

## Term Test II

Date:	2081/11/4	Full Marks	100
Level	BE	Time	
Programme	BCE		
Semester	V	3 hrs	

*Subject: - Embedded Systems*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. What is Embedded System? Explain the application domains of Embedded Systems. [8]
2. Explain the architecture of AVR microcontroller with diagram. [7]
3. What are datatypes in C? Explain about the general purpose C and embedded C programming. [8]
4. Write an Embedded C program for any AVR microcontroller to generate square wave of 8 microseconds on PB5 using Timer 0 overflow-interrupt while at the same time data is being transferred from PORTC to PORTD (Assume 8 MHz AVR clock frequency). [7]
5. Explain SPI communication protocol. [8]
6. A master device is communicating with a slave using I<sup>2</sup>C protocol, generating clock of 100 KHz. Slave address is 0x3A. Data to be sent is 0x4F. The start and stop condition takes 4 microseconds each. Calculate the total time taken to transmit the frame and how many such frames are transmitted in 5 seconds? [7]
7. Explain the interfacing of LM35 (analog temperature sensor) to AVR microcontroller with code. [8]
8. What is PWM? How can you control the width of PWM signals in AVR to control the brightness of a LED? [7]
9. Explain different VHDL modelling styles with examples. [8]
10. Explain about packages and sub-packages in VHDL. [7]
11. What is process in VHDL? Write VHDL code for designing 4:1 Multiplexer using behavioral modelling style. [7]
12. Explain priority inversion of Tasks in RTOS. How can this be resolved? [8]
13. Write Short Notes on: (*any two*)
  - a. RTOS task states
  - b. FreeRTOS
  - c. Half and Full Step Excitation sequence of Stepper Motor[5\*2=10]



*Pokhara University*  
*Everest Engineering College*  
**Final Internal Assessment**  
**Fall- 2024**

- Level:** Bachelor F.M. 100  
**Program:** BE CMP P.M. 45  
**Faculty:** Science & Technology Time: 3hrs  
**Section:** A/B  
**Subject:** Embedded System (5<sup>th</sup> Semester)
- Attempt all the questions.*
- 1    a) Draw the internal architecture of AVR microcontroller with its features. 7  
     b) What are the characteristics of embedded system? Explain the application areas of embedded system. 8
- 2    a) What is the difference between counter and timers in AVR? Write an ALP in AVR to illustrate the use of counter. 8  
     b) How serial communication is achieved in AVR microcontroller? Write a program in ATmega32 to receive bytes of data serially and out them on Port B. Set the baud rate of 9600, 8 – bit data and 1 stop bit. Use interrupt instead of polling. 7
- 3    a) Define Real Time System. Differentiate between Real Time Operating System and General-Purpose Operating System. 8  
     b) Explain Task Scheduling process in RTOS. 7
- 4    a) Discuss semaphore based and mutex based resource sharing techniques in RTOS. 7  
     b) Define VHDL. Explain different modelling styles in VHDL with a simple example. 8

- 5 a) Write a VHDL code for 8 x 1 multiplexer with behavior modelling 7  
b) Write a VHDL for 3 bits counter with any one of the modelling style. 8
- 6 a) Write down a program to interface a temperature sensor with ATmega32 microcontroller. 7  
b) Compare and contrast the features of Arduino, ESP32 and Raspberry Pi. 8
- 7 Write short notes on: (Any two) (2\*5=10)  
a) Deadlock in RTOS  
b) Wireless Communication in Embedded System  
c) MQTT

***\*\*Best Wishes\*\****

# Lumbini Engineering, Management & Science College

Level: Bachelor

Year: 2025

Program: BE

Full Marks: 100

Course: Embedded System (Computer – 5<sup>th</sup>)

Time: 3 Hrs

*Candidates are required to give their answers in their own words as far as practicable.  
The figures in the margin indicate full marks.*

