

Khulna University
Electronics and Communication Engineering Discipline
M.Sc. First Year, First Term Examination, Session: 2025-2026
Course No.: 0714 09 ECE 5105
Full Title of the Course: Electronics of Solids
Full Marks: 60 Time: 03 Hours Credits: 3.00

- The figure in the margin indicates full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Define crystalline solids and analyze the fundamental physical properties that distinguish them from amorphous and polycrystalline materials. [L2; CLO1] 03
- (b) Explain the concept of a crystal lattice and differentiate between a crystal lattice and a unit cell in terms of geometric symmetry. [L2; CLO1] 03
- (c) Identify and sketch the common lattice structures typically found in metals, including specific crystallographic directions. [L3; CLO1] 04
2. (a) A light source with a frequency of 7.5×10^{14} Hz is incident on a metal surface with a work function of 2.5 eV. Calculate the maximum kinetic energy of the emitted photoelectrons. Given: $h = 4.136 \times 10^{-15}$ eV·s. [L3; CLO2] 03
- (b) Utilize Bohr's atomic theory to calculate the radius of the electron orbit and the corresponding energy level for a hydrogen atom in the third excited state ($n = 3$). [L3; CLO2] 03
- (c) Derive the wave function and energy eigenvalues for a particle confined within an infinite one-dimensional potential well of width 'a' starting from the time-independent Schrödinger equation. Discuss how quantum numbers dictate the allowed energy states. [L6; CLO3] 04
3. (a) Formulate an explanation for the conductivity differences among metals, semiconductors, and insulators based on energy band theory. [L4; CLO3] 03
- (b) Define the Fermi level and contrast the carrier concentration mechanisms in intrinsic versus extrinsic semiconductors. [L2; CLO3] 02
- (c) Determine the position of the intrinsic Fermi level relative to the center of the bandgap in Silicon at $T = 300$ K. Given: $k = 8.62 \times 10^{-5}$ eV/K, $m_n^* = 1.08m_0$, and $m_p^* = 0.56m_0$. [L3; CLO3] 03
- (d) Describe the Hall effect. [L2; CLO2] 02
4. (a) Correlate a semiconductor's bandgap energy with its optical transparency. Explain why Silicon is opaque to visible light while materials like GaP can be transparent to certain wavelengths. [L4; CLO3] 04
- (b) Interpret the function of a monochromator in optical absorption experiments and mathematically describe how light intensity decays as it traverses a semiconductor sample. [L2; CLO1] 03
- (c) Compare and contrast direct and indirect recombination processes, highlighting their impact on optoelectronic device efficiency. [L4; CLO2] 03

Khulna University, Khulna**M.Sc. First Year First Term Examination, Session: 2025-2026****Electronics and Communication Engineering Discipline****Course No.: 0714 09 ECE 5147****Full Title of the Course: Research Methodology and Ethics****Full Marks: 60****Time: 03 Hours****Credit: 02**

- The figure in the margin indicates full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION AThere are **FOUR** questions in this section. Answer any **THREE** questions.

