Date: 08/06/2026
Time: 10.00 – 1.00

Khulna University, Khulna
3rd Year Term II Examination
Session: **2024-2025**
Electronics and Communication Engineering Discipline
Course No.: **ECE 3215**
Full Title of the Course: **Power System**
Full Marks: **60** Time: **03** Hours

- 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 per unit (pu) presentation of a system. Explain per unit representation of a transformer with necessary figures and equations. 3

(b) What is 1-line diagram? Suppose there are 3 generators at Goalpara that supply electricity to Khulna. The load is at KU end. Show this using a 1-line diagram. Also, draw the impedance diagram of the designed system. 4

(c) A single phase two-winding transformer is rated 25 kVA, 1100/440 volts, 50 Hz. The equivalent leakage impedance of the transformer referred to the low voltage side is $0.06\angle 78^{o}\ \Omega$. Using transformer rating as base values, determine the per-unit leakage impedance referred to low voltage winding and referred to high voltage winding. 3

2. (a) Define short, medium, and long transmission lines. Draw the nominal-π and nominal-T network of a medium transmission line. 3

(b) For a transmission line, show that AD – BC = 1, where A, B, C, and D are two-port network parameters. 3

(c) What do you mean by fault in a power system? Discuss the possible causes of faults occurred in the power system. Also, explain the consequences of the fault. 4

3. Find out the Y matrix of the 3 bus sample power system as shown in Fig. $Q_3(a)$. Data for this system are given in Table $Q_3(a)$. 10

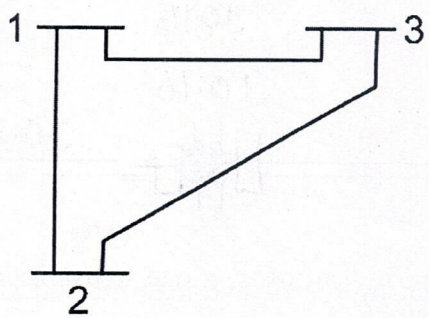


Fig. $Q_3(a)$

Table Q3(a): Per unit impedances and line charging for sample power system shown in Fig. Q3(a)

Bus code i-k	*Impedance* Z_{ik}	*Line charging* $y'_{ik/2}$
1-2	0.02 + *j*0.06	*j*0.03
1-3	0.08 + *j*0.24	*j*0.025
2-3	0.06 + *j*0.18	*j*0.020

4.(a) Write down the comparison between series and shunt Compensation. Also, discuss the application of FACTS controllers for power quality improvement in distribution system. 4

(b) State Fortescue theorem. How are the symmetrical components computed for an unsymmetrical system? 6

SECTION B

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

5.(a) What is power system stability problem? Define steady-state stability limit and transient stability limit. 3

(b) Write down the expression for maximum power developed by the motor and generator of a two machine system. Show the circle diagram of the power developed by the motor and generator. 7

6.(a) Write down the significance of stability and stability limit in a power system. Explain them with the necessary mathematical equations. 3

(b) Explain the maximum swing of the motor to a torque angle δ_m with the help of graphical interpretation and equations. Also, discuss the point by point solution of swing curve. 7

7 The single-line diagram of Figure 7 shows a generator connected through parallel high-voltage transmission lines to a large metropolitan system considered as an infinite bus. Numbers on the diagram are the values of per unit reactances. The transferred reactance of the generator is included in the values marked. Specify in electrical degree the critical clearing angle for the generator for a three-phase fault at the point p when the generator is delivering 1.0 per unit power. The voltage behind transient reactance is 1.25 percent for generator and 1.0 per unit for infinite bus. 10

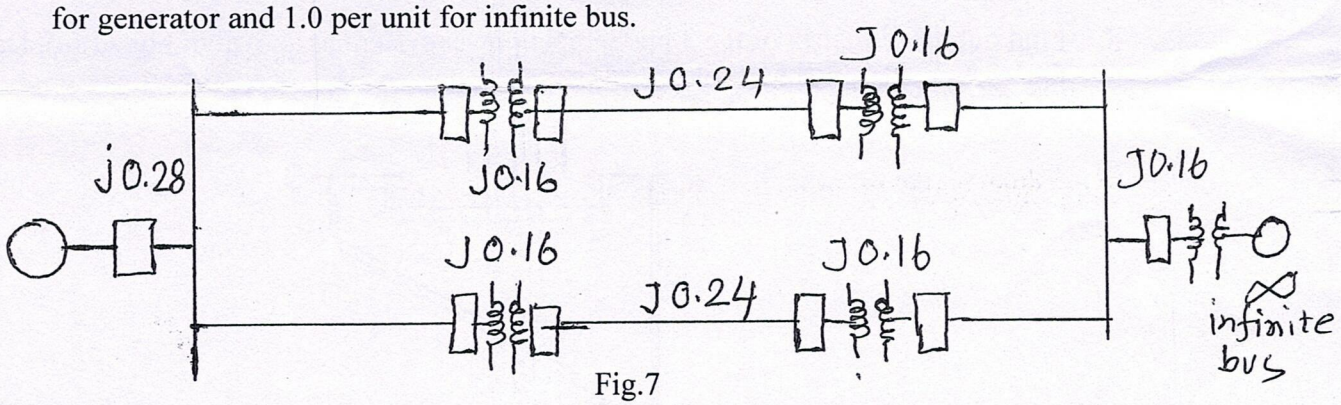


Fig.7

8.(a) What do you mean by sag of overload transmission lines? Deduce the equation of sag support at equal height. 5

(b) A transmission line has a span of 150 m between level supports. The conductor has a cross-sectional area of 2 cm^2. The tension in the conductor is 2000 Kg. If the specific gravity of the conductor material is 9.9 gm/cm^3, and wind pressure is 1.5 kg/m length, calculate the sag. What is the vertical sag? 5

Date: 09/06/2026

Khulna University, Khulna
Electronics and Communication Engineering Discipline
Third Year Second Term Examination
Session: **2024-2025**
Course No.: 071409 CSE 3251
Full Title of the Course: **Microprocessor and Embedded Systems**
Full Marks: **60** Time: **03** Hours Credit Hours: **03**

- The figures in the margin indicate 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) **Explain** the major functional units of the 8086 microprocessor and **illustrate** them by **drawing** a labeled block diagram of its internal architecture. [CLO1, L2] 03

b) The 8086 is a 16-bit microprocessor, and all of its registers are 16 bits wide. However, it has 20 address lines that allow it to access up to 2^{20} = 1 MB of memory. **illustrate** how the 8086 microprocessor, despite having 16-bit registers, is able to **generate** a 20-bit physical address for accessing 1 MB of memory. . [CLO2, L4] 02

c) Compute the values of CF, OF, PF, SF, and ZF flags after **executing** the following assembly instructions: [CLO3, L4] 05

```
MOV AX, 7FFFh
MOV BX, 8001h
ADD AX, BX
```

2 a) **Describe** the following **addressing modes** used in the 8086 microprocessor and **illustrate** each mode with a suitable **example**: [CLO1, L2] 04

- Register Addressing Mode
- Immediate Addressing Mode
- Direct Addressing Mode
- Register Indirect Addressing Mode

b) **Describe** the **Non-Maskable Interrupt (NMI)** and the **Maskable Interrupts (INTR)** in the **8086 microprocessor**, and **identify** which **flag** is used to **control** the maskable interrupts. [CLO1, L2] 03

c) The 8086 microprocessor has a single **CLK** input pin. However, to operate the microprocessor, it must be **connected** to a **crystal oscillator**, which has two output pins. **Describe**, with the help of a **neat labeled diagram**, how the crystal oscillator is **connected** to the 8086 and **explain** the role of the associated circuitry in generating the clock signal. . [CLO2, L2] 03

3 a) In a 8086 microprocessor system, only one byte can be accessed from a RAM at a time. Since the 8086 is a 16-bit processor, we need to **read** 2 bytes simultaneously. For this purpose, 2 memory banks are used. **Describe** how these two memory banks are **utilized** to **access** both 8-bit and 16-bit data in a single bus cycle, using **(BHE)'** and **A0** as the bank selectors, and **A19–A1** as the physical address lines. **Illustrate** your explanation with the necessary diagrams. [CLO3, L2] 05

b) The 8086 microprocessor **reads** memory from even addresses and can **fetch** up to 2 bytes in a single bus cycle. If a 16-bit data resides in memory starting from an **odd address**, **describe** how the 8086 **accesses** this data, and **determine** the number of bus cycles required. **Explain** the mechanism involved in reading split-word data from memory. [CLO3, L3] 05

4 a) Describe programmable interrupt controller and its working principle. [CLO3, L2] 05

b) Suppose the contents of **memory locations 5AF8h** and **5AF9h** need to be **added** and the result **stored** at **8AB8h**. **Write** the **8086 assembly code** to perform this operation. [CLO2, L2] 02

c) **Apply** the interrupt vector mechanism of the 8086 microprocessor to solve the following: 03
In the 8086 architecture, when an `INT nn` instruction is executed, the segment and offset of the Interrupt Service Routine (ISR) are loaded from memory using the formula:
IP = [4 × nn]
CS = [4 × nn + 2]
Now,
i) If the instruction `INT 21h` is called, from which **physical memory addresses** will the values of `IP` and `CS` be loaded?
ii) If `IP = 0FD85h` and `CS = 40ADh`, **calculate** the physical address of the ISR .
[CLO2, L5]

Section B

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

5 a) **Write** an 8051 assembly program to **check** whether the RAM location **0ABh** contains an even value. If it is even, **send** the value directly to **port P0**. If it is odd, **make** it even by **adding 1**, and then **send** the result to **P0**. [CLO1, L3] 02

b) Assume that the RAM bit location **48h** holds the status of whether a new SMS has been received. If the bit is **high**, it indicates that a new SMS has arrived since it was last checked. **Write** an 8051 assembly program to **display** "New SMS" on an LCD connected to **port P1** if the RAM bit **48h** is high. Otherwise, the LCD should **display** "No new SMS". Use lookup table to store the strings. [CLO2, L3] 04

c) Compute the status of the 8051 CY, AC, OV, and P flag after the addition of 9Ch and 64h in the following instructions. [CLO1, L2] 02
MOV A, #9Ch
ADD A, #64h

d) **Create** a **waveform** in which the first **10% of the cycle** is **high**, the next **20%** is **low**, the following **30%** is **high**, and the remaining **40%** is **low**. **Draw** the corresponding **waveform diagram**. You do **not** need to **write** the body of the **delay function**. [CLO3, L2] 02