**Attempt all the questions.**

- Q. 1 a) What is an Embedded system? List out the three main characteristics of embedded system that distinguish embedded system from other computing system. (7)
- b) Draw the block diagram of an AVR microcontroller and explain each block in detail. Also mention the features of AVR microcontroller. (8)
- Q. 2 a) Electroencephalogram (EEG) machine is an example of Embedded system. Justify it. (5)
- b) What do you understand by ISR? List the sequence of task that an AVR microcontroller performs while servicing an interrupt request. (5)
- c) Explain with diagram, why pull-up or pull-down resistors are important while reading the state of an input pin? (5)
- Q. 3 a) List out various problems associated with semaphores. Discuss with suitable examples about priority inversion and dead lock situations. (8)
- b) Write the case study on IoT based Smart Irrigation with examples. (7)
- Q. 4 a) Write down the truth table and VHDL code for full adder. (8)
- b) What are the basic signals used in SPI communication? What are the advantages and disadvantages of using SPI communication. (7)
- Q. 5 a) What are the goals of RTOS? (5)
- b) Discuss the various styles of modelling used in architecture body of hardware description in VHDL. (5)
- c) What are the differences between LoRa and Zigbee technologies. (5)
- Q. 6 a) Explain with necessary sketch, interfacing the LCD with AVR microcontroller and write a C program to Display “WELCOME” in the first line and in centre of the 16X2 line display. (8)
- b) Write a program for speed control of DC motor using PWM. (7)
- Q. 7. Write short notes on (Any Two) (2x5=10)
- Task and its states
  - VHDL realization of binary subtractor
  - MQTT Protocol

Madan Bhandari College of Engineering  
Urlabari-3, Morang  
Final Internal Examination (Fall 2024)

Level: Bachelor

Programme: B.E Computer

Year/Part:III/I

Subject: - Embedded System

Full Marks: 100

Pass Marks: 45

Time: 3 hrs

- 
- ✓ Candidates are required to give their answers in their own words as far as possible.
  - ✓ Attempt all questions

- ✓ 1. A) Define Embedded System. Explain essential components of embedded system. [7]
- ✓ B) List and describe the key application domain of ES [8]
- ✓ 2. A) Draw and explain the AVR architecture. [8]
- ✓ B) Write an 8051 C program to get a byte of data from P1, wait  $\frac{1}{2}$  second (i.e., 500 ms) and then send it to P2. [7]

OR

- ✓ Explain various Data types in C.
- ✓ 3. A) Define Real Time Operating system. Also describe the major function of real-time kernel. [8]

OR

Explain the execution of interrupt in details.

- ✓ B )Define scheduling? Explain various types of task scheduling techniques in RTOS. [7]
- ✓ 4 A) Write a VHDL code for 2\*4 Decoder . [8]
- ✓ B )Write a VHDL code for 4 bit full adder.[7]
- ✓ 5 A) Explain TCP/IP in details. [7]
- ✓ B ) Write an AVR C programming to interface 16\*2 LCD with an AVR microcontroller, the program should initialize LCD in 4 bit mode and display 'HELLO MBMAN'. [8]
- ✓ 6A) Describe the MQTT protocol and explain its key component. [7]
- ✓ B )Explain the basic concept of IoT and roles of ES in IoT. [8]
- ✓ 7 Write short notes on any two [5\*2=10]
  - ✓ A) Bluetooth
  - ✓ B) GSM
  - ✓ C) ESP32

# NATIONAL ACADEMY OF SCIENCE AND TECHNOLOGY

(Affiliated to Pokhara University)

Dhangadhi, Kailali

## Pre-University Examination

Level: Bachelor

Semester: V\_Fall

Year : 2024

Programme: B.E. Computer

F.M. : 100

Course: Embedded System

P.M. : 45

Time : 3hrs.

