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Question Paper Code : 80539

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Seventh/Eighth Semester

Electronics and Communication Engineering

EC 8791 — EMBEDDED AND REAL TIME SYSTEMS

(Common to: Biomedical Engineering/ Medical Electronics)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List any two key differences between complex systems and microprocessors.

2. What is the purpose of system architecture design in embedded system development?

3. List the two versions of the ARM architecture.

4. Mention the function of a timer unit in microcontrollers.

5. Outline the role of the bootloader in an embedded system.

6. What is the purpose of using the dataflow model in embedded programs?

7. Compare hard and soft real-time systems.

8. Write the concept of redundancy in fault tolerance.

9. Write the main purpose of an operating system in a computing system.

10. Why is priority-based scheduling used in real-time systems?

PART B — (5 × 13 = 65 marks)

11. (a) Compare and contrast different design methodologies commonly used in embedded system design. Discuss the advantages and disadvantages of each approach. (6+7)

Or

(b) Analyze the design challenges and solutions for a model train controller. Discuss how this example illustrates the general principles of embedded system design. (6+7)

12. (a) (i) Analyze the integrated peripheral features of the LPC214X family and their advantages for embedded system design. (7)

(ii) Interpret how ARM's Thumb-2 instruction set improves performance and code density with a practical example. (6)

Or

(b) (i) Analyze how different peripherals like UART, SPI, and I2C can be used together in a microcontroller-based system. (7)

(ii) Apply the concept of timer interrupts in an ARM microcontroller to create a real time clock application. (6)

13. (a) Analyze the process of assembly, linking, and loading in embedded system development, and discuss how each step affects the final executable. (6+7)

Or

(b) Analyze the different methods available for performance analysis in embedded systems, including profiling and benchmarking.

14. (a) Analyze the structure of a real-time system used in an industrial automation scenario. Discuss the key components and their interactions within the system.

Or

(b) Discuss the task assignment and scheduling strategies for a real-time operating system (RTOS) in a flight control system. Illustrate with examples.

15. (a) (i) Design a multirate system for a home automation system that controls lighting, temperature and security. (7)

(ii) Analyze the advantages and disadvantages of preemptive scheduling in an RTOS used for medical device monitoring. (6)

Or

(b) (i) Analyze the role of an operating system in managing hardware and software resources in a modern smart phone. (7)

(ii) Evaluate the differences between a general-purpose operating system and a real-time operating system (RTOS). (6)

PART C — ($1 \times 15 = 15$ marks)

16. (a) Imagine that you are tasked with designing an embedded system for a smart irrigation controller. This system will monitor soil moisture levels and automatically activate sprinklers based on pre-defined settings.

(i) Describe the design process for this embedded system. (5)

(ii) Summarize the steps involved, from requirement analysis to quality assurance techniques. (5)

(iii) Identify the key performance metrics you would consider during platform-level analysis for this application. (5)

Or

(b) Design and analyze an embedded program for a smart agriculture system that monitors and controls irrigation, soil moisture, and temperature. Consider the following aspects:

(i) Key components and their roles in the system.

(ii) Suitable model of programming and why?

(iii) Compilation techniques and potential challenges.

(iv) Performance analysis metrics and optimization strategies.

(v) Energy and power consumption analysis and optimization.

(vi) Strategies for minimizing program size.

(vii) Comprehensive validation and testing plan to ensure reliability and regulatory compliance.