6 a) Write a 8085 subroutine to produce a delay of 400 ms when the crystal frequency is 12 MHZ. [CLO2, L2] 05

b) Write a program to perform **Multiplication** of two 8-bit numbers stored in R0 and R1. If the result is greater than 8 bits ($> FFH$), turn on an error LED at P3.7. . [CLO2, L2] 02

c) Examine the following three lines of 8051 assembly code: 03

```
MOV A, #20
MOV A, 20
MOV P0.3, 20
```

Analyze and **describe** whether the value **20** in the instructions **represents the same thing** or has **different interpretations** in the context of these instructions. . [CLO2, L3]

7 a) A push-button is connected to pin P3.2. Write an assembly program that increments the value in RAM location 30h by 1 every time the button is pressed (receives a High signal). . [CLO2, L3] 03

b) An 8-bit number is stored in R5. Write a program to count the total number of **set bits (1s)** in that number and store the count in R2. . [CLO3, L3] 03

c) A block of 10 numbers is stored in RAM starting at address 40h. Write a program to find the **largest number** in the block and move it to Register R3. . [CLO3, L2] 03

d) **Identify** which **8051 port(s)** require **external pull-up resistors**, and **state** the typical **resistance value** of these resistors in **ohms**. [CLO2, L2] 01

8 a) Explain A/D conversion process in embedded systems. [CLO 4, L3] 04

b) Use bit-addressable instructions (SETB, CLR, CPL, JB) to monitor pin P1.2: If it becomes High, set the bits at RAM locations **20h.0, 20h.1, and 20h.2**. If it stays Low, clear them. [CLO3, L3] 02

c) An 8-bit value is in Register B. Without using the SWAP instruction, write a sequence of instructions to exchange the **upper nibble** and **lower nibble** of Register B. [CLO3, L4] 02

d) You have a string "READY" stored in a lookup table. Write a program to transfer this string to a sequence of RAM locations starting at 60h, ending when the null character is reached. [CLO2, L2] 02

Date: 09.06.2026

Khulna University, Khulna Time: 10.00 – 1.00

Electronics and Communication Engineering Discipline

3rd Year Second Term Examination

Session: **2024-2025**

Course No.: **CSE 3151**

Full Title of the Course: **Microprocessor and Embedded Systems**

Full Marks: **60** Time: **03** Hours Credit Hours: **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) **Explain** the major functional units of the 8086 microprocessor and **illustrate** them by **drawing** a labeled block diagram of its internal architecture. 04

(b) Compute the values of CF, OF, PF, and SF flags after executing given assembly instructions..... 04

```
MOV AX,7FFFh
MOV BX,8001h
ADD AX,BX
```

(c) Suppose the contents of **memory locations 5AF8h** and **5AF9h** need to be **added** and the result **stored** at **8AB8h**. **Write** the **8086 assembly code** to perform this operation. 02

2.(a) **List** and **describe** all the **predefined interrupts** of the **8086 microprocessor**. 05

(b) **Illustrate** how 8086 multiplexes address and data using ALE with a diagram. 05

3.(a) **Determine** the **minimum number of clock cycles** required for a **basic bus (read or write) cycle** of the **8086 microprocessor**. **Draw** the **timing diagram** of the 8086 basic bus cycle for both **read and write operations**, and **explain** the **read**, **write**, and **wait states** shown in your diagram. 06

(b) **List** the names of the following **8086 flags** — CF, PF, AF, ZF, SF, IF, DF, and OF — and **describe** their **full names** as well as their **functionalities**. 04

4.(a) The **8086 microprocessor** uses two separate **8-bit memory banks** to handle **16-bit data transfers**. **Explain** how the **8086 memory management technique** allows simultaneous access of **two bytes** in a single bus cycle using the signals **(BHE)'** and **A0** as **bank selectors**, and **apply** this concept to show how **8-bit** and **16-bit** data transfers are performed. 07

(b) **Describe** the **Non-Maskable Interrupt (NMI)** and the **Maskable Interrupts (INTR)** in the **8086 microprocessor**, and **identify** which **flag** is used to **control** the maskable interrupts. 03

SECTION B

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

5.(a) **Read** a data byte from **Port 02** and another from **Port 01**. **Divide** the data from Port 02 by the data from Port 01. **Send** the **quotient** to **Port 03** and **send** the **remainder** to **Port 00**. **Write** the **8051 assembly program** to accomplish this task. 02

(b) The user will **place** data on **Port1**. After placing the data, the user will **give** a high signal on **P2.3**. You have to **save** all the data provided by the user starting from **RAM location 35h**. **Write** an **8051 assembly program** to accomplish this task. 03

(c) **Write** an assembly language program for the 8051 microcontroller that performs the following tasks. First, store a lookup table containing the squares of the numbers from 0 to 9 at memory location 200h. Then, take an input number from Port1, access its square value from the lookup table, and display that value on Port2. Write the complete program to implement this functionality. 03

(d) **Write** a program to load 55H into ACC and repeat its complement 700 times. 02

6.(a) **Write** an **8051 assembly program** to **receive** a byte of data serially, **one bit at a time**, via **pin P2.7**, and **store** the byte in **register R7**. The byte is transmitted in **LSB-first** order. 03

(b) **Write** an **8051 assembly program** that will **take input** from **Port 01** and **display** its **3-digit decimal value** on **Port 00, Port 02, and Port 03**. 03

- **Port 02** should show the **most significant digit (MSD)**.
- **Port 00** should show the **least significant digit (LSD)**.

(c) **Read** an 8-bit data from Port02 of 8051 04

- If the data is not odd, send letter 'Nope' to P2
- If the data is odd, send letter 'Yeah' to P2

7.(a) Assume that the **ROM memory space** starting at **250h** contains the string **"BANGLADESH"**. **Write** an **8051 assembly program** to **transfer** the bytes from ROM into **RAM locations** starting at **40h**. 04

(b) A **switch** is connected to the **8051 pin P1.7**. **Write** an **8051 assembly program** to **check** the status of the switch and **perform** the following actions: 04

i) If **SW = 0**, **send** the letter **'N'** to **P2**.
ii) If **SW = 1**, **send** the letter **'Y'** to **P2**.

Use the **carry flag (CY)** to **check** the switch status.

(c) **Create** a **waveform** in which the first **40% of the cycle** is **high**, the next **30%** is **low**, the following **20%** is **high**, and the remaining **10%** is **low**. **Draw** the corresponding **waveform diagram**. You do **not** need to **write** the body of the **delay function**. 02

8.(a) **Explain** how to **switch** to the **default register bank** in the 8051 microcontroller. Then, **write** an **8051 assembly program** to **select register bank 3** (considering there are **4 register banks**: bank0, bank1, bank2, and bank3). 03

(b) **Take** an **8-bit input** from **Port 2**. **Count** the number of **1's** and **0's** in the input byte, and **display** the results on **Port 0** (number of 1's) and **Port 1** (number of 0's). **Write** an **8051 assembly program** to accomplish this task. 03

(c) **Examine** the following two lines of **8051 assembly code**: 03

```
MOV A, #32
MOV A, 32
MOV P0.3, 32
```

Analyze and **describe** whether the value **'32'** in both lines **represents the same thing** or not.

(d) **Read** a data byte from **8051 Port 2**. **Write** an **8051 assembly program** to **compute the 2's complement** of the input data. 01

Date: 14.06.2026

Khulna University, Khulna Time: 10.00 – 1.00

Electronics and Communication Engineering Discipline

Third Year Second Term Examination

Session: **2024-2025**

Course No.: **0714 09 ECE 3203**

Full Title of the Course: **Digital Communication**

Full Marks: **60** Time: **03** Hours Credit Hours: **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 the key difference between analog and digital communication? Discuss the advantages of digital communication over analog communication. [L1; CLO-1] 03

(b) Two signals, $x_1(t)$ and $x_2(t)$, are said to be orthogonal to each other. 05

a) What is meant by orthogonality of two signals?

b) Suppose a transmitter uses the following two signals:

$$s_1(t) = A, \quad 0 \le t \le T$$

$$s_2(t) = \begin{cases} A, & 0 \le t \le \frac{T}{2} \\ -A, & \frac{T}{2} \le t \le T \end{cases}$$

Find the orthonormal basis waveforms $\phi_1(t)$and $\phi_2(t)$such that $s_1(t)$and $s_2(t)$can be expressed as linear combinations of these basis waveforms. [L4; CLO-1]

(c) What is the role of encryption in digital communication? [L2; CLO-1] 02

2.(a) Explain the concept of Maximum Likelihood (ML) decoding in digital communication in your own words. Suppose 2-bit symbols are mapped to signal vectors as follows: 05

$$00 \rightarrow \mathbf{s}_{00} = (1,1)$$
$$01 \rightarrow \mathbf{s}_{01} = (1,-1)$$
$$10 \rightarrow \mathbf{s}_{10} = (-1,1)$$
$$11 \rightarrow \mathbf{s}_{11} = (-1,-1)$$

The received vector is $\mathbf{r} = (-0.5, 0.7)$

Using Maximum Likelihood (ML) decoding, compare the distances between the received vector and all possible signal vectors, and justify why the selected symbol is the most likely transmitted symbol. [L4; CLO-1]

(b) Define entropy. Consider a Binary Symmetric Channel (BSC) with input and output symbols represented as $\{0, 1\}$. The probability of error is $p = 0.1$. Assuming that the input symbols are equally likely, calculate the mutual information provided by the channel to the receiver. [L4; CLO-1] 05