*Candidates are required to give their answer in their own words as far as practicable. The figures in the margin indicate full marks.*

**Attempt all the questions.**

1. a) Explain the components and application areas of Embedded System. 7  
b) How I/O ports are configured in AVR microcontroller? Write a C program to configure PORT A and PORT B as output port and PORT C and PORT D as input port. Also, receive data from C and D and send them to A and B respectively. 8
2. a) Explain the different types of memory available in AVR microcontrollers. 8  
b) What are the registers associated with Timer0 and how would you use them to create a delay of 10milliseconds. Assume necessary data. 7
3. a) How does deadlock occur? 8  
b) Explain the significance of context switching in RTOS. 7
4. a) Mention the features of VHDL and the advantages associated with them. 8  
b) Write a VHDL program for full adder using two half adder and a or gate. 7
5. a) Write a VHDL program to detect a sequence '1011'. 7  
b) Write a C program for ATmega32 to display "Hello World" in a 16\*2 LCD (4-bit mode). 8
6. a) Write differences between UART, I2C and SPI. 8  
b) Write about MQTT protocol used in IoT Communication. 7
7. Write short notes on any two: 2×5  
a) ATM as embedded system  
b) PWM  
c) Sensor

**NEPAL COLLEGE OF INFORMATION TECHNOLOGY**  
**Assessment Fall 2024**

**Level:** Bachelor

**Year:** 2025

**Program:** BE\_CE\_M/D

**Full Marks:** 100

**Course:** Embedded System (New)

**Pass Marks:** 45

**Semester:** V

**Time :** 3 hrs.

*Candidates are required to answer in their own words as far as practicable.*

*The figures in the margin indicate full marks.*

*Attempt all the questions.*

1. a) Define an Embedded system. Why is it so hard to define? List and describe the main characteristics of ES that distinguish ES from other computing systems. Also, prove that the Digital camera is an example of ES. [7]  
b) You are assigned as an embedded systems engineer to develop a healthcare monitoring system, such as one for measuring body temperature and heart rate. Describe the essential design metrics, constraints, components, system architecture, challenges, and the design process required to implement this system. [8]
2. a) Why microcontroller is needed for ES? Explain the AVR(Atmega) microcontroller and its components with the figure. [8]  
b) Write a program to store and retrieve a value from the EEPROM memory of an AVR microcontroller. [7]

**Or**

Write a simple Embedded C program to blink an LED connected to PORTB pin 0 of an AVR microcontroller.

3. a) What does a real-time embedded system mean? How does RTOS ensure fairness in scheduling? Discuss trade-offs between fairness, latency, and complexity in task synchronization. [8]

**Or**

What is RTOS and how it is beneficial in ES applications? Explain with a block diagram. Discuss semaphore-based and mutex-based resource-sharing techniques in RTOS.

- b) What are the primary goals of task scheduling in an RTOS? What are the key challenges of task synchronization in embedded systems compared to general-purpose systems? [7]

**Or**

Which RTOS (FreeRTOS or VxWorks) is better suited for large-scale industrial applications, and why? Explain the architecture of FreeRTOS and VxRTOS.

4. a) Mention different types of data type in VHDL. Write VHDL code for 4:2 Encoder using behavioral modeling style. Also, verify it by drawing a wave..[8]

**Or**

How do std\_logic\_vector and std\_logic differ? Explain different styles of modeling in VHDL with proper examples and their differences.

- b) What is a test bench in VHDL? Write only the test bench code for the 4:2 Encoder. [7]

**Or**

Write VHDL code for the sequential circuit using Moore machine

5. a) A company is designing a smart home automation system in which various sensors (Temperature, Motion, Gas, etc.) and actuators (Light fans, door locks) communicate with a central hub. The system must support both wired and wireless communication for different devices. [7]

**Question**

- i) Identify and justify suitable communication protocols (Wired and wireless) for this system.
- ii) Compare SPI, I2C, and UART regarding data rate, complexity, and power consumption for sensor communication.
- b) A healthcare company is designing a wearable device to monitor heart rate and blood oxygen levels. The device should transmit data to a smartphone application and a cloud server for long-term analysis. [8]

**Question**

- i) Discuss the advantages and disadvantages of using Bluetooth low energy (BLE)
- ii) Evaluate the impact of latency, power consumption, and data throughput or protocol selection.
- iii) If real-time data processing is needed, which would be more suitable and why?

6. a) Write an AVR C program to interface a 7-segment display. Display numbers from 0 to 9 in a loop with a delay of 1 second. [7]

**Or**

What is sensor interfacing, and why is it important in embedded systems? What are the primary steps involved in interfacing a sensor with a microcontroller?

