definition of elements. Sensor time response - first and second-order responses. Transducers- Characteristics and Choice of the transducer. Applications of Transducers- Displacement measurement using Resistance Potentiometer- Capacitive differential pressure measurement, Flow measurement using Hotwire anemometer, speed measurement- Variable reluctance tachometers, Phase measurement- Analog and digital	7
II	**Signal conditioning circuits and Final control** Electronic amplifiers-Differential Amplifier, Instrumentation Amplifiers, Precision rectifiers, Log amplifiers, Carrier Amplifiers, Lock-In Amplifiers, Isolation Amplifiers, Charge amplifiers, Phase-sensitive detectors. Final control operation- signal conversion- actuators- control elements, Actuators- Electrical – Pneumatic- Hydraulic, Control elements-mechanical- electrical- fluid valves	6
III	**Data transmission and Virtual instrumentation system** Cable transmission of analog and digital data, Fiber optic data transmission, Pneumatic transmission. Process control Network- Functions- General characteristics- Fieldbus and Profibus, radio-wireless communication, WLAN architecture. Virtual instrumentation system: The architecture of virtual instruments – Virtual instruments and traditional instruments – concepts of graphical programming	7
IV	**Programmable logic controllers (PLC)** Programmable logic controllers- Organization- Hardware details- I/O- Power supply- CPU- Standards Programming aspects- Ladder programming- realization of AND, OR logic, the concept of latching, Introduction to Timer/Counters, Exercises based on Timers and Counters.	7
V	**SCADA and DCS systems** **SCADA**: Introduction, SCADA Architecture, Common System Components, Supervision and Control, HMI, RTU and Supervisory Stations, Protocols-IEC 60870-5-101 and DNP3. **DCS:** Introduction, DCS Architecture, Control modes.	5

Text Books

1. Curtis D Johnson , “Process Control Instrumentation Technology”, PHI Learning Pvt Ltd New Delhi, 1997
2. Doeblin E.O, “Measurement Systems: Application and Design”, Fourth Edition, McGraw Hill, Newyork, 1992
3. DVS. Murty, “Transducers and Instrumentation”, Second Edition, PHI Learning Pvt Ltd New Delhi, 2013
4. Jovitha Jerome, “Virtual instrumentation using LabVIEW”, Prentice Hall of India, 2010.
5. William Bolton, “Programmable Logic Controllers”, Fifth edition, ELSEVIER INDIA Pvt Ltd New Delhi, 2011
6. Stuart A. Boyer, "SCADA: Supervisory Control and Data Acquisition", Fourth edition, International Society of Automation, 2010

References:

1. G.K.McMillan, ‘Process/Industrial Instrument and control and hand book’ McGraw Hill, New York,1999
2. Michael P .Lucas, ‘Distributed Control system’, Van Nastrant Reinhold Company, New York
3. Patranabis, D., ‘Principles of Industrial Instrumentation’, Second Edition Tata McGraw Hill Publishing Co. Ltd. New Delhi
4. Robert B. Northrop, ‘Introduction to instrumentation and measurements’, CRC, Taylor and Francis 2005

Course Contents and Lecture Schedule:

No	Topic	No. of Lectures
1	**Sensors and Transducers (07 hours)**	
1.1	Introduction to Process Control - block diagram of the process control loop, definition of elements. Sensor time response - first and second-order responses.	2
1.2	Transducers- Characteristics and Choice of transducer.	1
1.3	Applications of Transducers- Displacement measurement using Resistance Potentiometer- Capacitive differential pressure measurement	2
1.4	Flow measurement using Hotwire anemometer, speed measurement- Variable reluctance tachometers, Phase measurement- Analog and digital	2
2	**Signal conditioning circuits and Final control (06 hours)**	
2.1	Electronic amplifiers-Differential Amplifier, Instrumentation Amplifiers, Precision rectifiers, Log amplifiers, Carrier Amplifiers	2
2.2	Lock-In Amplifiers, Isolation Amplifiers, Charge amplifiers, Phase sensitive detectors	2

2.3	Final control operation- signal conversion- actuators- control elements Actuators- Electrical – Pneumatic- Hydraulic Control elements-mechanical- electrical- fluid valves	2
3	**Data transmission and Virtual instrumentation system(07Hours)**	
3.1	Cable transmission of analog and digital data, Fiber optic data transmission, Pneumatic transmission	2
3.2	Process control Network- Functions- General characteristics- Fieldbus and Profibus, radio and wireless communication and WLAN	2
3.3	Virtual instrumentation system: architecture of virtual instruments – Virtual instruments and traditional instruments – concepts of graphical programming	3
4	**Automation using PLC (07 Hours)**	
4.1	Programmable logic controllers- Introduction	1
4.2	Organisation and Hardware details - I/O- Power supply- CPU etc.	2
4.3	Standards Programming aspects- Ladder programming- realization of AND, OR logic, concept of latching,	2
4.4	Introduction to Timer/Counters, Exercises based on Timers and Counters	2
5	**Automation using SCADA and DCS Systems (05 Hours)**	
5.1	Introduction to SCADA, its Architecture and Common System Components	1
5.2	Supervision and Control, HMI, RTU and Supervisory Stations, Protocols-IEC 60870-5-101 and DNP3.	3
5.3	DCS: Introduction, DCS Architecture, Control modes.	1