Aliah University
Department of Electrical Engineering, PhD Course Work
Even (Spring) Semester Examination, 2025
Subject: Research Methodology [PHD/RM-01]

Full Marks: 80 **Time**: 3 Hours

Section A: Short Answer Questions (2 × 10 = 20 Marks)

*Answer **any ten** of the following questions (each carries 2 marks).*

1. Define the term *research gap*.
2. What is the difference between qualitative and quantitative research?
3. Mention any two characteristics of a good research problem.
4. What is meant by hypothesis testing?
5. Differentiate between primary and secondary data.
6. Define sampling and state its importance in research.
7. What do you mean by plagiarism in research?
8. Explain the term 'research ethics'.
9. Name any two statistical tools commonly used in engineering research.
10. What is a literature review and why is it important?
11. Briefly explain the term 'pilot study'.
12. What is meant by research design?

Section B: Long Answer/Descriptive Questions (12 × 5 = 60 Marks)

*Answer **any five** of the following questions (each carries 12 marks).*

1. Explain in detail the different types of research methods used in engineering.
2. Discuss the steps involved in the formulation of a research problem with suitable examples.
3. What are the various methods of data collection? Compare survey and experimental methods.
4. Describe the process of writing a research proposal and highlight its key components.
5. What is hypothesis formulation? Explain the types and characteristics of a good hypothesis.
6. Explain different types of sampling techniques with advantages and limitations.
7. Discuss the importance and structure of a good research report or thesis.
8. Explain the role of statistical tools in data analysis with suitable examples in engineering research.

Aliah University

Electrical Engineering Department

Ph.D. Coursework Examination 2025

Research & Publication Ethics (PHD/RPE-02)

FM: 40 Times: 2 hrs

Instructions
- ✓ Attempt any four questions.
- ✓ Write your answer in simple english and as practical as possible.
- ✓ Different parts of the same question must be answered in one place.

Qu. No.	Statement of the question	Marks
1	What is meant by publication ethics? Discuss unethical practices used in research publication	10
2	What is publication misconduct? Mention the steps to identify it. Discuss complaint and appeals in the publication process.	10
3	How do you define "plagiarism?" Explain its types and importance in research.	10
4	Define conflict of interest (CI). Analyze classification of CI. Briefly discuss how they can be managed?	10
5	Write a short note on "Urkund (original software)".	10
6	Write a short note on "Impact factor" and "Journal Citation Report".	10

ALIAH UNIVERSITY
ELECTRICAL ENGINEERING
Ph.D. Course Work Examination, June 2025
SUBJECT NAME: Advanced Control Engineering
SUBJECT CODE: PHD/SP-04

TOTAL MARKS: 80 **TIME: 3 HOURS**

INSTRUCTIONS: -

1. Mention the question number clearly. Answer all parts of a question at single location.
2. Draw circuit & waveforms wherever necessary.
3. Acronyms & symbols have their usual meaning unless otherwise specified.
4. Make suitable assumptions wherever necessary.

Que. No.	**Answer any two questions((2x5=10)**	**Marks**
1.a.	Draw a state diagram and state model of a general multiple-input multiple-output (MIMO) system.	[5]
1.b.	Derive the similarity transformation matrices for any single-input single-output (SISO) system.	[5]
1.c.	Explain the concept of a state observer.	[5]

Que. No.	**Answer any five questions (5x14=70)**	**Marks**
2.a.	What is the pulse transfer function in a discrete control system? Find the state variable representation of an armature-controlled D.C. motor.	[2+12]
2.b	Obtain a controllable and observable canonical form from the given pulse transfer function $$\frac{Y(z)}{U(z)} = \frac{3z}{2z^3 + 5z^2 + 4z + 1}$$	[14]
2.c.	State Cayley Hamilton theorem. Write one property of the state transition matrix. Find the state transition matrix using the Cayley-Hamilton theorem. $$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & -1\\ 2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$	[3+2+9]
2.d.	What is the significance of eigenvalues in state space? Obtain the eigenvalues, eigen vectors, and modal matrix for the system matrix given below: $$A = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}$$	[3+11]
2.e.	Write the advantages of adaptive control. Give a suitable block diagram and describe a model reference adaptive control (MRAC) system.	[5+9]
2.f.	What is hold operation? Derive the expression for the transfer function of a zero-order holding circuit. Explain the operation of a basic digital control system and draw its block diagram.	[4+4+6]

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Aliah University
ELECTRICAL ENGINEERING
Ph.D. Course Work Examination, June 2025
SUBJECT NAME: Intelligent Control
SUBJECT CODE: PHD/SP-04

TOTAL MARKS: 80 **TIME: 3 HOURS**

INSTRUCTIONS:

1. Clearly mention the Question No. in the left margin of the answer sheet.
2. Write the answer as neatly as possible.
3. All parts of a question should be answered in one place.
4. Acronyms & symbols have their usual meaning unless otherwise specified.
5. Make suitable assumptions wherever necessary.

