Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title: Measurement Systems		Course Code:15MC43T
Mode (L:T:P) : 4:0:0	Credits:4	Core/ Elective: Core
Type of Course: Lectures & Student Activities		Total Contact Hours: 52
CIE= 25 Marks		SEE= 100 Marks

Pre-requisites: Knowledge of Applied Science & Basic Electrical and Electronics Engineering

Course Objectives: Understand the selection of suitable measurement system for a given Application

Course Outcome: At the end of the semester, the student should be able to

1. Understand the concept of measurement system,
2. Know the measurement of displacement, velocity, acceleration, force.
3. Know the measurement of pressure, flow, level, temperature and light
4. Understand the importance of signal conditioning.
5. Know the significance of DAS and control system
6. Understand the working of various display and recording devices

Course Outcome		Cognitive Level	Linked with PO	Teaching Hours
CO1	Understand the concept of measurement system	*U*	1,2	08
CO2	Know the measurement of displacement, velocity, acceleration, force	*U*	1,2	10
CO3	Know the measurement of pressure, flow, level, temperature and light	*U*	1,2	10
CO4	Understand the importance of signal conditioning.	*U*	1,2	06
C05	Know the significance of DAS and control system	*U/A*	1,2	08
C06	Understand the working of various display and recording devices	*U*	1,2	10
	Total	**Total sessions**		**52**

Legend: R; Remember, U: Understand A: Application

Mapping of Course Outcomes with Program Outcomes

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Measurement systems	**3**	**3**	-	-	-	-	-	-	-	-

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course Content and Weightage For SEE

Unit No	Unit Name	CO	Hour	Marks allocated for different Cognitive level Questions			Marks weightage (%)
				R	U	A	
1	Measurement system	**1**	**08**	**05**	**25**	**-**	**20.69**
2	Measurement Of Displacement, Velocity, Acceleration And Force	**2**	**10**	**-**	**20**	**-**	**13.79**
3	Measurement Of Pressure, Flow, Level, Temperature And Light	**3**	**10**	**-**	**30**	**-**	**20.69**
4	Signal conditioning	**4**	**06**	**-**	**15**	**-**	**10.34**
5	Data Acquisition System	**5**	**08**	**-**	**05**	**20**	**17.24**
6	Display and Recording devices	**6**	**10**	**-**	**25**	**-**	**17.24**
	Total		**52**	**145 Marks**			**100**

Contents

Unit-I

Measurement System

Introduction to measurement, Standards of measurement, Modes of measurement, generalized measurement system, Applications of Measurement System, Errors in measurement, sources of errors. Introduction, Classification of Transducer: Basic requirements: Sensitivity, Specifications, Advantages and Disadvantages,

8 Hours

Unit-II

Measurement Of Displacement, Velocity, Acceleration And Force

Displacement measurement: Potentiometer sensor, LVDT, Position measurement: Optical encoder, Hall Effect sensor, Proximity measurement: Eddy current, Inductive, Velocity measurement: Electromagnetic, Tacho generators, Acceleration measurement: Piezoelectric accelerometer, strain gauge accelerometer**,** Force measurement: Hydraulic Load cell, spring balance, strain gauge, load cell. RVDT, Synchros and Resolvers

10 Hours

Unit-III

Measurement Of Pressure, Flow, Level, Temperature And Light

Fluid transducers: Pressure measurement: bourdon tube, tactile sensor, Flow measurement: orifice meter, venturi meter, Level measurement: float gauge, capacitance level sensor, Temperature Sensors: Temperature measurement: RTD's, Bimetallic strip, Light measurement: Working principles of photoelectric and photoconductive transducer, photo voltaic cell.

10 Hours

Unit-IV

Signal Conditioning

General Measurement system component, signal conditioning and necessity, processes Adopted, Functions of dc and ac signal conditioning system, DC Wheatstone's bridge

6 Hours

Unit-V

Data Acquisition System

Introduction, generalized DAS, objectives, configurations, analog and automated DAS, Single channel, multichannel DAS, applications, ADC: successive approximation, DAC: Weighted Resister

8 Hours

Unit-VI

Display and Recording Devices

Introduction: Analog, Digital Indicating Instrument, Working of LED, Seven segment display, LCD, Recorders: X-Y graphic recorder, Advantages and applications of X-Y graphic recorder, Oscillographic UV recorder, Magnetic tape recorders, Printers: Dot matrix, Ink-jet, Laser.

10 Hours

References

1.0 "Electronic measurements and instrumentation" by R.K.Rajput, S.CHAND publication

2.0 Introduction to measurements and instrumentation" by Arun K.Ghosh, 3rd ed,2009 –PHI publication

3.0 Electronic Instrumentation, KALSI, Mc Graw Hills.3ed

e-References

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https://en.wikipedia.org/wiki/System_of_measurement
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Student Activity

Activity No.	Description of the Student Activity
1	Identify the sensors/ transducers/actuators display devices used in various applications and prepare a hand written report comprising of its working principle.