3.(a) What is the purpose of source encoding? A source emits six symbols with probabilities 0.30,0.25,0.15,0.12,0.10,and 0.08. Construct a Huffman code for the source. Also calculate the average code length, source entropy, and coding efficiency. [L4; CLO-1] 04

(b) Differentiate between coherent detection and non-coherent detection in digital communication. Explain the detection process of an ASK-modulated signal using an envelope detector. [L4; CLO-1] 04

(c) Among ASK, FSK, and PSK modulation techniques, which one is most resilient to noise? Justify your answer. [L4; CLO-2] 02

4.(a) What is the advantage of using 16-PSK over 8-PSK? For a tribit input of $Q = 0, I = 0$ and $C = 0(000)$, determine the output phase for the 8-PSK modulator shown in Fig. 4(a). Show the location of the corresponding signal point in the 8-PSK constellation diagram. [L5; CLO-3] 05

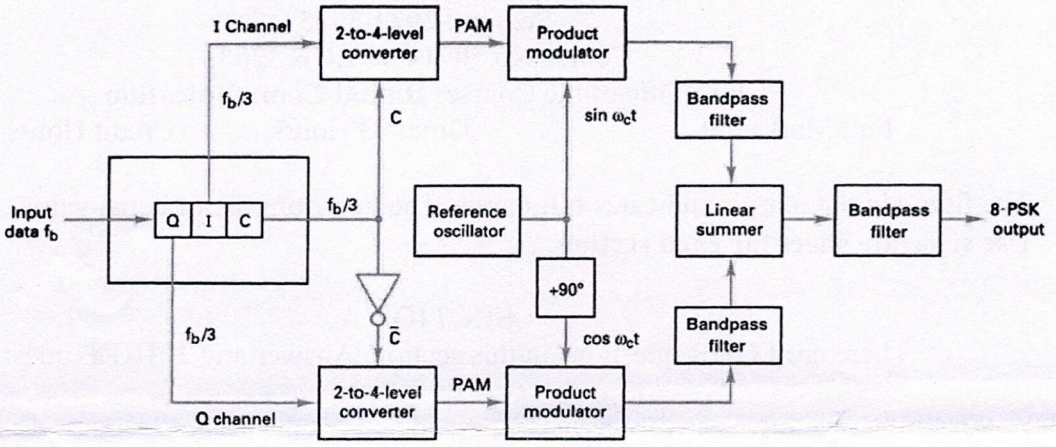


Fig. 4(a)

(b) Explain the concept of Inter-symbol Interference (ISI) in baseband digital communication. State or derive the Nyquist criterion for distortion-less transmission and explain how this criterion ensures zero ISI at the sampling instants. [L5; CLO-4] 05

SECTION B

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

5.(a) Derive the probability of error for an on-off signaling (OOK) scheme using the concept of threshold detection. [L1, CLO 5] 04

(b) Polar binary pulses received with peak amplitude A_p = 1mV. Channel noise rms amplitude is 192.3 μV. Use threshold detection and equally likely probability of bits to find the detection error probability for polar, unipolar and bipolar cases. [L3, CLO 5] 03

(c) Draw the following waveform for the bit sequence – 0110000000100001100: 03
(i) Bipolar AMI, (ii) B8ZS and (iii) HBD3. [L3, CLO 5]

6.(a) Prove that, "Quantization error equals the difference between sampled value and quantized value". [L2, CLO 5] 03

(b) Explain the concept of PCM receiver with necessary figure. [L2, CLO 5] 04

(c) Compare among PCM, DPCM and DM systems. [L3, CLO 5] 03

7.(a) Discuss the concept of redundancy in error detection and correction. [L3, CLO 5] 03

(b) Find the minimum hamming distance for the following cases: 2+2=
(i) Detection of two errors 04
(ii) Correction two errors. [L1, CLO 5]

(c) Find the values of k and n in the hamming code $c(n,k)$ with d_{min} = 3 to create a dataword of at least 11 bits. [L4, CLO 5] 04

8.(a) Draw a (2,1,2) convolution encoder. Find it's rate. Also sketch the trellis diagram and the state diagram. [L4, CLO 5] 2+1+2+1=6

(b) Explain the model of a spread spectrum communication system. [L2, CLO 5] 04

Date: 14.06.2026

Khulna University, Khulna Time: 10.00 – 1.00

Electronics and Communication Engineering Discipline

3rd Year Term II Examination

Session: **2024-2025**

Course No.: **ECE 3107**

Full Title of the Course: **Digital Communication**

Full Marks: **60** Time: **03** Hours Credit Hours: **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 symbol, digital waveform, data rate, and baud rate. Mention some advantages of digital over analog communication. 4

(b) Write down sampling theorem. Briefly explain impulse sampling both in time and frequency domain. 4

(c) Sketch the block diagram and explain the basic digital communication system. 2

2.(a) Write down the difference between baseband and passband signal. What is aliasing? Explain the ways of eliminating aliasing. 3

(b) Sketch and explain the generation and reconstruction of in-phase and quadrature samples from band-pass signal. 4

(c) 12 speech signals, each bandwidth limited to 3.5 kHz and sampled at a rate of 8 kHz are to be transmitted as PAM signals over a certain channel using TDM. Assuming a guard time of half the pulse width, calculate the minimum bandwidth of the channel, if the cross-talk factor (arising from high frequency limitation of the channel) between adjacent channels is less than 10^{-3}. 3

3.(a) Represent the binary data, $X = \{1\ 1\ 0\ 1\ 0\ 0\ 1\ 1\ 0\ 1\}$ in RZ-Polar, NRZ-Bipolar and Manchester format. 3

(b) For the binary input sequence $X = \{1\ 1\ 0\ 1\ 0\ 0\ 1\ 1\ 0\ 1\}$, find the duo-binary coder output using pre-coder. Also explain the binary signal recovering process at the receiver with necessary block. 5

(c) Draw a BPSK signal for the binary input $X = \{1\ 1\ 0\ 1\ 0\ 0\ 1\}$ using sinusoidal carrier signal. 2

4.(a) Draw and explain briefly the PSK transmitter and receiver. 4

(b) Compare BPSK and QPSK in terms of error performance. 2

(c) What is Quadrature Phase Shift Keying (QPSK), and how does it improve data rate? Why GMSK is preferred in mobile communication? 4

SECTION B

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

5.(a)	What is meant by optimum detection?	02
(b)	Describe binary hypothesis testing in communication systems.	04
(c)	Explain the principle of correlation detection with a block diagram.	04
6.(a)	Explain the concept of QAM demodulation with necessary figure.	03
(b)	Describe QPSK detection with appropriate figure.	04
(c)	Draw the constellation diagram of QPSK and 8PSK.	03
7.(a)	Define signal error and burst error.	03
(b)	State and explain the condition for error detection capability of a block code in terms of minimum Hamming distance.	04
(c)	We need a dataword of at least 7 bits. Calculate values of k and n that satisfy this requirement.	03
8.(a)	Draw a (2,1,2) convolution encoder. Find it's rate. Also sketch the trellis diagram and the state diagram.	2+1+ 2+1= 6
(b)	Decode the received data bit sequence, `0110110000` using Viterbi Algorithm.	04

Date: 16/06/2026

Khulna University, Khulna Time: 10.00 – 1.00

3rd Year Term II Examination

Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **ECE 3201 (R)**

Full Title of the Course: **Electrical Engineering Materials**

Full Marks: **60** Time: **03** Hours

- 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 polarization. A rare gas is subjected to an electric field **E**. Prove that $\varepsilon_r - 1 = 4\pi NR^3$, where symbols have their usual meanings. 5

(b) Define orientational polarization. Show that orientational polarization is inversely proportional to the temperature and proportional to the square of the permanent dipole moment. 5

2. (a) The centers of two identical atoms of polarizability $\boldsymbol{\alpha}$ farad m^2 are separated by a distance of $\boldsymbol{a}$ meters. A homogeneous electric field **E** is applied in a direction parallel to the line joining the centers of the two atoms. Calculate the internal field $\mathbf{E}_i$ at the position of each of the atoms. For $\alpha = 2 \times 10^{-40}$ farad m^2 and $a = 5 \times 10^{-10}$ m, determine the ratio between $\mathbf{E}_i$ and **E.** 5

(b) What do you understand by spontaneous polarization? 3

(c) Differentiate between Ferroelectric and Piezoelectric materials. 2

3.(a) Derive the Clausius-Mosotti expression for the dynamic field. 4

(b) Explain the frequency dependence of the electronic polarizability in detail. 6

4.(a) What do you mean by dipolar relaxation? Suppose an electric field $\mathbf{E}(t) = \mathrm{E}_o cos\omega t$ is applied across a dielectric material. If τ represents the relaxation time of the material, show that the polarization vanishes when $\gg 1$. 5

(b) Define dielectric loss. Prove that the imaginary part gives rise to absorption of energy by the dielectric material from the alternating field. 5

SECTION B

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

5.(a) What are the factors that may slow down electron's flow in a metal? What is meant by Debye temperature? Show that above the Debye temperature the thermal conductivity of pure metals are independent of temperature. 4

(b) The temperature difference between the inside and the outside of a glass window is 70° F. The glass has a thermal conductivity of 0.025 calories/sec/cm/°C and is 1 cm thick. Find the energy loss in joules through the window per square meter per day. 4

(c) Define the Lorenz number. Explain its significance in relating electrical conductivity and thermal conductivity in materials. 2

6.(a) What is a superconductor? Explain the phenomenon of superconductivity with reference to zero electrical resistance and the Meissner effect. Define and discuss critical temperature, critical magnetic field, and critical current density. 5

(b) Explain the BCS theory of superconductivity. What are Cooper pairs? Describe how electron-phonon interaction leads to the formation of Cooper pairs and the onset of superconductivity. 5

7.(a) Differentiate between Type I and Type II superconductors. Describe the applications of superconductors in modern technology. 5

(b) What is a SQUID (Superconducting Quantum Interference Device)? Explain its working principle based on Josephson junctions and discuss its applications in ultra-sensitive magnetic field detection. 5