- | | | |
|------|---|----|
| 1(a) | What do you mean by research? State and explain the main objectives of research. [L2; CLO1] | 03 |
| 1(b) | Differentiate between research methods and research methodology. [L4; CLO1] | 03 |
| 1(c) | Discuss the major steps involved in the research process with a flowchart. [L3; CLO1] | 04 |
| 2(a) | Define a 'Research Problem' and list any two sources from which such a problem may arise. [L1; CLO2] | 01 |
| 2(b) | Why does the supervisor emphasize the 'necessity of defining the research problem' before starting the investigation? Explain based on the concept that a well-defined problem is half-solved. [L2; CLO2] | 02 |
| 2(c) | The students need to follow a specific technique to define their problem. Illustrate the five key steps involved in the technique of defining a research problem that the students should follow to satisfy their supervisor. [L3; CLO2] | 03 |
| 2(d) | Compare and contrast 'Exploratory' and 'Descriptive' research designs. Given the supervisor's requirement for a 'rigid design to minimize bias and maximize reliability', argue which of these two designs is more suitable for the students' final phase of investigation. [L5; CLO2] | 04 |
| 3(a) | Define 'Primary Data' and 'Secondary Data' as used in research. [L1; CLO3] | 01 |
| 3(b) | Compare the Questionnaire and Schedule methods of data collection. Which one would be more suitable if the researcher's participants were from a rural, illiterate population? Justify your answer. [L2; CLO3] | 02 |
| 3(c) | During the field study, a temperature sensor records a series of values: 22°C, 23°C, 200°C, and 24°C. Applying the Editing operation of data processing, explain how the researcher should handle the 200°C value and why this step is critical before analysis. [L3; CLO3] | 03 |
| 3(d) | The researcher must process both numerical battery life data (Quantitative) and narrative user feedback on comfort (Qualitative). Analyze the key differences in how these two types of data are processed and interpreted. Provide one specific ECE-related example for each processing approach based on the scenario. [L5; CLO3] | 04 |
| 4(a) | What is Interpretation? Explain the techniques of Interpretation. [L2; CLO4] | 03 |
| 4(b) | Describe the steps of Report Writing. [L3; CLO4] | 03 |
| 4(c) | Suppose you are asked to prepare the Layout of the Research Report for this study. Analyze the three main sections (Preliminary Pages, Main Text, and End Matter), and evaluate why including 'References' and 'Appendices' is essential for a technical report. [L4; CLO4] | 04 |

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

- | | | |
|------|--|----|
| 5(a) | Explain the statement: "Engineers should hold paramount the safety, health, and welfare of the public". List and describe the key ethical prohibitions that engineers must follow according to professional codes of ethics. [L4, CLO 5] | 04 |
| 5(b) | Discuss the ethical, professional and social values in engineering practice. With the help of necessary examples, define value judgments, statements of preference, expert opinions, and mere opinions. [L2, CLO 5] | 03 |
| 5(c) | With the help of necessary case study, distinguish between conflicts of interest vs. conflicts of commitment. Also explain the conflict of values/beliefs with necessary example. [L4, CLO 5] | 03 |
| 6(a) | Define cost-benefit analysis, risk-benefit analysis and risk shifting. With the help of examples, clarify civil rights, alienable right, absolute right, copyright and intellectual property rights. [L3, CLO 6] | 04 |
| 6(b) | Write down the basis of Human rights. Distinguish between a "human right" and a "special right" with the help of an example (hypothetical or real) for each to illustrate your answer. [L4, CLO 6] | 03 |
| 6(c) | Compare and contrast the process of solving substantive engineering design problems with the process of addressing challenging ethical problems. Explain these criteria with necessary example. [L3, CLO 6] | 03 |
| 7(a) | Discuss the origin and key principles of the Nuremberg Code. How did it shape modern research ethics frameworks? Critically evaluate the effectiveness of Nuremberg progeny guidelines in addressing ethical challenges in contemporary research. [L4, CLO 6] | 04 |
| 7(b) | What is self-deception and how does it compare with observer bias? Also explain the group misconduct and its handling techniques regarding laboratory procedure. [L4, CLO 4] | 03 |
| 7(c) | Compare and contrast the dynamics of a supervisor–trainee relationship with those of a mentor–mentee relationship. Highlight the primary goals and power structures of each. [L3, CLO 4] | 03 |
| 8(a) | Evaluate the role of academic institutions, journals, and government agencies in the failure to detect and prevent the misconduct occurred in The Korean Stem Cell Fraud. Describe the scientific claims and subsequent investigation of Hwang Woo-suk. What led to the exposure of fraud? [L3, CLO 7] | 04 |
| 8(b) | Write down the widely accepted criteria for citation of research publications or presentation. [L3, CLO 5] | 03 |
| 8(c) | Define the term salami science or salami slicing and explain why it is considered a problematic practice in research. What is self-plagiarism, and how does it differ from traditional plagiarism? [L3, CLO 6] | 03 |