- b) For Smart Home Automation System [8]

**Question**

- i. Describe how Arduino can be used to develop a home automation system.
- ii. What sensors and actuators are required for this system?
- iii. How does Arduino handle the communication between devices?
- iv. How MQTT protocol be used for this system? Explain.

7. Write short notes on: (Any two) [2\*5=10]

- a) Priority Inversion and Priority Inheritance
- b) Multithreading vs Multitasking
- c) Sensor and actuators interfacing
- d) Raspberry PI vs ESP32 for IoT
- e) ZigBee, LoRa, GSM

# Nepal engineering college

Assessment Fall 2024

Level: Bachelor

Programme: BE

Course: Embedded Systems (New Syllabus)

Year :2025

Full Marks: 100

Time: 3 Hours

Candidates are required to give their answers in their answer in their own words as far as practicable.

The figures in the margin indicate full marks.

*Attempt all the questions*

- |   |                                  |   |     |
|---|----------------------------------|---|-----|
| 1 | a)                               | What is embedded system? List and define the three main characteristics of embedded system that distinguish such system from other computing system?  | 7   |
|   | b)                               | Explain the general characteristics of ATMEGA32 AVR microcontroller with its basic architecture.  | 8   |
| 2 | a)                               | Write a program to toggle an LED connected to Port D with a delay of a few milliseconds. Include an appropriate circuit   | 8   |
|   | b)                               | Why are interrupts favored over polling? Distinguish between interrupt-driven and polling-based approaches.   | 7   |
| 3 | a)                               | Write a program to continuously send the message 'The Earth is but One Country' to the serial port using a baud rate of 9600, 8-bit data, and 1 stop bit.   | 7   |
|   | b)                               | What problems can arise when resource sharing is implemented without semaphores? How can semaphores be used to address these issues in multitasking systems?  | 8   |
| 4 | a)                               | Explain what a real-time system is. Discuss the different types of real-time systems with examples.   | 8   |
|   | b)                               | Explain the different types of modeling in VHDL with suitable example.  | 7   |
| 5 | a)                               | Write a VHDL program for which output will be 1 when the sequence 1101 is detected.   | 7   |
| 6 | a)                               | Draw and explain the frame structure of a UART packet.  | 7   |
|   | b)                               | Explain the process of interfacing a DC motor with a microcontroller using a switch. How can the switch be used to control the direction of the motor's rotation? Include the necessary circuit diagram and code for the operation. | 8   |
|   | b)                               | Describe the architecture of an IoT system. Discuss the function of each layer, including sensing, network, data processing and application layers, with suitable examples.   | 8   |
| 7 | Write shorts notes on: (any two) |   | 5+5 |
|   | a)                               | Role of Embedded System in IoT domain.  |     |
|   | b)                               | Washing Machine as an example of Embedded System.   |     |
|   | c)                               | Seven Segment display to display digits from 0-9.   |     |

**POKHARA ENGINEERING COLLEGE**  
**Internal Assessment Examination**

Level: Bachelor  
 Programme: BCE  
 Course: Embedded System

Semester – Fall

Year : 2025  
 Full Marks: 100  
 Pass Marks: 45  
 Time : 3hrs.

*Candidates are required to give their answers in their own words as far as practicable.*

*The figures in the margin indicate full marks.*

*Attempt all the questions.*

1. a) Discuss the essential features that differentiate embedded systems from general-purpose computing systems. 8
- b) List and describe at least three key application domains of embedded systems 7
2. a) Draw and explain the AVR microcontroller architecture with its key components 3+5
- b) Write a program to store and retrieve a value from the EEPROM memory of an AVR 7
3. a) What is an RTOS, and how does it benefit embedded system applications? 2+5
- b) Describe the conditions that can lead to deadlock in RTOS-based embedded systems. 8
4. a) What are the primary differences between structural and behavioral modeling styles in VHDL? Explain briefly with some simple examples. 2+5
- b) Write a VHDL code to implement a Multiplexer. 8
5. a) A company is designing a smart home automation system where various sensors (temperature, motion, gas, etc.) and actuators (lights, fans, door locks) communicate with a central hub. The system must support both wired and wireless communication for different devices. 4+5

**Questions:**

- i. Identify and justify suitable communication protocols (wired and wireless) for this system.
- ii. Compare SPI, I2C, and UART in terms of data rate, complexity, and

power consumption for sensor communication.  
 b) Difference between LoRa and Bluetooth.