Note:

1. Group of max four students should do any one of the above activity or any other similar activity related to the course COs and get it approved from concerned Teacher and HOD.
2. No group should have activity repeated or similar
3. Teacher should ensure activities by group must cover all COs
4. Teacher should asses every student by using suitable **Rubrics** approved by HOD

Rubrics

Dimension	Exemplary	Accomplished	Developing	Beginning	Roll No. of the Student				
	5/4	3	2	1	1	2	3	4	5
Organization	Information presented in logical, interesting sequence	Information in logical sequence	Difficult to follow presentation--student jumps around	Cannot understand presentation--no sequence of information	2				
Subject Knowledge	Demonstrates full knowledge by answering all class questions with explanations and elaborations	At ease with expected answers to questions but does not elaborate	Uncomfortable with information and is able to answer only rudimentary questions	Does not have a grasp of the information. Cannot answer questions about subject	3				
Graphics	Explain and reinforce screen text and presentation	Relate to text and presentation	Occasionally uses graphics that rarely support text and presentation	Uses superfluous graphics or no graphics	4				
Oral Presentation	Maintains eye contact and pronounces all terms precisely. All audience members can hear	Maintains eye contact most of the time and pronounces most words correctly. Most audience members can hear presentation	Occasionally uses eye contact, mostly reading presentation, and incorrectly pronounces terms. Audience members have difficulty hearing	Reads with no eye contact and incorrectly pronounces terms. Speaks too quietly	5				
Total Score=2+3+4+5=14/4=3.5=4									

Institutional Activity

Activity No	Description of the Institutional Activity
1	Arrange student to build a prototype circuit using thermistor/ LDR/ Photo diodes
2	Motivate student to take case study on transducers to inculcate self and continuous learning.

Course Assessment Pattern

Particulars			Max Marks	Evidence	Course outcomes
Direct Assessment	**CIE**	Three tests (Average of three tests)	20	Blue books	1,2,3,4,5,6
		Student Activity	05	Student Activity Sheets	1,2,3,4,5,6
	SEE	End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	**Student Feedback on course**	Middle of the course		Feedback forms	1, 2&3
		End of the course		Feedback forms	1,2,3, 4, 5&6

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	I/II SEM		20
	Year:		

Name of Course coordinator : Units:__

CO's:____

Question no	Question	MARKS	CL	CO	PO
1					
2					
3					
4					

Note: Internal Choice may be given in each CO at the same cognitive level (CL).

Model Question Paper (CIE)

Date and Time	Semester	Course	Max Marks
1Test(6 th weak of sem) 10-11 Am	IV SEM	Measurement systems	20
	Year: 2015-16	Course code:15MC43T	

Name of Course coordinator : **Units:1,2 CO: 1,2**

All questions carries equal marks

Question No	Question	CL	CO	PO
1	Explain the Modes of Measurements with Examples OR Briefly explain the sources of Errors.	U	3	1,2
2	How Transducers are are classified. OR Explain briefly the various stages of general measurement system.	U	3	1,2
3	Explain briefly the working of Hall Effect displacement transducer OR Explain briefly the LVDT with Neat diagram.	U	4	1,2
4	Explain the working of Capacitive Tacho meter OR Explain briefly the Piezoelectric Accelerometer with Neat diagram	U	4	1,2

Model Question Paper
IV Semester Diploma in Mechatronics Engineering
Measurement Systems

Instructions: Answer any six questions from part A and Seven full questions from part B

PART-A

Answer any six questions. **5X6=30 marks**

1. Define the following terms: Accuracy, Errors, Correction, Static Error, Static correction
2. Explain the various sources of Errors
3. Explain briefly the LVDT with Neat diagram
4. Explain briefly the working of Fluid level measurement transducer
5. Explain the Load cell
6. Explain signal conditioning and its necessity
7. Explain the working of wheatstone bridge
8. Explain the Different components of DAS
9. Differentiate between Analog and Digital Instruments

PART- B

Answer any seven full questions. **10x7=70 Marks**

1. Draw the block diagram of the representation of a generalized Measurement system and point out the functions performed by each element **10m**
2. a) Discuss the functions of Transducer in an Electronic Instrumentation system **5m**
   b) How Transducers are are classified **5m**
3. a) Explain briefly the Variable reluctance transducer to measure displacement **5m**
   b) Explain the working of Capacitive Tacho meter **5m**
4. a) Explain briefly the Piezoelectric Accelerometer with Neat diagram **5m**
   b) Explain briefly the working of Bonded strain gauge **5m**
5. a) Explain the working of Photo voltaic cell **5m**
   b) Explain the working of Eddy current proximity sensors **5m**
6. a) Explain the working of RVDT. **5m**
   b) Explain briefly the D.C signal conditioning **5m**
7. With neat block diagram explain briefly Analog and Automated data DAS. **10m**
8. Explain briefly the Successive Approximation A-D converter **10m**
9. Explain briefly the working of X-Y Recorders **10m**
10. Explain briefly the construction and Operating principle of Magnetic tape recorders. **10m**