8.(a) Define magnetization (M) and magnetic susceptibility (χ). How are they related? Explain the physical meaning of positive and negative susceptibility. 3

(b) Differentiate between diamagnetic, paramagnetic, and ferromagnetic materials based on their atomic magnetic moments and response to an external magnetic field. 4

(c) Describe the difference between soft magnetic materials and hard magnetic materials with suitable examples and applications. 3

Date: 18/06/2026

Khulna University, Khulna Time: 10.00 – 1.00

3rd Year Term II Examination

Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **071409 ECE 3209**

Full Title of the Course: **Semiconductor Processing and Fabrication Technology**

Full Marks: **60** Time: **03** Hours

- 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 an Integrated Circuit and distinguish between active and passive components with examples of each. [L1; CLO1] 3

(b) Explain why 'Yield' is considered one of the most critical factors in semiconductor manufacturing and list four factors that influence it. [L2; CLO1] 3

(c) Analyze the advantages of ICs over discrete circuits, specifically focusing on how batch fabrication contributes to reduced costs and higher reliability. [L4; CLO1] 4

2. (a) Compare Silicon and Germanium as substrate materials. Why is Silicon preferred for high-temperature operations and high PIV ratings? [L2; CLO1] 3

(b) Discuss the importance of 'Stress-free' film deposition. How does excess stress in a deposited film lead to electrical shorts or surface contamination? [L4; CLO1] 3

(c) Explain the operation of Molecular Beam Epitaxy (MBE) and list its primary advantages and disadvantages compared to other deposition methods. [L2; CLO1] 4

3. (a) Define 'Oxidation' and list three primary purposes of growing a silicon dioxide (SiO_2) layer on a wafer. [L1; CLO2] 2

(b) Explain the two steps of the diffusion process: Pre-deposition and Drive-in. How do these steps differ in terms of impurity concentration and depth? [L2; CLO2] 3

(c) During a constant-source diffusion, the surface concentration is maintained at $N_s = 5 \times 10^{20}$ cm^{-3}. After 2 hours at 1000°C, the diffusion depth is 0.5 μm. Estimate the impurity concentration at this depth using the erfc relation. Given that $D = 3 \times 10^{-14}$ cm^2/s, and use the standard erfc table, attached here with (Table for Q3(c)). [L4; CLO2] 5

4.(a) Compare Wet Etching and Dry Etching (RIE) in terms of 'Isotropy' and 'Directionality'. Why is dry etching preferred for VLSI patterns? [L2; CLO2] 3

(b) Analyze the 'Liftoff' process used in GaAs technology. How does it differ from traditional etching for defining metallized patterns? [L4; CLO2] 3

(c) Describe the two-step RCA cleaning process (SC-1 and SC-2). What specific residues does each step aim to remove? [L2; CLO2] 4

SECTION B

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

5.(a) Explain the process of coating photoresist on a wafer using the spin coater. (CLO3; L2) 4

(b) List some differences between photolithography and electron beam lithography (EBL). (CLO3; L2) 4

(c) Mention the factors that control the resolution of EBL. (CLO3; L1) 2

6.(a) Draw the cross-sectional view of a diffused monolithic resistor. (CLO4; L3) 2

(b) Draw the cross-sectional view of an emitter-base diode with collector shorted to base. Also discuss the significance of it. (CLO4; L3, L5) 5

(c) List some differences between a monolithic integrated transistor and a discrete planar transistor. (CLO4; L2) 3

7.(a) Draw the cross-sectional view of a CMOS NAND gate. (CLO4; L3) 3

(b) Mention some characteristics of a super-β transistor. (CLO4; L1) 3

(c) Draw the cross-sectional view of a MOS capacitor. Also draw the equivalent circuit of it and explain. (CLO4; L2, L3) 4

8.(a) List some differences between partially depleted and fully depleted SOI devices. (CLO4; L4) 3

(b) List the steps involved in IC packaging process. Explain the die attach process. (CLO4; L1, L2) 2+2=4

(c) Explain thermosonic bonding process briefly. (CLO4; L2) 3

Table for Q3(c)-Numerical Values of the Complementary Error Function

η	$erfc(\eta)$	η	$erfc(\eta)$
0	1.0	1.1	0.11980
0.05	0.94363	1.2	0.08969
0.1	0.88754	1.3	0.06599
0.15	0.83200	1.4	0.04772
0.2	0.77730	1.5	0.03390
0.25	0.72367	1.6	0.02365
0.3	0.67137	1.7	0.01621
0.35	0.62062	1.8	0.01091
0.4	0.57161	1.9	0.00721
0.5	0.47950	2.0	0.00468
0.6	0.39615	2.5	0.000407
0.7	0.32220	3.0	0.0000221
0.8	0.25790	3.5	0.00000074
0.9	0.20309	4.0	0.00000001
1.0	0.15730	∞	0.0000000000

Date: 18/06/2026

Khulna University, Khulna

Third Year **Second** Term Examination, Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **0714 09 ECE 3213**

Full Title of the Course: **Data Engineering**

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 A

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

1(a) Compare Data, Information, and Knowledge. [L-1; CLO-1] 02

1(b) The following table shows a survey of 100 students records of gender (Male, Female) and drink preference (Tea, Coffee). 3.5

	Tea	Coffee
Male	30	20
female	20	30

Perform a Chi-Square test method to test whether drink preference is independent of gender. Consider the value of $\alpha = 0.05$. [L-3; CLO-3]

1(c) Suppose you have a dataset. $x = \{10,15,20,25,30\}$. Convert the values of this Dataset within the range $[-1, +1]$. [L-2; CLO-2] 02

1(d) For the following data, find out the value of Mode: [L-2; CLO-2] 2.5

Class Boundary	20-30	30-40	40-50	50-60	60-70
Frequency	30	38	70	42	20

2(a) Suppose you have the following classes $C = \{C_1, C_2, C_3, C_4\}$ having the corresponding logic values, $z = \{2.0,1.0,0.1,0.5\}$. If you use a softmax layer, what will be its output? Which class will be selected as the decision class and why? [L-4; CLO-2] 3.5

2(b) What do you understand by Qualitative Data and Quantitative Data? Give two examples of those types of Data. [L-2; CLO-2] 02

2(c) What do you understand by 3-Sigma rule? For the dataset $D = \{75,82,90,68,95\}$, Calculate the Z-score for 82. [L-2; CLO-2] 03

2(d) Make a stem-and-leaf plot for the following data 1.5
$S = \{31,34,23,25,28,36,41,37,45,43,53,52,46,55,57\}$. [L-2; CLO-1]

3(a) Consider you have the following dataset,

Student Name	A	B	C	D	E	F	G
Score	65	70	72	NaN	75	NaN	68

03

Find the missing value of D and F using Parametric Distribution Imputation. Consider a random standard normal value for D is $Z_D = 0.35$ and F is $Z_F = -0.35$. [L-3; CLO-2]

3(b) For the following dataset, find Covariance Matrix, Value of Variances, and Covaraiances. [L-3; CLO-3] 03

Samples	Feature		
	F_1	F_2	F_3
Sample 1	2	4	6
Sample 2	4	6	8
Sample 3	6	8	10

3(c) The following table shows the data for exam scores under 3 teaching methods: [L-3; CLO-3] 04

Method A	65	70	75	80	60
Method B	75	80	85	90	70
Method C	55	60	65	70	50

Usimg ANOVA test method, test whether the three means differ significantly? Consider $\alpha = 0.05$.

4(a) Suppose you have the following Left Table and Right Table. 02

Left Table			Right Table.	
Student ID	Study Hours		Student ID	Study Hours
101	12		101	85
102	08		103	92
103	15		104	78

Perform the following join operation. a) Inner Join, b) Left Join, c) Right Join, and d) Full Outer Join. [L-2; CLO-2]

4(b) Suppose you have the following Dataset, having Six samples, and Four features. Make a correlation table for this Dataset. Based on the value of correlation, make an appropriate reduction of features. [L-4; CLO-3] 06

Sample	Feature			
	F_1	F_2	F_3	F_4
1	1	2	10	5
2	2	4	9	4
3	3	6	8	6
4	4	8	7	5
5	5	10	6	7
6	6	12	5	6

4(c) Why is Data Encoding important in Data Engineering? Define One Hot Encoding. Suppose you have four classes, $C = \{Walk, Run, Sit, Stand\}$, convert these classes into one-hot encoding. [L-2; CLO-1] 02

SECTION B

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

5(a) Define samples and attributes. Explain how models use data for prediction, classification, and decision-making. [L1; CLO-4] 03

5(b) A company wants to predict its daily coffee sales (y) based on two factors: x_1: temperature ($^\circ C$) and x_2: number of advertisements placed. They have some observed data points as follows: 05

Day	Temperature (x_1)	Advertisements (x_2)	Coffee Sales (y)
1	18	1	45
2	22	2	55
3	25	3	68
4	30	2	72

i. Find the multiple linear regression model for the given data.
ii. Compute the root mean squared error (RMSE) and F-statistic of the regression model. Also, interpret the value of RMSE and F-statistic [L4; CLO-4]

5(c) How can a distribution plot be used to assess the performance of a regression model? Explain your answer with a necessary figure. [L4; CLO-4] 02

6(a) For large practical datasets, explain how the regression coefficients are computed efficiently. [L2; CLO-4] 02

6(b) The following small dataset contains the response y_i of a sensor for different input concentrations x_i: 08

x_i	1	2	4	6	8
y_i	1.20	1.95	2.70	3.10	3.35

The non-linear regression model for this data is given by:

$$f(x; a, b) = \frac{ax}{b + x}$$

where a and b are unknown model parameters.
Estimate the parameters a and b using the Gauss-Newton iterative approach. Use the initial guesses:

$$a^{(0)} = 4, b^{(0)} = 2$$

Perform at least two iterations. Compare the prediction errors after the first and second iterations. [L6; CLO-4]