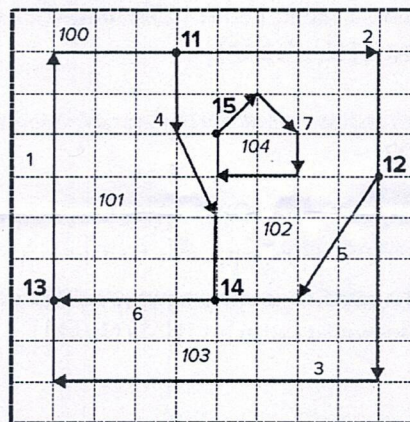
Khulna University
Electronics and Communication Engineering Discipline
M.Sc. First Year First Term Examination, Session: 2025-2026
Course No.: **0731 09 URP 5155**
Full Title of the Course: **Geographic Information System**
Total Marks: **60** Time: **03 Hours** Credit: **02**

- The figure in the margin indicates full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

*There are **four** questions in this section. Answer any **three** questions.*

1. (a) Describe the strengths and limitations of GIS. [L2; CLO1] 02
(b) Explain the key components of a GIS and their roles. [L2; CLO1] 04
(c) Evaluate the effectiveness of different GIS applications in your discipline. [L5; CLO3] 04
2. (a) What do you mean by datum? [L1; CLO2] 02
(b) Illustrate the concept of Datum with appropriate diagram. [L2; CLO2] 05
(c) Compare the three types of map projections by the projection or developable surface. [L4; CLO2] 03
3. (a) Describe the three types of simple features used in GIS and their geometric properties. [L2; CLO2] 03
(b) Using the following data structure of a polygon coverage, build the Polygon-arc and Arc-coordinate lists. [L6; CLO4] 05



- (c) Explain the difference between a personal geodatabase and a file geodatabase. [L2; CLO2] 02
4. (a) Compare and contrast the georelational and object-based data models with suitable examples. [L4; CLO4] 02
(b) Illustrate and explain four types of class relationships used in the object-based data model with examples. [L4; CLO4] 04
(c) Prepare an 8×8 raster and encode it using the run-length encoding method. [L3; CLO5] 04

Section B

There are **four** questions in this section. Answer any **three** questions.

5. (a) Analyze a spatial problem where the Intersect tool is more appropriate than Union. Justify your answer with reasoning. [L4; CLO3] **03**
- (b) Discuss about the four different methods of feature manipulation operations with appropriate figure. [L2; CLO3] **04**
- (c) Both nearest neighbor analysis and Moran's I can apply to point features. How do they differ in terms of input data? [L4; CLO3] **03**
6. (a) What is the difference between local and neighborhood operations? [L2; CLO4] **02**
- (b) Create a 5×5 raster with randomly assigned cell values. Using a 3×3 moving window, perform a focal operation using the 'majority' statistic and present the output. [L3; CLO4] **04**
- (c) Refer to the following figure, analyze the input and zonal raster to determine the output raster when a zonal operation is applied using the mean statistic. [L4; CLO4] **04**

1	2	2	1
1	4	5	1
2	3	7	6
1	3	4	4

Input raster

1	1	2	2
1	1	2	2
1	1	3	3
3	3	3	3

Zonal raster

7. (a) Explain the difference between location errors and topological errors. [L2; CLO2] **02**
- (b) Explain how the Douglas-Peucker algorithm simplifies lines. [L2; CLO4] **04**
- (c) Use a diagram to illustrate how a large cluster tolerance for editing can unintentionally alter the shapes of line features. [L2; CLO2] **04**
8. (a) Illustrate and explain common topological errors in polygon and line features using appropriate figure. [L2; CLO2] **05**
- (b) Compare and differentiate between Union and Merge operations in GIS with suitable examples. [L4; CLO5] **02**
- (c) Analyze how buffer zones are used in government regulations to protect sensitive areas and control land use, with relevant examples. [L4; CLO3] **03**