Model Question Bank
IV Semester Diploma in Mechatronics Engineering
Measurement Systems

Unit-I

Measurement system

Cognitive level- Remembering

1. List the Modes of Measurements
2. Define Calibration
3. List the functions of Transducer in an Electronic Instrumentation system
4. Define the following terms: Accuracy, Errors, Correction, Static Error, Static correction, Relative Error

Cognitive level- Understanding

1. Explain the Modes of Measurements with Examples.
2. Draw the block diagram of the representation of a generalized Measurement system and point out the functions performed by each element.
3. Explain briefly the various stages of general measurement system.

4. Describe the applications of Measurement system.
5. How can Accuracy be expressed? Briefly explain.
6. Enumerable the various sources of Errors.
7. Briefly explain the sources of Errors.
8. How Transducers are are classified?

Unit-II

Measurement Of Displacement, Velocity, Acceleration And Force

Cognitive level- Understanding

1. Explain Briefly the Linear motion and Angular motion Potentio meters
2. Explain the specifications for transducers while selecting for any applications
3. Explain briefly the LVDT with Neat diagram
4. Explain the working principle of Capacitive Transducers
5. Explain Piezo electric effect
6. Explain briefly the Mutual Inductance transducer with Neat diagram
7. Explain briefly the Variable reluctance transducer to measure displacement
8. Explain briefly the Piezoelectric Accelerometer with Neat diagram
9. Explain the working of Capacitive Tacho meter.
10. Explain briefly the Eddy current or Drag cup tachometer type transducer with Neat diagram
11. Explain briefly the working of Hydraulic Load cell
12. Explain the working of Eddy current proximity sensors.
13. Explain briefly the working of Hall Effect displacement transducer
14. Explain the working of Load cell
15. Explain the working of strain gauge
16. Explain briefly the working of Foil type Strain gauge
17. Explain briefly the working of Bonded strain guage
18. Explain the working of synchros and Resolvers.
19. Explain the working of RVDT

Unit-III

Measurement of Pressure, Flow, Level, Temperature And Light

Cognitive level- Understanding

1. Explain briefly the Thermister and List its applications
2. Explain briefly the Electromagnetic type transducer to measure flow
3. Explain briefly the working of Fluid level measurement transducer.
4. Explain the working of Capacitive Transducers to measure level
5. Explain the working of Photoelectric Transducers
6. Explain the working principles of photo Emissive cell
7. Explain the working of Photo voltaic cell.
8. Explain the working of photoconductive cell,

Unit-IV

Signal conditioning

Cognitive level- Understanding

1. Explain signal conditioning and its necessity.
2. Describe the process are usually adopted in signal conditioning.
3. Explain briefly the D.C signal conditioning.
4. Explain briefly the A.C signal conditioning.
5. Explain the working of Wheatstone's bridge.

Unit-V

Data Acquisition System

Cognitive level- Understanding

1. Explain Data Acquisition System
2. Draw the block diagram of generalized DAS
3. Explain the Different components of DAS
4. Discuss the Objectives of a DAS
5. Discuss the factors that decide the configuration of a DAS.
6. Explain briefly the Data Loggers
7. Explain briefly the procedure of A-D Converters
8. Explain briefly Quantizing and Coding
9. Explain the components used in A-D converters
10. Discuss the applications of DAS

Cognitive level- Application

1. With neat block diagram explain briefly Analog and Automated data DAS.
2. Explain briefly the single channel DAS with neat diagram.
3. Explain briefly the Multi channel DAS with neat diagram.
4. Explain briefly the Successive Approximation A-D converter.
5. Explain briefly the Un weighted Resister type D-A converter.

Unit-VI

Display and Recording devices

Cognitive level- Understanding

1. How are output devices are categorized
2. Differentiate between Analog and Digital Instruments
3. How are digital displays are classified.
4. Explain briefly the working of LED.
5. Discuss the Advantages and Applications of LED
6. Explain briefly the working of seven segment Display
7. Explain the operating principles of LCD Display
8. Discuss the types of printers.
9. Discuss the applications of X-Y Recorders
10. Explain the working of X-Y Recorders
11. Explain the working of Oscilloscopic UV Recorder.
12. Explain the construction and Operating principle of Magnetic tape recorders
13. Explain the Dot-Matrix printers
14. Explain the ink-Jet printers
15. Explain the Laser printers