7(a) Define bias and variance in machine learning. Explain the bias-variance trade-off and discuss how bias and variance are related to model underfitting and overfitting. Support your answer with suitable examples or diagrams. [L4; CLO-4] 05

7(b) Explain the concepts of cross-validation and grid search in machine learning. How can cross-validation be used together with grid search to select the best hyperparameters for a model? Support your answer with a suitable example. [L3; CLO-4] 05

8(a) What are the 5 Cs of data science ethics? Explain each principle and discuss its importance in responsible data science practice. [L2; CLO-5] 05

8(b) What is meant by Generative AI? Why does ethics matter in the context of Generative AI? [L2; CLO-5] 05

Date: 21/06/2026

Khulna University, Khulna

Third Year **Second** Term Examination, Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **0714 09 ECE 3107**

Full Title of the Course: **Electromagnetic Fields & Waves**

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) Provide a brief mathematical and physical explanation of Gauss's law. Use Gauss's law to find the electric field due to a uniformly distributed line of charge. [L2, CLO1] 05

1(b) Derive an expression for **E** due to a sphere of radius 'a' of uniform care density ρ_v in region: (i) $r < a$, (ii) $r = a$, (iii) $r > a$. [L2, CLO1] 05

2(a) What do you mean by electric dipole and dipole moment? Deduce the expression for the electric potential due to an electric dipole at a point far away from the dipole. [L2, CLO1] 05

2(b) Show that **E**= -grad(φ). Deduce Poisson's equations. [L2, CLO2] 05

3(a) Determine the charge density due to the following electric flux density: [L2, CLO2] 06

(i) $\overline{D} = 10xy\hat{a}_x - 6x^2\hat{a}_y \text{ C/m}^2$

(ii) $\overline{D} = \rho\sin\psi\hat{a}_\rho + 2\rho\cos\psi\hat{a}_\psi + 2z^2\hat{a}_z \text{ C/m}^2$

3(b) Compute the vector magnetic potential at a point $P(r,\theta,\varphi)$ due to a circular loop of current *I*. [L3, CLO3] 04

4(a) For the following vector magnetic potential, find out $\overline{B}$ at (1,0,-1): [L4, CLO3] 05

$\overline{A} = 5x^2y\hat{a}_x + xy\hat{a}_y - 3xyz\hat{a}_z$. Wb/m

4(b) Use $\nabla \times \overline{H} = \overline{J}$ to determine $\overline{J}$ at (1,0,-1) for 05

$\overline{H} = yz(x^2 + y^2)\hat{a}_x - xy^2\hat{a}_y + 4x^2y^2\hat{a}_z$. [L5, CLO3]

SECTION B

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

5(a) What do you mean by the static and dynamic electromagnetic field? [L1, CLO4] 02

5(b) Using Maxwell's equations, derive the one-dimensional electromagnetic wave equation. [L4, CLO4] 04

5(c) An EM wave propagating in a certain medium is described by $\mathbf{E} = 25\sin(2\pi \times 10^6 t - 6x)\mathbf{a}_z$ V/m [L5, CLO5] 04

(i) Determine the direction of wave propagation.

(ii) Compute the period, the wavelength, and the velocity.

6(a) What do you mean by the transverse electromagnetic wave and uniform plane wave? [L1, CLO4] 02

6(b) Deduce $\mathbf{E}(z,t) = E_0 e^{-\alpha z}\cos(\omega t - \beta z)\,\mathbf{a_x}$,where symbols have their usual meanings. [L5, CLO4] 05

6(c) Suppose an electromagnetic wave is travelling in a medium that is characterized by $\varepsilon = 2\varepsilon_0$, $\mu = 5\mu_0$. If at 5 MHz, the phase constant is 10 rad/m, calculate the [L5, CLO5] 03

(i) wave velocity, (ii) intrinsic impedance

(iii) attenuation constant

7(a) Explain why mobile phone signals become weak inside an elevator. [L2, CLO5] 02

7(b) Explain the Poynting theorem and determine the unit and direction of $\mathbf{E_x} \times \mathbf{H_y}$. [L1+L4, CLO4] 2+2=4

7(c) Sea water plays a vital role in the study of submarine communications. Assuming that for sea water $\sigma = 4$ S/m, $\varepsilon_r = 80$, $\mu_r = 1$ and $f = 100$ MHz, calculate the (i) phase velocity (ii) wavelength (iii) skin depth (iv) intrinsic impedance. [L5, CLO5] 04

8(a) Define the wave polarization. What are the necessary and sufficient conditions of a linear polarization? [L2, CLO4] 1+2=3

8(b) For the case of reflection of plane wave at normal incidence, deduce the following relation: 03

$$\Gamma = \frac{\eta_2 - \eta_1}{\eta_2 + \eta_1}$$

Where symbol have their usual meanings. [L2, CLO4]

8(c) Given that $\mathbf{E_s} = E_0(\mathbf{a_x} - j\mathbf{a_y})e^{-j\beta z}$, determine: [L5, CLO5] 04

(i) Polarization of the wave (linear, circular or elliptical). Justify your answer.

(ii) Sense of rotation (CW or CCW) of the wave. Justify your answer.

Important Relations:

$$\alpha = \omega\sqrt{\frac{\mu\varepsilon}{2}\left[\sqrt{1+\left(\frac{\sigma}{\omega\varepsilon}\right)^2}-1\right]} \quad / \quad \beta = \omega\sqrt{\frac{\mu\varepsilon}{2}\left[\sqrt{1+\left(\frac{\sigma}{\omega\varepsilon}\right)^2}+1\right]} \quad \text{and} \quad \eta = \sqrt{\frac{j\omega\mu}{\sigma+j\omega\varepsilon}}$$

Cylindrical coordinates:

$$\nabla = \boldsymbol{a_\rho}\frac{\partial}{\partial\rho} + \boldsymbol{a_\varphi}\frac{1}{\rho}\frac{\partial}{\partial\varphi} + \boldsymbol{a_z}\frac{\partial}{\partial z}$$

$$\nabla \times \mathbf{A} = \frac{1}{\rho}\begin{vmatrix} \mathbf{a_\rho} & \rho\mathbf{a_\varphi} & \mathbf{a_z} \\ \frac{\partial}{\partial\rho} & \frac{\partial}{\partial\varphi} & \frac{\partial}{\partial z} \\ A_\rho & \rho A_\varphi & A_z \end{vmatrix}$$

Date: 21/06/2026

Khulna University, Khulna

Electronics and Communication Engineering Discipline

Third Year **Second** Term Examination

Session: **2024-2025**

Course No.: **ECE 3207 (R)**

Full Title of the Course: **Digital Signal Processing**

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 static and dynamic systems with an example. 04

1(b) Check the stability. 06

$$\text{(i) } y(n) = a^n u(n), \quad \text{(ii) } y(n) = \left(\frac{1}{2}\right)^n u(n)$$

2 Consider the system, $y(n) = y(n-1) + 2y(n-2) + x(n) + 3x(n-1)$. 5+2+3=10

(i) Find $H(z)$, (ii) Realize using, direct form-I and (iii) direct form-II.

3 Compute 8-point DFT of the sequence $x(n) = \{1, 2, 1, 2, 1, 2, 2, 1\}$ using radix-2 DIF-FFT algorithm. 10

4 Compute IDFT of the sequence 10

$x(n) = \{7, -0.707 - j0.707, -j, 0.707 - j0.707, 1, 0.707 + j0.707, j, -0.707 + j0.707\}$.

SECTION B

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

5(a) List and briefly explain the basic computational elements required to implement a digital network for a linear shift-invariant system. 05

5(b) Find the frequency response of the system defined by the network shown in Fig. Q5(b). 05

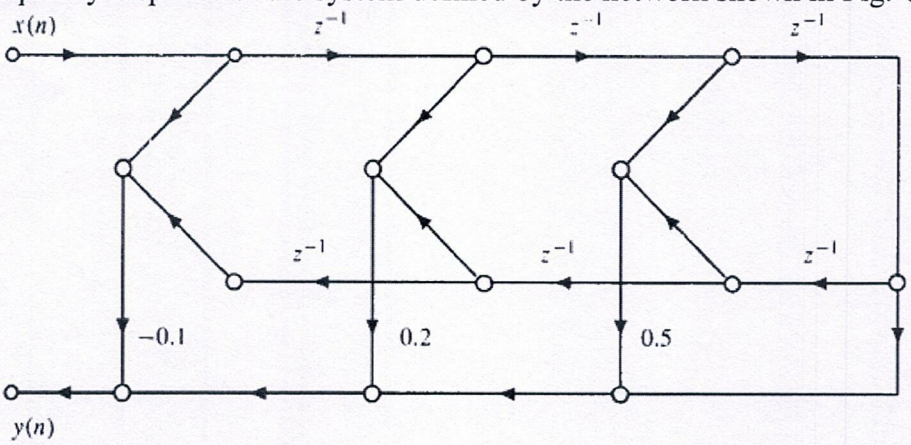


Fig. Q5(b)

6(a) List the different structures for (i) FIR systems and (ii) IIR systems. Describe the Direct Form IIR structures briefly. 05

6(b) A linear shift-invariant system has a unit sample response given by 05

$h(0) = -0.01$
$h(1) = 0.02$
$h(2) = -0.10$
$h(3) = 0.40$
$h(4) = -0.10$
$h(5) = 0.02$
$h(6) = -0.01$

(i) Draw a signal flowgraph for this system that requires the minimum number of multiplications.

(ii) If the input to this system is bounded with $|x(n)| < 1$ for all n, what is the maximum value that the output, $y(n)$, can attain?

