

CODE	COURSE NAME	CATEGORY	L	T	P	CREDITS
EET384	INSTRUMENTATION AND AUTOMATION OF POWER PLANTS	VAC	3	1	0	4

**Preamble:** This course introduces measurements and instruments used in power plants. Automation of power plants and Supervisory control and data acquisition are also discussed.

**Prerequisite:** Introduction to Power Engineering/ Energy Systems

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

<b>CO 1</b>	Analyse different instruments used for measuring parameters in a power plant.
<b>CO 2</b>	Explain various control systems in power plants.
<b>CO 3</b>	Identify different components of SCADA for applications in power plants.

**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
<b>CO 1</b>	3	3										1
<b>CO 2</b>	3	3										1
<b>CO 3</b>	3	3										1

**Assessment Pattern**

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember (K1)	10	10	10
Understand (K2)	20	20	40
Apply (K3)	20	20	50
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 any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

### Course Level Assessment Questions

#### Course Outcome 1 (CO1):

1. Explain the working of a digital frequency meter (K2)
2. Explain the working of a radiation detector (K2)

#### Course Outcome 2 (CO2):

1. Compare the performance of boiler following mode and turbine following mode of operation in power plants. (K4).
2. Explain interlocks in boiler operation (K2).

#### Course Outcome 3 (CO3):

1. Discuss about the various SCADA architectures. Compare them.(K2, K3)
2. Explain the ladder logic approach of programming in a PLC(K2,).

### Model Question paper

#### QP CODE:

PAGES:2

Reg. No: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY  
SIXTH SEMESTER B.TECH DEGREE EXAMINATION,  
MONTH & YEAR  
Course Code: EET384**

**Course Name: INSTRUMENTATION AND AUTOMATION OF POWER PLANTS**

Max. Marks: 100

Duration: 3 Hours

#### PART A (3 x 10 = 30 Marks)

**Answer all Questions. Each question carries 3 Marks**

1. Explain briefly the working principle of an induction type wattmeter.
2. Discuss the role of dust monitor in power plants.
3. Write notes on temperature measurement techniques used in boilers?
4. Discuss how pedestal vibration is measured in boilers?
5. Explain what do you mean by co-ordinated control in boilers.
6. Discuss the role of distributed control system in a power plant.
7. List out the differences between RTUs and IEDs.

8. State the advantages and disadvantages of PLC.
9. Discuss the operating states of a power system.
10. Explain briefly what do you mean by Energy Management System.

**PART B (14 x 5 = 70 Marks)**

**Answer any one full question from each module. Each question carries 14 Marks**

**Module 1**

11. a. With the help of a neat diagram, explain the working of a digital frequency meter. (7)  
 b. Explain how the flow of feed water is measured in power plants. (7)
12. a. With the help of a neat sketch, explain the working of a power factor meter. (10)  
 b. Explain the working of a radiation detector. (4)

**Module 2**

13. a. Explain how flame monitoring is done in boilers. (6)  
 b. Discuss the pressure measuring devices in boilers. (7)
14. a. Describe with a neat schematic, how shaft vibration can be detected. (7)  
 b. Explain the working of a non contact type speed measuring device. (7)

**Module 3**

15. a. Explain the control of boiler drum level in power plant operation. (7)  
 b. Explain how steam temperature can be controlled in boilers. (7)
16. a. Compare the performance of boiler following mode and turbine following mode of operation in power plants. (7)  
 b. Explain interlocks in boiler operation. (7)

**Module 4**

17. a. Describe the basic components of a SCADA system. (4)  
 b. Describe the components of an IED. (4)  
 c. Explain the ladder logic approach of programming in a PLC (6)
18. a. Explain the objectives of SCADA. (4)  
 b. Discuss about the various SCADA architectures. Compare them. (10)

**Module 5**

19. a. Discuss the main requirements of an Energy Management System. (4)  
 b. With the help of a diagram, explain what do you understand by an EMS framework. (10)
20. Explain the applications of SCADA in generation operation and management. (14)

**Syllabus**

**Module 1**

Measurements in power plants: Electrical measurements – current, voltage, power, frequency, power factor etc. – non electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor.