Khulna University, Khulna
M.Sc. First Year First Term Examination, Session: 2025-2026
 Electronics and Communication Engineering Discipline
 Course No.: **0714 09 ECE 5133**
 Full Title of the Course: **Machine Learning**
 Full Marks: **60** Time: **03** Hours Credit: **03**

- The figure in the margin indicates full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

- 1(a) Define Machine Learning. [L-1; CLO-1] 02
- 1(b) Consider the dataset represented in the following table. "Weather" and "Wind" are the two attributes, and the target is "Play". Make a reasonable decision tree using ID3 algorithm [L-3; CLO-3] 05

	Weather	Wind	Play
1	Sunny	Weak	No
2	Sunny	Strong	No
3	Overcast	Weak	Yes
4	Rainy	Weak	Yes

- 1(c) For the following data, draw the ROC point for the thresholds 0.5 and 0.8. [L-3; CLO-3] 03

Actual Class	1	1	0	0	1	0
Predicted Probability	0.9	0.8	0.7	0.4	0.3	0.2

- 2(a) Write the steps of the CART algorithm. Consider the dataset represented in the following table. where Study Hour and Attendance represent features, and Result represents the target. Select and explain the best split based on this available dataset using the CART algorithm. [L-3; CLO-2] 05

ID	Study Hour	Attendance	Result
1	High	Good	Pass
2	High	Poor	Pass
3	Low	Good	Fail
4	Low	Poor	Fail

- 2(b) What is regularization? Why do we use it? Write the names of different types of regularization techniques. [L-2; CLO-2] 2.5
- 2(c) Explain the Random Tree Algorithm. [L-2; CLO-3] 2.5
- 3(a) Explain the XGBoost algorithm. [L-2; CLO-3] 02
- 3(b) What is PCA? Prove that, for the PCA, $W^T S W = \lambda$. [L-2; CLO-3] 03
- 3(c) For the following data, where two features and four samples are available. What will be the projected one-dimensional data if you are using the PCA algorithm? $x = \begin{bmatrix} 2 & 0 \\ 0 & 2 \\ 3 & 1 \\ 1 & 3 \end{bmatrix}$ [L-3; CLO-3] 05

4. Classify the following dataset using the Adaboost Algorithm. Perform the classification operation for up to three iterations. [L-4; CLO-3] 10

	1	2	3	4	5	6	7	8	9	10
x_1	1	2	3	3	4	5	5	6	6	7
x_2	2	3	3	4	2	3	4	3	5	4
y	+1	+1	+1	-1	-1	-1	-1	-1	-1	-1

Use the following information:

For iteration 1: Candidate 1: $h(x) = +1$ if $x_1 \leq 4$ else -1; Candidate 2: $h(x) = +1$ if $x_2 \leq 3$ else -1; Candidate 3: $h(x) = +1$ if $x_2 \leq 4.5$ else -1

For iteration 2: Candidate 1: $h(x) = +1$ if $x_2 \leq 9.5$ else -1; Candidate 2: $h(x) = +1$ if $\{x_1 \leq 3.5 \text{ or } x_1 \geq 6.5\}$ else -1;

For iteration 3: Candidate 1: $h(x) = +1$ if $x_2 \leq 3.5$ else -1; Candidate 2: $h(x) = +1$ if $x_2 \leq 4.5$ else -1; What will be the Accuracy after three iterations? [L-4; CLO-3]

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. Minimize the function $f(x) = (x - 5)^2$ using the Whale Algorithm with two iteration. The given equation shows that, the true minimum value of $x^* = 5$. Consider there are three Whales $\{x_1, x_2, x_3\}$. Consider the initial values of x_1, x_2, x_3 as $X^0 = [x_1 = 0, x_2 = 8, x_3 = 2]$. Consider for the First Iteration,

Whale 1	$x_1 = 0$	$r_1 = 0.3$	$r_2 = 0.7$	$p = 0.4$
Whale 2	$x_2 = 8$	$r_1 = 0.9$	$r_2 = 0.4$	$p = 0.3$
Whale 3	$x_3 = 2$	$r_1 = 0.2$	$r_2 = 0.5$	$p = 0.6$

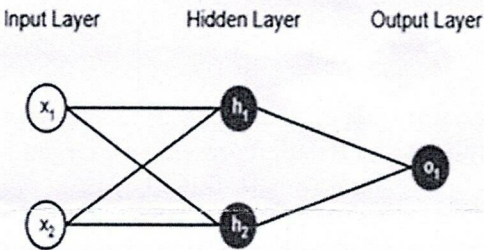
and, $l = 0.3$.

