

# POKHARA UNIVERSITY

Level: Bachelor  
Programme: BE  
Course: Embedded System (New)

Semester: Fall

Year : 2024  
Full Marks : 100  
Pass Marks : 45  
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.***

1. a) What is an embedded system? List and define the three main characteristics of embedded system that distinguish such system from other computing system? 7
- b) You are tasked with designing an embedded system for a **Home security system** that includes motion detection, door sensors, and alarms. Discuss the design metrics, constraints, structure, challenges, and steps in the design process for developing this system. Also, list out the other application areas of ES. 8
2. a) Write a program to toggle the LEDs connected to PORTD of the ATmega32 microcontroller. Also, include a properly labeled diagram illustrating the connection of LEDs to the GPIO pins of PORTD. 7

## OR

Write a program to turn ON the LEDs connected to PORTD of the ATmega32 microcontroller when the switch is pressed and turn them OFF when the switch is released. Include a properly labeled diagram illustrating the connection of the switch and LEDs to the GPIO pins of PORTD.

- b) Write an AVR program in C to generate a square wave using Timer 0 and Timer 1 AVR microcontroller. 8
3. a) How does RTOS differ from a general-purpose operating system (GPOS) in an Embedded system? Explain with key features of an RTOS? Also, differentiate between FreeRTOS and VxWorks. 7
- b) If two tasks are deadlocked over a resource, how does an RTOS detect and resolve the deadlock? How would you handle synchronization between tasks and interrupts in a time-critical embedded application? 8

**OR**

Explain priority inversion, Discuss the methods to address this problem.

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|----|----|---|-----|
| 4. | a) | What is a test bench in VHDL? Write only the test bench code for <b>4:1 Mux</b> .   | 7   |
|    | b) | Describe various VHDL modeling styles with examples and illustrate how a full adder can be modeled using structural modeling style.   | 8   |
| 5. | a) | Design an embedded system for Wearable Health Monitoring devices. Discuss how UART, SPI, and I <sup>2</sup> C interact with sensors, displays, and controllers.               | 7   |
|    | b) | How would you send an SMS using a GSM module in an embedded application? Also define LoRa, and how does it differ from other wireless communication protocols?                | 8   |
| 6. | a) | Write a program to interface a seven-segment display with a microcontroller to sequentially display digits from 0 to 9 with a 2 ms delay. Include a suitable circuit diagram. | 7   |
|    | b) | A smart parking system using embedded devices requires each parking lot sensor to report availability status to a cloud server.   | 8   |
|    |    | i. How would you manage MQTT design for multiple parking lots?  |     |
|    |    | ii. How can you ensure consistent status updates during server outages?   |     |
|    |    | iii. Explain the working of a system using Arduino and sensors.   |     |
|    |    | iv. What communication protocols can be used to send data to the cloud?   |     |
|    |    | v. How can the system be enhanced for real-time monitoring?   |     |
| 7. |    | Write short notes on: ( <b>Any two</b> )  | 2×5 |
|    | a) | Sensor Interfacing  |     |
|    | b) | Arduino and Raspberry for IoT   |     |
|    | c) | Context Switching   |     |