7(a) List the window types used for designing FIR filters. Analyze and compare the main-lobe width and side-lobe amplitude characteristics of the Rectangular window versus the Blackman window. Explain how these spectral characteristics directly influence the resulting filter's transition width and stopband attenuation. 05

7(b) Find the Kaiser window parameters, β and N, to design a low-pass filter with a cutoff frequency $\omega_c = \pi/2$, a stopband ripple $\delta_s = 0.002$, and a transition bandwidth no larger than 0.1π. 05

8(a) Draw the frequency response curves for Butterworth filter of orders N = 2, 4, 8, and then explain the effect of the filter orders. Also, draw the frequency responses of Chebyshev type I, Chebyshev type II and elliptic filters. 04

8(b) Design a low-pass Butterworth filter to meet the following specifications: 03

$f_p = 6\text{kHz}$ $f_s = 10\text{kHz}$ $\delta_p = \delta_s = 0.1$

8(c) Use the bilinear transformation to design a first-order low-pass Butterworth filter that has a 3-dB cutoff frequency $\omega_c = 0.5\pi$. 03

Date: 24/06/2026

Khulna University, Khulna

Third Year **Second** Term Examination, Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **0714 09 ECE 3201**

Full Title of the Course: **Control Systems**

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) Draw and explain the block diagram of a generalized control system. Explain the applications of control systems in engineering and daily life. [L-1,2; CLO-1] 3+2 = 05

1(b) State the importance of transfer function in control engineering. Determine the transfer function of the PI controller shown in Fig.Q1b. [L-2,5; CLO-1] 1+4 =05

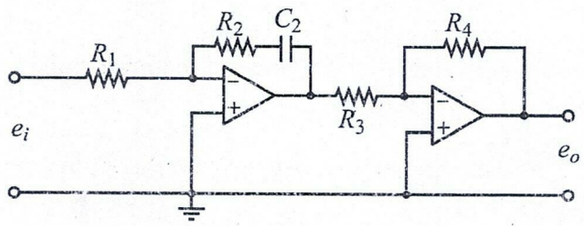


Fig.Q1b

2(a) Obtain a state space representation of the following control system in matrix form. [L-5; CLO-1] 05

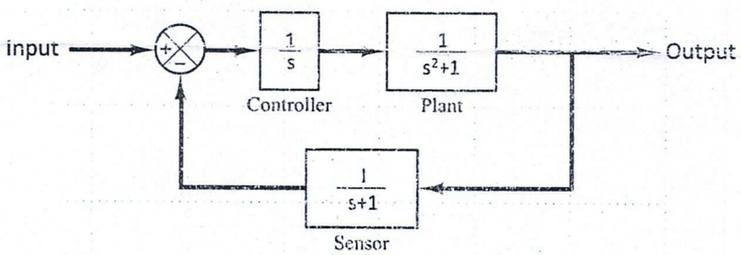


Fig.Q2a

2(b) Convert the state and output equations shown below to a transfer function. [L-5; CLO-1] 05

$$\dot{x}=\begin{bmatrix}-4 & -1.5\\ 4 & 0\end{bmatrix}x+\begin{bmatrix}2\\ 0\end{bmatrix}u(t),\ y=[1.5 \quad 0.625]x.$$

3(a) A unity feedback system has the transfer function, $T(s)=\frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$. Explain the effect of varying ζ and ω_n on the system response. [L-5; CLO-2] 04

3(b) A second-order system has damping ratio $\zeta = 0.5$ and natural frequency $\omega_n = 4\ rad/s$. Determine (i) peak time, (ii) rise time (iii) settling time and (iv) maximum overshoot. [L-5; CLO-2] 04

3(c) Define a nonminimum-phase system. Discuss its main characteristics and provide suitable real-life examples. [L-2; CLO-2] 02

4(a) Obtain the transfer function $\frac{C}{R}$ from the signal flow graph shown in figure 3(b). [CLO 1; L3] 05

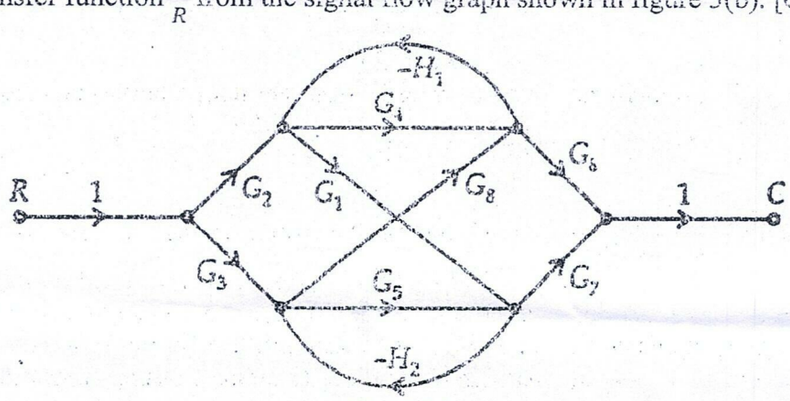


Fig. 3(b)

4(b) Define position error constant K_p, velocity error constant K_v, and acceleration error constant K_a. Determine the system type and compute the steady-state errors for standard step, ramp, and parabolic inputs for a unity feedback system whose forward transfer function is given by $G(s) = \frac{1000(s+8)}{(s+7)(s+9)}$. [L-5; CLO-2] 2+3 =05

SECTION B

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

5(a) The closed-loop transfer function of system is 05

$$T(s) = \frac{s^3 + 2s^2 + 7s + 21}{s^5 - 2s^4 + 3s^3 - 6s^2 + 2s - 4}$$

Determine how many closed loop poles lie in the right half plane, in the left half plane, and on jω axis. [CLO2; L3]

5(b) The characteristic equation of feedback control system is 05

$$s^4 + 20s^3 + 15s^2 + 2s + K = 0$$

i) Determine the range of K for the system to be stable
ii) Can the system be marginally stable? If so, find the required value of K and the frequency of oscillation. [CLO2; L3]

6(a) Explain the significance of root locus in control system analysis? Why does the root locus start at poles and end at zeros? [L-2,5; CLO-3] 03

6(b) Given a unity feedback system that has the forward transfer function 07

$G(s) = \frac{K(s-2)(s-4)}{s^2+6s+25}$. Do the following

i) Find the imaginary axis crossing.
ii) Find the break-in point.
iii) Draw the root locus. [CLO3; L3]

7(a) Draw the Bode plots for the following functions [CLO4; L3] 04

i) $G(s) = \frac{1}{3}(s+3)$
ii) $G(s) = 1/j\omega$

7(b) Use Nyquist's criterion to determine whether the closed-loop system having the following open-loop transfer function is stable or not. If not, how many closed-loop poles lie in the right half s plane? [CLO2; L5] 06

$$G(s)H(s) = \frac{1+4s}{s^2(1+s)(1+2s)}$$

8(a) For a phase lead network, show that 04

$\frac{E_2(s)}{E1(s)} = \frac{1}{a}\left[\frac{1+aT_s}{1+Ts}\right]$. Where symbols have their usual meanings. [CLO5; L2]

8(b) The forward transfer function of a unity feedback system is given by $G(s) = \frac{K}{s(s+4)(s+5)}$. 06

After solving the root locus, it is found that the centroid of asymptotes is at -3; the angles of asymptotes are along 60°, 180°, and 300°; the breakaway point is at -1.47, and the points of intersection of the root locus with the imaginary axis are ± j4.47. At first, draw the root locus. Then design a lag compensator for $K_v \geq 5$, $\zeta = 0.707$ and $\omega_n = 2$ rad/sec. [CLO 3,5; L3]

Date: 25/06/2026

Khulna University, Khulna

Third Year **Second** Term Examination, Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **ECE 3109**

Full Title of the Course: **Electromagnetic Fields & Waves**

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) Interpret Gauss's law physically and mathematically using necessary illustrations. Use Gauss's law to find the electric field due to a uniformly distributed line of charge. 05

1(b) Derive an expression for **E** due to a sphere of radius 'a' of uniform care density ρ_v in region: (i) $r < a$, (ii) $r = a$, (iii) $r > a$. 05

2(a) Define an electric dipole. Deduce the expression for the electric potential due to an electric dipole. 05

2(b) Three-point charges $q_1 = -3\text{x}10^{-6}$ C, $q_2 = -10^{-6}$ C and $q_3 = 5\times10^{-6}$ C are placed in the air at the corners of an equilateral triangle of 50 cm side. Determine the magnitude and direction of the force on q_3. 05

3(a) Employ direct integration of Poison's formula to find the electric potential distribution in the depletion region of a P-N diode. Draw the charge-, potential gradient-, and potential-distribution across the junction. 05

3(b) A circular loop located on $x^2 + y^2 = 25$, z = 0 carries a direct current of $10A$ along $\boldsymbol{a_\varphi}$. Determine **H** at (0, 0, 4) and (0, 0, -4). 05

4(a) State Stokes' theorem. Prove that, $\nabla \times \mathbf{H} = \mathbf{J}$. 05

4(b) What is vector magnetic potential? If the vector magnetic potential, 05

$\boldsymbol{A} = -\hat{k}\frac{\mu_0 I}{4h}\log(x^2 + xy^2)$, then find $\boldsymbol{B}$ and $\boldsymbol{H}$.

SECTION B

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

5(a) What do you mean by the dynamic electromagnetic field? Write Maxwell's equations in the phasor forms. 04

5(b) For the dynamic electromagnetic fields, prove that Maxwell's third equation is modified to $\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$. 04

5(c) If $\mathbf{E} = 2\sin(10t + x - \frac{\pi}{4})\mathbf{a_y}$ V/m, determine the phasor from of **E**. 02

6(a) Show that the velocity of an electromagnetic wave in free space is approximately 3×10^8 m/s. 02

6(b) Deduce $\nabla^2 E_s - \gamma^2 E_s = 0$; where symbols have their usual meanings. 05

6(c) An electric field in a medium, where $\varepsilon = 4\varepsilon_0$, $\mu = 4\mu_0$, is given by: 03

$$\mathbf{E} = 50\cos(10^8 t + \beta x)\mathbf{a_y} \text{ V/m}$$

(i) Find the direction of wave propagation and wave velocity.

(ii) Calculate β.