For the Second Iteration,

Whale 1	$r_1 = 0.4$	$r_2 = 0.3$	$p = 0.2$
Whale 2	$r_1 = 0.2$	$r_2 = 0.9$	$p = 0.7$
Whale 3	$r_1 = 0.6$	$r_2 = 0.4$	$p = 0.1$

and, $l = -0.4$. [L-4; CLO-3]

- 6(a) What is logit? Define the Sigmoid function and find its derivative. [L-2; CLO-4] 2.5
- 6(b) For the network available in the following figure, assume all neurons have the same weight $w = [1,1]$, and the same bias $b = 0$. Consider that all neuron outputs are passed through a sigmoid activation function. Find the values of h_1, h_2 , and σ_1 , where the input is $x = [2,3]$. [L-3; CLO-4] 3.5



- 6(c) Explain the method of Lagrange multipliers. Using the method of Lagrange multipliers, minimize $f(x, y) = x^2 + y^2$ subject to, $g(x, y) = x + y = 1$. [L-3; CLO-4] 04
- 7(a) What are Bidirectional Attention and Causal Attention? Explain them. [L-2; CLO-3] 03
- 7(b) Consider the following small dataset, which is fit by a simple linear model $y'_i = wx_i + b$. Using the Gradient Descent Algorithm, find the value of w and b up to 3 iterations. Consider the initial value of $w = 0, b = 0$, and $\alpha = 0.5$. [L-4; CLO-3] 07

x	1	2	3
y	1	2	2.9

- 8(a) What is Patch Embedding? Suppose you have an Image 224×224 , and the patch size is 16×16 . How many total patches will be produced? What will be the pixel number of each patch? [L-2; CLO-4] 03
- 8(b) For the following information, calculate the value of Precision (Macro) and Recall (Micro)

Actual	Predicted		
	Class-A	Class-B	Class-C
Class-A	40	2	3
Class-B	5	30	5
Class-C	2	4	35

04

Also, calculate the overall Accuracy. [L-3; CLO-3]

- 8(c) What is Token? Why is Tokenization needed? Explain Word-level Tokenization. [L-2; CLO-4] 03

Khulna University, Khulna
M.Sc. First Year First Term Examination, Session: 2025-2026
Electronics and Communication Engineering Discipline
Course No.: 0714 09 ECE 5137
Full Title of the Course: Telemedicine and Telehealth
Full Marks: 60 Time: 03 Hours Credit: 03

- The figure in the margin indicates full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

- | | |
|---|----|
| 1(a) What is real-time telemedicine? Write down the difference between telemedicine and telehealth.
[L 1,2; CLO1] | 03 |
| 1(b) Justify how telemedicine connects remote areas and empowers chronic patients who are less mobile? [L5; CLO1] | 03 |
| 1(c) What is WAN? Design two telemedicine networks using ring and star topology of LAN.
[L1,6; CLO1,2] | 04 |
| 2(a) What is tele-home health care? Explain the benefits of LAN over WAN. [L1,5; CLO1,2] | 03 |
| 2(b) Explain full mesh and dual home WAN topology with necessary figures. [L1,5; CLO2] | 04 |
| 2(c) Justify how a WAN interconnect LAN to establish a telemedicine network between three remote areas. [L1,5; CLO1,2] | 03 |
| 3(a) What is satellite? Justify why a geostationary satellite appears stationary relative to any point on earth? [L1,5; CLO3] | 03 |
| 3(b) Justify how a smartphone-based telemedicine system can be used in remote chronic patient monitoring and management with necessary figure. [L5; CLO1,3] | 04 |
| 3(c) Define health data management. Explain the benefits of health data management. [L1,5; CLO4] | 03 |
| 4(a) Explain how video conferencing overcome the limitation of audio conferencing in telemedicine. Design a V-SAT-based telemedicine system. [L5,6; CLO3] | 04 |
| 4(b) Justify how a smartphone can be used as a smart tool for medical resources. [L5; CLO1] | 03 |
| 4(c) Define hospital information system (HIS). Explain the properties of an effective HIS.
[L5,6; CLO4] | 03 |

