



VIT[®]

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

REG.NO.:

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST -I-KEY
FALL SEMESTER 2024-2025

SLOT: E1+TE1

Programme Name & Branch : B.Tech & Mechanical Engineering
Course Code : BMEE210L
Course Name : Mechatronics and Measurement Systems
Faculty Name(s) : M.Boopathi, N.Senthilnathan, Sathish Paulraj GP,
Bharanitharan S, DRS.Raghuraman
Class Number(s) : VL2024250103803,VL2024250108099,
VL2024250103801,VL2024250103802,
VL2024250103800

Date of Examination : 29.08.2024

Exam Duration : 90 minutes

Maximum Marks: 50

General instruction(s): Answer all questions

Q. No	Question	Marks
1.	Clarify about mechatronics systems design approach with a diagram:- MECHATRONIC DESIGN PROCESS Information for future modules/upgrades • The mechatronic design process consists of three phases: modeling and simulation, prototyping, and deployment. • All modeling, whether based on first principles (basic equations) or the more detailed physics, should be modular in structure. • A first principle model is a simple model which captures some of the fundamental behavior of a subsystem. A detailed model is an extension of the first principle model providing more function and accuracy than the first level model. • Connecting the modules (or blocks) together may create complex models. Each block represents a subsystem, which corresponds to some physically or functionally realizable operations, and can be encapsulated into a block with input/output limited to input signals, parameters, and output signals. Diagram – 6 marks	10



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Explanation – 4 marks		
2.	What differentiate closed loop system from open loop system? With necessary diagrams, discuss in detail. Open loop system Closed Loop System The diagrams shown are typical. Student may choose any type of application representing the circuit. Explanation: 1. In an open-loop system, control actions are not dependent on the output generated. On the other hand, a closed-loop system is a kind of system in which the control action relies on the output produced. 2. A controller and a plant are the physical components of an open-loop system. On the other hand, closed-loop control systems utilize a controller, feedback element, plant, and error detector as physical components. 3. The open-loop system generated output doesn't change or modify the control actions. In contrast, the closed-loop system generated output change and modifies the control action. 4. In terms of cost, closed-loop system is more costly than the open-loop system. 5. In terms of reliability, closed-loop control system is more reliable than open control loop system. 6. An open-loop control system is incapable of dealing with external disturbances. In contrast, the closed-loop control system is prepared to deal with external disturbances. 7. The physical components of the open-loop control system are fairly simple to configure. In contrast, the setup of the main components of the closed-loop system is quite complicated.	10



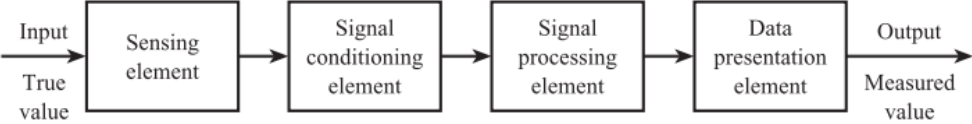
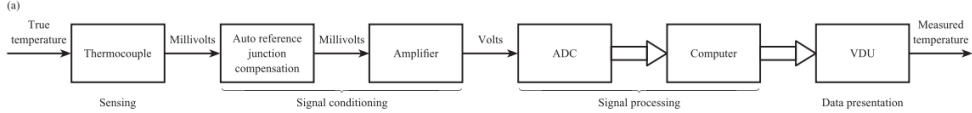
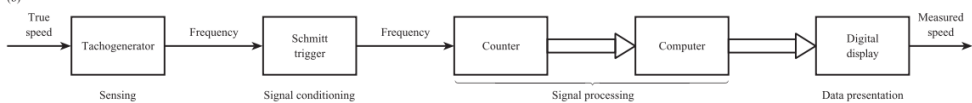
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	8. Open-loop systems are sometimes known as manual or non-feedback control system. In contrast, closed-loop control systems are frequently referred to as automatic control systems or feedback control systems. 9. Open-loop control systems are inaccurate because there is no automated correcting mechanism. In contrast, there is an automatic corrective mechanism that ensures the closed-loop control system's accuracy. 10. Open-loop systems need less maintenance than the closed-loop control system. In contrast, closed-loop systems need more maintenance. 11. Open-loop control systems respond to input faster because it contains several physical components to process the information. In contrast, closed-loop control system responds more slowly because it has more components than the open-loop control system. 12. Open-loop control systems are commonly utilized in practical applications such as automatic washing machines, immersion heaters, automatic traffic signal systems, and so on. In contrast, closed-loop control systems are commonly utilized in several applications, including toasters, rocket launching systems, air conditioners, refrigerators, radar tracking systems, and so on. Diagram – 4 marks Explanation – 6 marks	
3.	Match any measurement system (of your choice) with the general structure (block diagram) of measurement system and explain the functions of each element General measurement system  Examples of measurement systems (a)  (b) 	10