7(a) How is the direction of the induced EMF determined in Faraday's law of electromagnetic induction? Show with a neat sketch. 02

7(b) What do you mean by the skin depth? Show that $\delta = \frac{1}{\sqrt{\pi f \mu \sigma}}$; where symbols have their usual meanings. 04

7(c) At f = 100 MHz, show that silver ($= 6.1 \times 10^7$ S/m, $\mu_r = 1, \varepsilon_r = 1$) is a good conductor, while rubber ($\sigma = 10^{-15}$ S/m, $\mu_r = 1, \varepsilon_r = 3.1$) is a good insulator. 04

8(a) Show that intrinsic impedance of a good conductor is given by $\eta = \sqrt{\frac{j\omega\mu}{\sigma}}$; where symbols have their usual meanings. 03

8(b) What do you mean by the wave polarization? Write down the necessary and sufficient conditions for a circular polarization. 03

8(c) A lossy dielectric has an intrinsic impedance of $200\angle 30^0\,\Omega$ at a particular radian frequency ω. If, at that frequency, the plane wave propagating through the dielectric has the magnetic field component 04

$$\mathbf{H} = 10\,e^{-\alpha x}\cos(\omega t - \frac{1}{2}x)\mathbf{a_y} \text{ A/m}$$

Find: (i) **E**, and (ii) α

Important relations:

$$\alpha = \omega\sqrt{\frac{\mu\varepsilon}{2}\left[\sqrt{1+\left(\frac{\sigma}{\omega\varepsilon}\right)^2}-1\right]} \text{ and } \beta = \omega\sqrt{\frac{\mu\varepsilon}{2}\left[\sqrt{1+\left(\frac{\sigma}{\omega\varepsilon}\right)^2}+1\right]} \text{ and } \eta = \sqrt{\frac{j\omega\mu}{\sigma+j\omega\varepsilon}}$$

$$\nabla = \boldsymbol{a_\rho}\frac{\partial}{\partial\rho} + \boldsymbol{a_\varphi}\frac{1}{\rho}\frac{\partial}{\partial\varphi} + \boldsymbol{a_z}\frac{\partial}{\partial z} \text{ and } \nabla\times\mathbf{A} = \frac{1}{\rho}\begin{vmatrix}\mathbf{a_\rho} & \rho\mathbf{a_\varphi} & \mathbf{a_z}\\ \frac{\partial}{\partial\rho} & \frac{\partial}{\partial\varphi} & \frac{\partial}{\partial z}\\ A_\rho & \rho A_\varphi & A_z\end{vmatrix}$$

Date: 29/06/2026

Khulna University, Khulna

Third Year **Second** Term Examination, Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **0714 09 ECE 3205**

Full Title of the Course: **Microwave Engineering**

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) Write down the differential voltage and current equations for high-frequency transmission lines. Deduce the equations. [L2, CLO1] 05

1(c) Define Voltage Standing Wave Ratio. Express the reflection co-efficient and Voltage Standing Wave Ratio in terms of the load and characteristic impedances. [L3, CLO1] 05

2(a) Show that transmission co-efficient is given by, $\tau = \frac{2Z_L}{Z_L + Z_0}$. [L3, CLO2] 04

2(b) A 50 ohm 15 GHz transmission line is terminated by a load of $(60 - j30)$ ohm. Find the voltage standing wave ratio (VSWR) using Smith Chart. Find the distance of voltage maximum from the load in meter. Also calculate the reflection co-efficient. [L4, CLO3] 06

3(a) What do you mean by impedance matching? A load impedance of (50-j60) ohm is to be matched to a 50 ohm transmission line. Find: (i) the distance between the stub used and the load, (ii) the stub length. [L5, CLO2] 08

3(b) What is the minimum distance between the two stubs used for double-stub impedance matching? [L2, CLO2] 02

4(a) Deduce an expression for the cut-off frequency of TE mode in a circular cylindrical waveguide. What is the reason of a doubly infinite variation in this waveguide? [L3, CLO3] 05

4(b) The inner dimensions of a TM_{20} rectangular guide are: a = 22 mm, b = 1.5 cm. Determine the cut-off frequency and attenuation/phase shift, as applicable, at 5 GHz. [L5, CLO4] 05

SECTION B

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

5(a) What is velocity modulation? Explain the velocity modulation process of two-cavity Klystron amplifier with necessary figure. [L5, CLO5] 04

5(b) Justify that the maximum efficiency of two-cavity Klystron is 58%. [L5, CLO5] 02

5(c) A two-cavity Klystron has the following parameters: [L5, CLO6] 04

$V_0 = 1000V$, $I_0 = 25mA$, $f = 3GHz$, $d = 1mm$, and $L = 4cm$. Determine v_0, average gap transit angle, beam coupling co-efficient, dc transit angle, and depth of velocity modulation.

6(a) What is reflex Klystron? Briefly explain the working mechanism of a reflex Klystron with necessary figure. [L5, CLO6] 03

6(b) What are the differences between TWT and Klystron? Justify that the maximum efficiency of reflex Klystron is 22.7%. [L5, CLO5] 05

6(c) What do you mean by frequency pushing and pulling mechanism of magnetron? [L1, CLO5] 02

7(a) What do you mean by crossed-field device? Explain the constructional features of hole and slot magnetron with necessary figure. [L5, CLO5] 03

7(b) What is travelling wave antenna? Derive the fundamental form of a radar range equation. [L5, CLO6] 04

7(c) What do you mean by broadside and endfire array? Derive the space factor for each one of them. [L5, CLO6] 03

8(a) What is frequency independent antenna? Explain the working mechanism of a log periodic antenna. [L5, CLO6] 04

8(b) Design a Yagi-Uda antenna for the frequency of 647 MHz. [L6, CLO6] 03

8(c) An antenna has a loss resistance of 10Ω, power gain of 20 and directivity of 22. If the antenna is drawing a current of 4 A, determine the radiation resistance and the power being radiated by the antenna. [L6, CLO6] 03

Important Equations Required:

$$E_x = -\frac{j}{k_c^2}\left(\beta\frac{\partial E_z}{\partial x} + \omega\mu\frac{\partial H_z}{\partial y}\right)$$

$$E_y = \frac{j}{k_c^2}\left(-\beta\frac{\partial E_z}{\partial y} + \omega\mu\frac{\partial H_z}{\partial x}\right)$$

$$H_x = \frac{j}{k_c^2}\left(\omega\varepsilon\frac{\partial E_z}{\partial y} - \beta\frac{\partial H_z}{\partial x}\right)$$

$$H_y = -\frac{j}{k_c^2}\left(\omega\varepsilon\frac{\partial E_z}{\partial x} + \beta\frac{\partial H_z}{\partial y}\right)$$

$$\nabla_t^2 E_z = -k_c^2 E_z$$

$$\nabla_t^2 H_z = -k_c^2 H_z$$

$$\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial\psi}{\partial r}\right) + \frac{1}{r^2}\frac{\partial^2\psi}{\partial\phi^2} + \frac{\partial^2\psi}{\partial z^2} = \gamma^2\psi$$

Date: 30/06/2026

Khulna University, Khulna
Electronics and Communication Engineering Discipline
Third Year Second Term Examination
Session: **2024-2025**
Course No.: **0714 09 CSE 3151**
Full Title of the Course: **Computer Network and Security**
Full Marks: **60** Time: **03** Hours Credit Hours: **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 a network? Give one example of a network. [L-1; CLO-1] **2**

(b) Describe how devices are connected in mesh, star, bus, and ring topologies. Illustrate each topology with an appropriate diagram. [L-1; CLO-1] **6**

(c) Design a local area network consisting of three computers. Use appropriate devices to ensure communication among them. The diagram should include the names of the networking devices used and the IPv4 addresses (with CIDR notation) assigned to all relevant devices. [L-6; CLO-3] **2**

2. (a) Briefly explain the function of each layer of the TCP/IP protocol suite. [L-1; CLO-1] **5**

(b) A parity-check code guarantees detection of an odd number of bit errors. Do you agree with this statement? Explain why or why not. [L-5; CLO-4] **3**

(c) What is a Hamming distance? If we want to detect up to 2-bit errors, what should be the minimum Hamming distance required? [L-2; CLO-4] **2**

3. (a) Suppose Station A needs to send the following frame to Station B. The flag pattern is used to indicate the start and end of the frame. However, the same flag pattern also appears within the actual data. Station B might mistakenly interpret it as the end of the frame. Explain how Station A should send the frame and how Station B should read the received frame to avoid this problem. [L-3; CLO-3] **5**

01111110	Header	0001111111001111101000111111111110	Trailer	01111110
Flag		Data		Flag

(b) What is meant by flow control? Explain the sliding-window flow control protocol using an appropriate example. [L-1; CLO-4] **5**

4. (a) How is a damaged frame handled in the Go-Back-N automatic repeat request error-control method? [L-2; CLO-4] **4**

(b) What is the purpose of media access protocols? Describe the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) method using a flow diagram. [L-2; CLO-3] **6**

Section B

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

5. (a) Distinguish between a hub and a switch. [L-4; CLO-3] **2**

(b) What is the main function of a router? Explain it with an example. [L-2; CLO-3] **3**

(c) What is classless addressing? Why was it introduced? [L-2; CLO-2] **3**

(d) State the purpose of an address mask. [L-1; CLO-2] **2**

6. An organization has the IP block 10.0.0.0/24, and node subsets for: [L-4; CLO-4] **10**

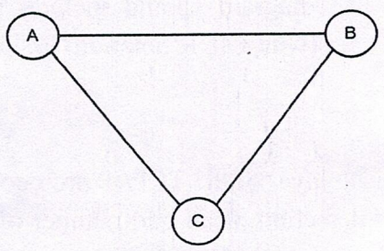
- Dept A: 100 hosts
- Dept B: 50 hosts
- Dept C: 25 hosts
- Dept D: 10 hosts

Find:

i. suitable subnet masks
ii. IP ranges for each subnet
iii. remaining unused IPs

7. (a) The following graph represents a network. Each node includes a table showing the least-costs and next hops to reach all other nodes at a particular stage. Explain how node A updates its routing table using the Distance Vector Routing algorithm after receiving distance vectors from its two neighbors—node B and node C, respectively. [L-3; CLO-4] **4**

To	Cost	Next
A	0	-
B	1	-
C	2	B



To	Cost	Next
A	5	-
B	0	-
C	3	-

To	Cost	Next
A	2	-
B	2	A
C	0	-

(b) The following table shows the link-state database of a network. Using this database (available to all nodes), create the least-cost tree and the routing table for node B. [L-3; CLO-4] **6**

	A	B	C	D	E	F	G
A	0	2	∞	3	∞	∞	∞
B	2	0	5	∞	4	∞	∞
C	∞	5	0	∞	∞	4	3
D	3	∞	∞	0	5	∞	∞
E	∞	4	∞	5	0	2	∞
F	∞	∞	4	∞	2	0	1
G	∞	∞	3	∞	∞	1	0

8. (a) Explain how modification, masquerading, replay, and repudiation attacks affect data integrity. [L-1; CLO-5] **2**

(b) Use the additive cipher with $k = 15$ to encrypt the plaintext 'book'. Then decrypt the message to get the original plaintext. [L-3; CLO-5] **3**

(c) Describe the DES function in the Data Encryption Standard (DES) with a suitable diagram. [L-1; CLO-5] **5**

Date: 30/06/2026

Khulna University, Khulna
Electronics and Communication Engineering Discipline
Third Year Second Term Examination
Session: **2024-2025**
Course No.: **CSE 3251**
Full Title of the Course: **Computer Network and Security**
Full Marks: **60** Time: **03** Hours Credit Hours: **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.