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

- 5(a) What is a paramedic? Explain what does a paramedic do? [L1,5; CLO4] 03
- 5(b) What is electronic drug storage? Justify the benefits of electronic drug storage over the traditional drug storage. [L1,5; CLO5] 03
- 5(c) What are the vital components of a secure healthcare system? Explain with necessary figure. [L1, 5; CLO6] 04
- 6(a) What is firewall? Discuss private and public key data encryption with necessary figures. [L1,6; CLO6] 04
- 6(b) Draw and explain the client-server based PACS system architecture. [L5; CLO7] 03
- 6(c) Justify why PACS based workflow is superior than film-based workflow with necessary figures. [L5; CLO7] 03
- 7(a) Why image compression is necessary in telemedicine and telehealth? Briefly explain the basic block diagram of a compressor unit. [L1,5; CLO7] 04
- 7(b) What is uniform and nonuniform quantization? Justify which quantization is more effective for human visual system and why. [L1,5; CLO7] 03
- 7(c) Explain the benefits of lossless compression method. [L5; CLO7] 03
- 8(a) What is Huffman coding? Determine the Huffman code and compression ratio for the following histogram. [L1,5; CLO7] 05

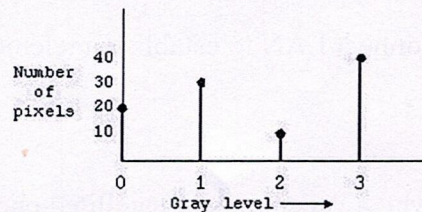


Fig. 8 (a)

- 8(b) What is bit-plane RLC? Determine the RLC number for matrix (a) and gray level pairs for matrix (b). [L1,5; CLO7] 05

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

(a)

$$\begin{bmatrix} 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 \\ 10 & 10 & 10 & 10 & 10 & 12 & 12 & 12 \\ 10 & 10 & 10 & 10 & 10 & 12 & 12 & 12 \\ 0 & 0 & 0 & 10 & 10 & 10 & 0 & 0 \\ 5 & 5 & 5 & 0 & 0 & 0 & 0 & 0 \\ 5 & 5 & 5 & 10 & 10 & 9 & 9 & 10 \\ 5 & 5 & 5 & 4 & 4 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

(b)

Khulna University

Electronics and Communication Engineering Discipline
M.Sc. First Year, First Term Examination, Session: 2025-2026

Course No.: **0714 09 ECE 5115**

Full Title of the Course: **Continuous and Discrete Time Signals and Systems**

Full Marks: **60**

Time: **03 Hours**

Credits: **3.00**

- The figure in the margin indicates full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

- 1.(a) Determine whether or not each of the following signals are periodic. If a signal is periodic, determine its fundamental period. [CLO 1; L5] 05

(i) $x(t) = \sin^2 t$

(ii) $x(t) = \cos \frac{1}{4} n$

- 1.(b) Consider the RC circuit shown in Fig. Q1(b). Evaluate the relationship between the input $x(t)$ and the output $y(t)$. [CLO 2,3; L5] 05

(i) If $x(t) = v_s(t)$ and $y(t) = v_c(t)$

(ii) If $x(t) = v_s(t)$ and $y(t) = i(t)$.