Qn. No.	Answer any five questions	Marks 16x5=80
1.	Write the differences between Fuzzy logic control and conventional control techniques. Explain the Mamdani Fuzzy Control technique with a suitable diagram and example.	6+10
2.a.	What are the main tools of Intelligent Control? What is computational intelligence? Why do we need it? .	3+2+3
2.b.	With a neat sketch, discuss the reinforcement learning neural network.	8
3.	Write the different types of learning methods of Artificial Neural Network (ANN). What is supervised learning? Give examples of applications of ANN in the Electrical Engineering field.	5+6+3
4.a.	Write the difference between activation functions and membership functions with a suitable diagram.	8
4.b.	For the Mamdani system, using your intuition, draw a diagram to represent the membership of water temperature (cold, warm, and hot) and water flow rate (low and medium). **Take Gaussian, triangular, and trapezoidal membership functions.** The temperature range is 0 degree to 60 degree and the flow rate is 0-3 Lt/min.	8
5.a.	What do you mean by perceptron learning? Write the differences between a fuzzy set and a classical set.	3+5
5.b.	Write the objectives of intelligent techniques in control system applications. Explain any type of defuzzification method.	3+5
6.a.	Write the difference between a biological neuron and an artificial neuron with a neat and clean diagram.	6
6.b.	Write a short note on the Genetic algorithm.	10

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Aliah University

PhD Coursework Examination, June 2025

Subject: System Identification and Estimation ; Code: PHD/SP-04

TOTAL MARKS: 80 **TIME: 3 HOURS**

Answer any five questions (5×16=80)

1. (a) What do you mean by a model of a system? Explain different types of model. [5]
   (b) Draw a flowchart and explain system identification procedure. [7]
   (c) Explain the different methods of system identification. [4]

2. (a) Prove that the estimated vector parameter $\theta = (\varphi^T\varphi)^{-1}\varphi^T y$ [where φ is regression vector and **y** is the output] using least-squares estimation technique. [7]

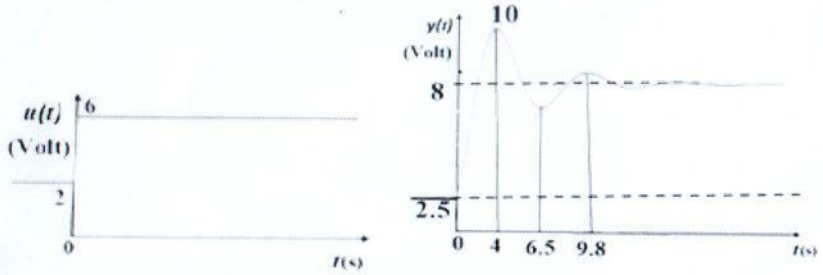
   (b) Estimate the values of the unknown parameters of the linear model $y(t) = \alpha + \frac{\beta}{2}t$ using linear regression and least-squares estimation technique. The experimental data are given in Table 1. [9]

Table 1

t (s)	1	5
y (m)	5	15

3. (a) What are the different challenges associated with the closed-loop identification technique? Describe the direct method of closed-loop identification technique. [8]

   (b) The input $u(t)$ and output $y(t)$ waveforms of a system are given below. Estimate the transfer function of the system. [8]

