Technical University of Denmark

Practice Examination

Course: Networked Embedded Systems

Course No.: 02226/02116

Important Notes:

- The final written exam will not be in PDF format like this test exam.
- Instead, it will be hosted by the Digital Exam (DE) platform of DTU as a Multiple Choice Exam.
- The final written exam will be with all aids allowed (written aids and electronic aids allowed, but no internet).
- Remember to bring PDF copies of online resources, such as the NES Labs solutions from Nordic's DevAcademy.
- The final written exam will have a duration of 4 hours.
- The final written exam will be composed of 50 multiple choice questions.
- DE will present the questions in random order and the answers within each question also in random order.
- There will be always only one correct answer: a response that is more correct than the rest. There are always 3 incorrect answers.
- You will only be able to select one answer per question.
- Every correct answer corresponds to 1 point.
- Every incorrect answer corresponds to -0.2 points.
- This means that somebody who answers all 50 questions randomly would expect to receive approximately 5/50 points on average.
- The final exam will have questions related to the lectures and the NES lab.

Test Exam

Q1. Which of the following statements is true?

A. If I buy two 1K resistors and I measure them, their resistances will be identical.

B. The output voltage from an AC-DC converter is a constant flat DC voltage.

C. A voltage divider can be used to shift a 3.3V signal to a 5V signal.

D. Batteries build internal resistance that limits the maximum current they can source.

Q2. Assuming a 10-bit single-ended ADC with reference voltage at 5V, which of the following statements is false?

A. An input voltage of 10V will be mapped to the number 2047.

B. An input voltage of 5V will be mapped to the number 1023.

C. An input voltage of 2.5V will be mapped to the number 511.

D. An input voltage of 1.25V will be mapped to the number 255.

Q3. Which of the following serial protocols uses identification numbers to specify the peripheral that should use the bus?

A. UART

B. SPI

C. I2C

D. GPIO

Q4. Four CAN devices (A, B, C, D) transmit concurrently. Their IDs are the following, A: 10101010101, B: 11101110111, C:11011011011, D:11110111101. Which device will get the priority?

A. A

B. B

C. C

D. D

Q5. You are designing the wireless communication between a battery-powered indoor air quality sensor and a mains-powered IoT Hub. Your objective is to maximize the battery lifetime of the sensor. Which of the following MAC schemes is the most energy-efficient wireless solution for this objective?

A. CSMA/CA

B. Duty-Cycled CSMA/CA

C. Synchronous MAC based on time slots

D. Duty Cycling based on a wakeup radio

Q6. Assuming that REG is an 8-bit register, which of the following C statements toggles the second least significant bit of REG?

A. `REG = (0x01<<1)^REG;`

B. `REG = (0x01<<2)^REG;`

C. `REG = (0x01<<1)|REG;`

D. `REG = (0x01<<2)|REG;`

Q7. In NES Lab "2.1 Turn on the LED by pushing a Button (polling based)", we created an application that turns on LED1 when button0 (labelled as Button 1 on the schematic) is pressed. The Nordic Thingy:53 has two push buttons. What single-line change do we have to do so that LED1 is turned on when button1 (labelled as Button 2 on the schematic) is pressed?

A. Change `bool val = gpio_pin_get_dt(&button);` to `bool val = gpio_pin_get_dt(&button1);`

B. Change `static const struct gpio_dt_spec led = GPIO_DT_SPEC_GET(LED0_NODE, gpios);` to `static const struct gpio_dt_spec led = GPIO_DT_SPEC_GET(LED1_NODE, gpios);`

C. Change `#define SW0_NODE DT_ALIAS(sw0)` to `#define SW0_NODE DT_ALIAS(sw1)`

D. Change `static const struct gpio_dt_spec button = GPI_DT_SPEC_GET(SW0_NODE, gpios);` to `static const struct gpio_dt_spec button = GPIO_DT_SPEC_GET(SW1_NODE, gpios);`

Q8. Which of the following statements about time synchronization is false?

A. Periodic time synchronization is needed because clocks used by embedded systems drift from each other and from the UTC time.

B. GPS is famous for its localization services, but it is also used for time synchronization with the satellites' atomic clocks.

C. PTP has the same assumptions as NTP but achieves better performance by taking better timestamps at hardware level.

D. A way to eliminate time synchronization problems in networks embedded systems is to measure the drift of their clocks and calibrate it with a constant adjustment.

Q9. Which of the following statements about TSCH is false?

A. TSCH uses channel hopping to avoid external interference.

B. Collisions in TSCH are impossible.

C. In TSCH, each device periodically synchronizes its clock with its time source.

D. TSCH supports multi-hop networks.

Q10. Which of the following statements about Embedded AI is false?

A. Embedded AI has typically a lower latency compared to cloud-based AI.

B. Embedded AI is typically more accurate than cloud-based AI.

C. Embedded AI is typically more private than cloud-based AI.

D. Embedded AI is typically more resource-efficient than cloud-based AI.

Answers

Q1. D

Q2. A

Q3. C

Q4. A

Q5. B

Q6. A

Q7. C

Q8. D

Q9. B

Q10. B