	Question Description	**Marks**
1.	(a) What is a network? Give one example of a network.	**2**
	(b) Draw a conceptual view of the Internet (uppercase I), which shows how the Internet is formed around the world.	**2**
	(c) Describe how devices are connected in mesh, star, bus, and ring topologies. Illustrate each topology with an appropriate diagram.	**6**
2.	(a) Briefly explain the function of each layer of the TCP/IP protocol suite.	**5**
	(b) A parity-check code guarantees detection of an odd number of bit errors. Do you agree with this statement? Explain why or why not.	**3**
	(c) What is a Hamming distance? If we want to detect up to 2-bit errors, what should be the minimum Hamming distance required?	**2**
3.	(a) Suppose Station A needs to send the following frame to Station B. The flag pattern is used to indicate the start and end of the frame. However, the same flag pattern also appears within the actual data. Station B might mistakenly interpret it as the end of the frame. Explain how Station A should send the frame and how Station B should read the received frame to avoid this problem.	**5**

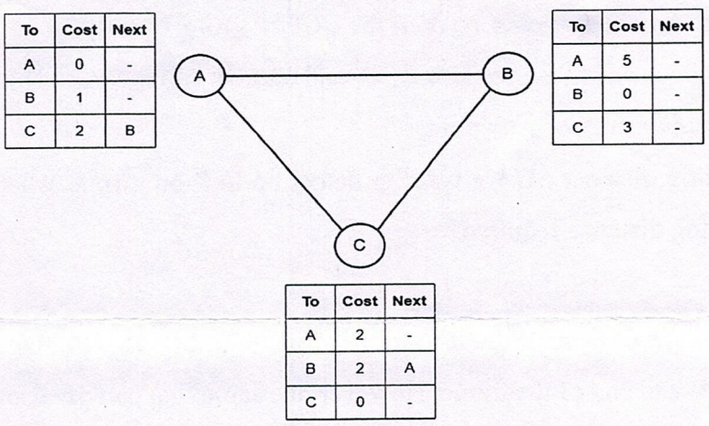
01111110	Header	00011111110011111010001111111111110	Trailer	01111110
Flag		Data		Flag

	(b) What is meant by flow control? Explain the sliding-window flow control protocol using an appropriate example.			**5**
4.	(a) How is a damaged frame handled in the Go-Back-N automatic repeat request error-control method?			**4**
	(b) What is the purpose of media access protocols? Describe the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) method using a flow diagram.			**6**

Section B

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

	Question Description	Marks
5.	(a) Distinguish between a hub and a switch.	**2**
	(b) What is the main function of a router? Explain it with an example.	**3**
	(c) What is classless addressing? Why was it introduced?	**3**
	(d) State the purpose of an address mask.	**2**
6.	(a) Define IP addressing.	**2**
	(b) Given IP 10.0.0.0/30. Find • Number of hosts • Network and broadcast address	**3**
	(c) A network uses subnet mask 255.255.255.192. Find number of subnets and hosts per subnet.	**5**
7.	(a) The following graph represents a network. Each node includes a table showing the least-costs and next hops to reach all other nodes at a particular stage. Explain how node A updates its routing table using the Distance Vector Routing algorithm after receiving distance vectors from its two neighbors—node B and node C respectively.	**4**



	Marks
(b) The following table shows the link-state database of a network. Using this database (available to all nodes), create the least-cost tree and the routing table for node B.	**6**

	A	B	C	D	E	F	G
A	0	2	∞	3	∞	∞	∞
B	2	0	5	∞	4	∞	∞
C	∞	5	0	∞	∞	4	3
D	3	∞	∞	0	5	∞	∞
E	∞	4	∞	5	0	2	∞
F	∞	∞	4	∞	2	0	1
G	∞	∞	3	∞	∞	1	0

8.	(a) Explain how modification, masquerading, replay, and repudiation attacks affect data integrity.	**2**
	(b) Use the additive cipher with $k = 15$ to encrypt the plaintext 'book'. Then decrypt the message to get the original plaintext.	**3**
	(c) Describe the DES function in the Data Encryption Standard (DES) with a suitable diagram.	**5**

Date: 02/07/2026

Khulna University, Khulna Time: 10.00 – 1.00

3rd Year Term II Examination

Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **0413 09 BA-3281**

Full Title of the Course: **Industrial Management and Law**

Full Marks: **60** Time: **03** Hours

- 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) Discuss Henry Mintzberg's ten managerial roles. [L2; CLO 1] 6

(b) What is the conceptual and diagnostic skill of managers? [L1; CLO 1] 4

2. (a) Discuss different sources of recruitment. [L2; CLO 2] 5

(b) What is employee training? Why is it necessary for employees? What are the different types of training available for employees? [L1; CLO 2] 5

3. (a) What is departmentalization? Discuss different bases of departmentalization with examples. [L2; CLO 3] 6

(b) Distinguish between leadership and management. If a person uses coercive power to control the behavior of his subordinates, is the person a leader or manager? Justify your answer. [L4; CLO 3] 4

4.(a) What is plant layout? Discuss some of the factors that affect plant location. [L2; CLO 3] 5

(b) Discuss the product layout process layout with its advantages and disadvantages. [L2; CLO 3] 5

SECTION B

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

5.(a) "All contracts are agreements, but not all agreements are contract." Explain the statement with valid judgement. [L5; CLO 4] 3

(b) Discuss different ways of terminating a contract by mutual agreement. [L2; CLO 4] 4

(c) Explain the concept of Caveat Emptor. [L2; CLO 4] 3

6.(a) Discuss the classification of goods according to the Sale of Goods Act. [L2; CLO 5] 4

(b) Distinguish between sale and agreement to sale. [L4; CLO 4] 3

(c) What is condition and warrants? [L1; CLO 6] 3

7.(a) What are the key provisions of Factories Act, 1965 of Bangladesh? [L1; CLO 6] 4

(b) State the rules regarding health and hygiene, welfare and safety according to the Factories Act of Bangladesh. [L2; CLO 6] 6

8.(a) What are the essential features of negotiable instruments? [L1; CLO 5] 5

(b) Distinguish between bill exchange and cheque. [L4; CLO 5] 5

Date: 02/07/2026

Khulna University, Khulna Time: 10.00 – 1.00

3rd Year Term II Examination

Session: **2024-2025**

Electronics and Communication Engineering Discipline

Course No.: **BA 3281**

Full Title of the Course: **Industrial Management and Law**

Full Marks: **60** Time: **03** Hours

- 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) Explain the concept and nature of management. Clearly define "management" and "managers" and describe their significance in modern technology-driven organizations (e.g., ECE industries such as telecom or electronics manufacturing). 5

(b) Apply the concept of managerial roles and skills to an ECE organization. Illustrate how technical, human, and conceptual skills are used by managers in real-world engineering contexts. 5

2. (a) Apply different job design approaches (e.g., job rotation, job enrichment) in an ECE-based firm such as a semiconductor or telecom company. Explain how these approaches improve employee productivity and satisfaction. 5

(b) What are the common bases of departmentation in organizations? 5

3.(a) Analyze the role of organizational goals in planning. Differentiate between types of goals (strategic, tactical, and operational) and explain how multiple goals are managed in a complex engineering project. 5

(b) Evaluate the major barriers to effective goal setting and planning in engineering organizations. Critically assesses strategies managers can use to overcome these barriers and successfully implement plans. 5

4.(a) Apply the control process in an ECE-related organization (e.g., quality control in electronic production). Explain each step with practical examples. 5

(b) Design an effective control system for an engineering organization. Your design should address characteristics of effective control and propose solutions to minimize employee resistance. 5

SECTION B

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

5.(a) Explain the relationship between law and society. Discuss its relevance in regulating engineering industries and professional practices. 5

(b) Apply the concept of a contract in an engineering context (e.g., project agreement, vendor contract). Explain the essential elements with examples. 5

6.(a) Analyze the concept of an offer and its legal rules. Differentiate between valid and invalid offers using examples from engineering contracts. 5

(b) Evaluate different situations in which an offer may lapse. Critically assess their implications in industrial and engineering agreements. 5

7.(a) Define the capacity of parties to contract. Explain the concept of a "sound mind" with relevant examples. 5

(b) Analyze categories of disqualified persons under the law. Discuss how these restrictions affect contractual agreements in industrial settings. 5

8.(a) Apply the concept of buyer, seller, and goods in a real-life engineering business scenario. Classify different types of goods with examples. 5

(b) Evaluate the differences between a "sale" and an "agreement to sell." Critically assess their legal implications in industrial transactions. 5