**Module 2**

Measurement in boiler and turbine: Metal temperature measurement in boilers, piping. System for pressure measuring devices - smoke and dust monitor - flame monitoring. Introduction to turbine supervising system - pedestal vibration - shaft vibration - eccentricity measurement. Installation of non-contracting transducers for speed measurement.

**Module 3**

Controls in boilers: Boiler drum level measurement methods - feed water control - soot blowing operation - steam temperature control - Coordinated control - boiler following mode operation - turbine following mode operation - selection between boiler and turbine following modes. Distributed control system in power plants interlocks in boiler operation - Cooling system - Automatic turbine runs up systems.

**Module 4**

Introduction to SCADA systems: - Elements of a SCADA system - benefits of SCADA system - SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system

SCADA System Components: - Remote Terminal Unit-(RTU), Intelligent Electronic Devices (IED) - PLC: Block diagram, Ladder diagram, Functional block diagram, Applications, Interfacing of PLC with SCADA.

**Module 5**

SCADA Applications: □ Operating states of a power system - Energy management System (EMS) – EMS framework – Generation operation and management – Load forecasting – unit commitment – hydrothermal co-ordination – Real time economic dispatch and reserve monitoring – real time automatic generation control

**Text books:**

1. P. K. Nag, "Power Plant Engineering" 2nd Edition, Tata McGraw-Hill Education, 2002.
2. R.K.Jain, "Mechanical and Industrial Measurements", 10th Edition, Khanna Publishers, New Delhi, 1995.
3. Sam. G.Dukelow, "The Control of Boilers", 2nd Edition, ISA Press, New York, 1991.
4. Stuart A. Boyer, 'SCADA-Supervisory Control and Data Acquisition', Instrument Society of America Publications, USA, 2004.

**Reference Books:**

1. David Lindsley, "Boiler Control Systems", McGraw Hill, New York, 1991.
2. Jervis M.J, "Power Station Instrumentation", Butterworth Heinemann, Oxford, 1993.

**Course Contents and Lecture Schedule:**

Sl. No	Topic	No. of Lectures
<b>1</b>	<b>Measurements in a power plant (8 hours)</b>	
1.1	Electrical measurements – Current, voltage, power, frequency, power factor etc.	2
1.2	Non electrical parameters – Flow of feed water, fuel, air and steam with correction factor for temperature – Steam pressure and steam temperature	2
1.3	Drum level measurement – Radiation detector	2
1.4	Smoke density measurement – Dust monitor.	2
<b>2</b>	<b>Monitoring (9 hours)</b>	
2.1	Measurement in boiler and turbine: Metal temperature measurement in boilers, piping.	2
2.2	System for pressure measuring devices, smoke and dust monitor, flame monitoring.	2
2.3	Introduction to turbine supervising system, pedestal vibration	1
2.4	Shaft vibration, eccentricity measurement.	2
2.5	Installation of non-contracting transducers for speed measurement.	2
<b>3</b>	<b>Control systems (9 Hours)</b>	
3.1	Controls in boiler: Boiler drum level measurement methods, feed water control, soot blowing operation, steam temperature control	2
3.2	Coordinated control, boiler following mode operation, turbine following mode operation	1
3.3	Selection between boiler and turbine following modes.	1
3.4	Distributed control system in power plants interlocks in boiler operation.	1
3.5	Cooling system, Automatic turbine runs up systems.	2

<b>4</b>	<b>SCADA systems (10 Hours)</b>	
4.1	Introduction to SCADA systems: - Elements of a SCADA system - benefits of SCADA system	1
4.2	SCADA Architecture: □ Various SCADA architectures, advantages and disadvantages of each system	2
4.3	SCADA System Components: - Remote Terminal Unit-(RTU),	3
4.4	Intelligent Electronic Devices (IED) - PLC: Block diagram, Ladder diagram, Functional block diagram	3
4.5	Applications, Interfacing of PLC with SCADA.	1
<b>5</b>	<b>SCADA applications (9 Hours)</b>	
5.1	SCADA Applications: □ Operating states of a power system	2
5.2	Energy management System (EMS) – EMS framework	3
5.3	Generation operation and management – Load forecasting – unit commitment	2
5.4	Hydrothermal co-ordination – Real time economic dispatch and reserve monitoring – real time automatic generation control	2