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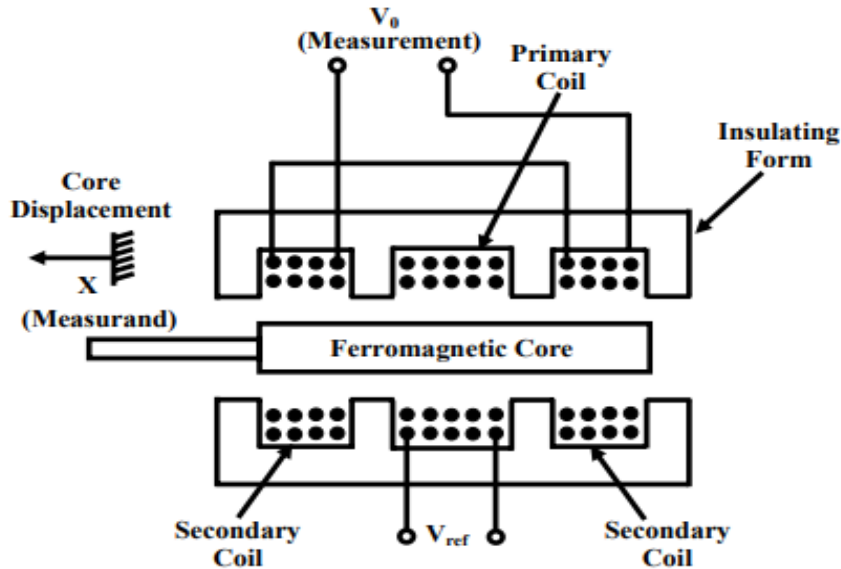
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	(c) (d) General measurement system diagram – 4 marks Measurement system matching diagram – 4 marks Explanation – 2 marks	
4.	What are all the possible errors in a general measurement system? Enlighten them with examples. The error in measurement is the difference between the measured value and the true value of the measured dimension. Error may be absolute or relative. $\text{Error in Measurement} = \text{Measured Value} - \text{True Value}$ The actual value or true value is a theoretical size of dimension free from any error of measurement which helps to examine the errors in a measurement system that lead to uncertainties. Generally, the errors in measurements are classified into two testing types—one, which should not occur and can be eliminated by careful work and attention; and the other, which is inherent in the measuring process/system. Therefore, the errors are either controllable or random in occurrence. Absolute error Relative error Static error Loading error Dynamic error Controllable error Random error List of errors – 2 marks Explanation – 4 marks Example – 4 marks	10
5.	a. Explain the principle of operation of linearly variable differential transformer(LVDT) with neat sketch.(8 marks) LVDT	10

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Construction of LVDT.

LVDT works on the principle of variation of mutual inductance. It is one of the most popular types of displacement sensor. It has good linearity over a wide range of displacement. Moreover the mass of the moving body is small, and the moving body does not make any contact with the static part, thus minimizing the frictional resistance. Commercial LVDTs are available with full scale displacement range of $\pm 0.25\text{mm}$ to $\pm 25\text{mm}$. Due to the low inertia of the core, the LVDT has a good dynamic characteristics and can be used for time varying displacement measurement range

Diagram – 4 marks

Explanation – 4 marks

b. List some applications of LVDT(2 marks)

A Linear Variable Differential Transformer (LVDT) is an electrical transducer or sensor used for the

- Measurement of physical quantities such as force, tension, pressure, and weight.
- Industrial automation.
- Aircraft.
- Power turbines.
- Hydraulics.