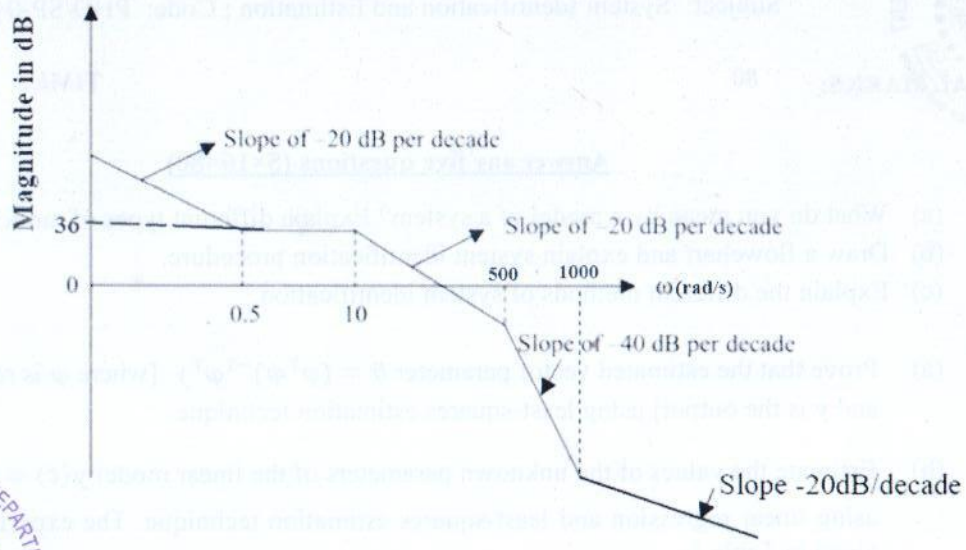


4. (a) Show that Wiener–Hopf's relationship has filter property. [3]
   (b) Explain how impulse response can be identified using Wiener–Hopf's relationship. [7]
   (b) Explain how transfer function can be identified using power spectra. [6]

5. (a) Derive the autoregressive exogenous (ARX) model structure and draw its block diagram. Write the difference between finite impulse response (FIR), autoregressive exogenous (ARX) and autoregressive moving average exogenous model structures. [6]
   (b) Explain how the parameters of finite impulse response (FIR) model structure can be estimated using linear regression and least square estimation technique. [10]

6. (a) What do you mean by frequency response of a system? Write the advantages of Bode plot. [6]

(b) The asymptotic Bode magnitude plot of a system is shown in the figure below. Determine the transfer function of the system. [10]



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Aliah University

Dept. of Electrical Engineering

Ph.D. Course Work Examination, June 2025

SUBJECT NAME: **SENSOR AND DEVICES**

SUBJECT CODE: **PHD/SP-04**

TOTAL MARKS: 80] **[TIME: 3 HOURS**

INSTRUCTIONS: -

1. Clearly mention the **Question No**. in the left margin of the answer sheet.
2. Write answer **neatly** as practicable as possible.
3. Write answers **to the point**, keeping in mind the allotted **marks.**
4. Write in your own words from your own understanding.
5. All part of a question should be answered **at one place**.
6. Draw circuit/figure & waveforms wherever applicable (including numerical).
7. **Acronyms & symbols** have their usual meaning.

Answer any five

Que-1 (A) Classify different categories of sensing based on the nature of the environment being sensed and the physical sensor being used. Discuss about virtual sensing. **[3+5]**

(B) Differentiate between sensors and actuators. Explain various characteristics of sensors. **[3+5]**

Que-2 (A) Explain why "in case of a sensor more the resolution, the more is the precision"? Why a sensor's accuracy does not depend upon its resolution? **[3+3]**

(B) Discuss about each of the following sensors in detail – **[5+5]**

i) Ultrasonic sensor (HC-SR04)

ii) PIR sensor

Que-3 (A) Describe the concepts behind wireless sensor networks (WSN). Illustrate how WSN should be used with proper examples. **[4+4]**

(B) With the help of appropriate diagrams, explain the function blocks of IoT. **[8]**

Que-4 (A) What do you understand by fourth industrial revolution? Explain. **[5]**

(B) State various characteristics of Industry 4.0. **[5]**

(C) Describe the several advantages that the Industry 4.0 standard offers. **[6]**

Que-5 (A) What do you mean by the term "smart grid"? Explain the role of the Internet of Things (IoT) in smart grid technology and applications. **[2+8]**

(B) Explain in detail how sensor based IoT system plays an important role in green house control, and help in improving productivity. **[6]**

Que-6 (A) Explain the concept of embedded systems. **[5]**

(B) What are the various levels of IoT systems? Develop IoT Level 1 using the applicable block diagram while taking the case study of home automation into consideration. **[3+8]**

Que-7 (A) Define how the applications interface with the lower layer protocols to send the data over the network? Explain Message Queuing Telemetry Transport (MQTT) protocol. **[4+6]**

(B) What is the function of a load cell? Explain the working of a strain gauge with relevant diagram. **[2+4]**

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