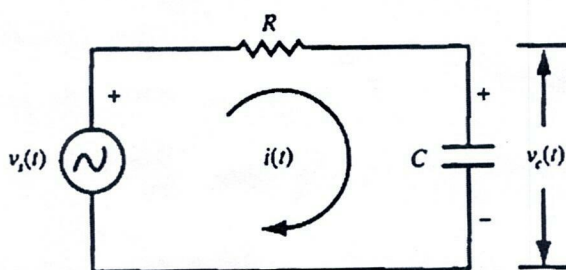


Fig. Q1(b)

2. A system has the input-output relation given by 02×5=10

$$y(n) = T\{x(n)\} = nx(n)$$

Determine whether the system is (i) memoryless, (ii) causal, (iii) linear, (iv) time-invariant, or (v) stable. [CLO 1, L5]

3. The system shown in Fig. Q3(i) is formed by connecting two systems in cascade. The impulse responses of the systems are given by $h_1(t)$ and $h_2(t)$, respectively, and 06+04=10

$$h_1(t) = e^{-2t}u(t) \text{ and } h_2(t) = 2e^{-t}u(t)$$

- a) Find the impulse response $h(t)$ of the overall system shown in Fig. Q3 (ii).
 b) Determine if the overall system is BIBO stable. [CLO 2,3; L5]

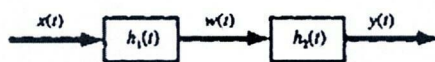


Fig. Q3(i)

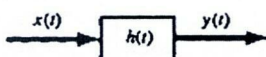


Fig. Q3(ii)

- 4.(a) Evaluate the Laplace transform $X(s)$ and sketch the pole-zero plot with the ROC for the following signal $x(t)$: 04

$$x(t) = e^{-2t}u(t) + e^{-3t}u(t)$$

[CLO 4, L5]

- 4.(b) Find the inverse Laplace transform of 06

$$X(s) = \frac{5s + 13}{s(s^2 + 4s + 13)} \quad \text{Re}(s) > 0$$

[CLO 4, L3]

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

- 5.(a) Evaluate the z-transform $X(z)$ and sketch the pole-zero plot with the ROC for the following sequence: 04

$$x(n) = \left(\frac{1}{3}\right)^n u(n) + \left(\frac{1}{2}\right)^n u(-n-1)$$

[CLO 4, L5]

- 5.(b) Find the inverse z-transform of 06

$$X(z) = \frac{2 + z^{-2} + 3z^{-4}}{z^2 + 4z + 3} \quad |z| > 0$$

[CLO 4, L3]

- 6.(a) Consider a continuous-time LTI system described by 06

$$\frac{dy(t)}{dt} + 2y(t) = x(t)$$

Using the Fourier transform, determine the output $y(t)$ to the following input signal:

$$x(t) = e^{-t}u(t)$$

[CLO 4, L5]

- 6.(b) Consider a sequence 04

$$x(n) = \{1, -1, -1, 1\}$$

Determine the DFT $X(k)$ of $x(n)$ using the decimation-in-time FFT algorithm.

[CLO 4, L5]

7. A causal discrete-time LTI system is described by 10

$$y(n) - \frac{3}{4}y(n-1] + \frac{1}{8}y(n-2) = x(n)$$

Where $x(n)$ and $y(n)$ are the input and output of the system, respectively.

(i) Determine the frequency response $H(\omega)$ of the system.

(ii) Find the impulse response $h(n)$ of the system.

[CLO 4, L5]

8. Consider the continuous-time feedback system depicted in Fig. Q8 with $H(s) = \frac{1}{s-1}$ and $G(s) = s - b$. 10

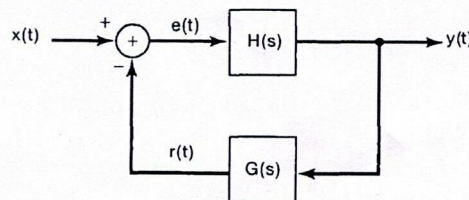


Fig. Q8

Evaluate the real values of b for which the feedback system will be stable.

[CLO 4, L5]