- 6
6. a) What are the key layers of the TCP/IP model? Briefly describe their functions. 8
- b) Describe the working principle of the MQTT protocol and explain its key components. 7
7. Write short notes on any two: 2×5
  - a) Sensors and Actuators
  - b) Timers and Counters in AVR
  - c) GSM/GPRS

# POKHARA UNIVERSITY

Level: Bachelor      Internal Exam      Year : 2025  
Programme: BE Computer (III/I)      Full Marks: 100  
Course: Embedded Systems      Pass Marks: 45  
Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Define an embedded system. How does it differ from a general purpose computing system? Explain in brief. 7
- b) Explain the architecture of AVR microcontrollers. Highlight its key features. 8
2. a) How are I/O ports configured in AVR microcontrollers? Explain with the help of an appropriate example. 8
- b) Write a program to store and retrieve a value from the EEPROM memory of an AVR microcontroller. 7
3. a) What is an RTOS, and how does it benefit embedded system applications? 8
- b) Discuss semaphore-based and mutex-based resource sharing techniques in RTOS. 7
4. a) What are the primary differences between structural and behavioural modelling styles in VHDL? Explain briefly with some simple examples. 8
- b) Write a VHDL code to implement a full-adder. 7
5. a) Implement a Moore state machine for an elevator control system with states for up, down, and idle. 7
- b) A smart farming solution includes soil moisture sensors, weather stations, and irrigation controllers connected via an embedded system. Data should be transmitted to a central monitoring unit and accessible via mobile apps. 8
  - i. Compare LoRa and Zigbee for long-range, low-power communication in an agricultural setting.
  - ii. What are the trade-offs between using wired vs wireless communication in this scenario?
6. a) Write an AVR C program to interface a 16x2 LCD (in 4-bit mode) with an AVR microcontroller (e.g., ATmega16/ATmega32). The program should: 7
  - i. Initialize the LCD in 4-bit mode.

- ii. Display the message "AVR LCD TEST".
- b) Compare the features of Arduino, ESP32, and Raspberry Pi as IoT platforms. 8
7. Write short notes **any two:** 2×5
- a) Embedded system in automotive industry
  - b) MQTT protocol
  - c) Bluetooth

# United Technical College

Semester: Fall

Level: Bachelor

Programme: BE

Course: Embedded system

Year: 2025

FullMarks: 100

PassMarks: 45

Time: 3hrs

*Candidates are required to give their answers in their own words as far as practicable.*

*The figures in the margin indicate full marks.*

*Attempt all the questions.*

1. a) What is Embedded system? Write any six differences between general purpose system and Embedded system.  $2+6=8$   
b) Explain the types of embedded system based on performance of microcontroller? Also write some application of embedded system.
2. a) What is RTOS? Explain soft and hard real time system.  $3+4=7$   
b) What is task scheduling? Explain different type of task scheduling algorithm.
3. a) What is VHDL? Explain why VHDL is used for designing.  $8$   
b) Write a VHDL code for 4 to 1 MUX.  $8$
4. a) Explain serial and parallel communication with suitable example. Compare USART I2C and SPI.  
b) Explain TCP/IP based on embedded system.  $3+5=8$
5. a) Explain IOT in detail with suitable example.  
b) Explain MQTT protocol with suitable block diagram.  $8$
6. a) What is sensor? Explain analog and digital sensor with suitable example.  
b) What are different displaying interfacing used in embedded system? Explain.  $7$
7. Write short note on (Any two)  
➤ Wireless communication  
➤ Architecture of AVR  
➤ Multithreading in RTOS  $8$   
 $2*5=10$