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Question Paper Code : 10546

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

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. Specify the major levels of abstraction in the design process of embedded systems.
2. Compare the steps involved in the design flow of water fall model and spiral model.
3. "ARM processors have low power dissipation"— Justify the statement by highlighting the significant functions of lower models.
4. List the interrupts supported by the vectored interrupt controller of LPC 2148.
5. Show an example of circular buffer for efficient data handling in storing a subset of data stream.
6. Brief the function of cyclomatic complexity, while selecting the paths of a program for testing.
7. Define sporadic tasks in periodic task model.
8. Highlight the significance of clock synchronization in real time systems.
9. Draw the sequence diagram for a pre-emptive execution of an operating system having two tasks with a kernel and required timer.
10. What is priority inversion?

PART B — (5 × 13 = 65 marks)

11. (a) Illustrate a simple system of model train controller with its system set up and signalling the train diagrams. Draw the class diagram for the train controller commands and the major sub-systems and explain their functions. (13)

Or

- (b) (i) Elaborate the role of design reviews on a critical component in quality assurance process. (5)
- (ii) Requirements and specifications are two important steps in system design. Analyze the contribution of control-oriented specification languages in the use-case of real world, safety critical systems designed for air-crafts. (8)
12. (a) (i) Illustrate the operation of LPC 2148-Timer unit and its special function registers. (8)
- (ii) Write an ALP/C program to generate a square wave of 1 KHz frequency at the lowest four pins of port ϕ . (5)

Or

- (b) (i) Explain the operation of single edge controlled PWM in LPC 2148 and calculate its frequency. (8)
- (ii) Write briefly on the sub-systems of UART systems in LPC 2148. Highlight their significant functions in serial communication. (5)
13. (a) (i) Analyze the performance of compiler optimization techniques to optimize the code they generate with a sample C code. (10)
- (ii) Draw the standard data flow graph for the given block of C code : (3)

$$W = a + b$$

$$X = a - c$$

$$Y = x + d$$

$$X = a + c$$

$$Z = y + c.$$

Or

- (b) Perform the program -level energy and power analysis for a battery-powered systems. Measure the energy consumption for a sample piece of code and explore the memory effects and energy optimization. (13)

14. (a) Identify the requirements of task assignment in real time systems. Explain the task-assignment process of rate monotonic first fit algorithm with a sample set of tasks assigned. (13)

Or

- (b) Elaborate the fault tolerances techniques practiced in real time systems. (13)

15. (a) Determine the strategies for power optimization process in system architecture. Discuss the power-down trade-off, predictive power management policies and image distribution in a selected architecture. (13)

Or

- (b) Specify the need for Inter-Process Communication (IPC). Discuss the two major states of IPC mechanisms and justify the role of elastic buffers in them. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Demonstrate the operation of EDF scheduling algorithm for the sample set of processes narrated in the table below.

Process	Execution time	Period
P1	1	4
P2	2	6
P3	3	12

Derive the CPU utilization and explain the implementation of the same. (15)

Or

- (b) Design an engine control unit for controlling the operation of a fuel-injected engine based on the measurement of the running engine. The inputs are throttle, RPM, intake air volume and intake manifold pressure. The outputs are injector pulse width and spark advance angle. Define the periods of data in the engine controlled and draw its class diagram for system architecture. Support your design with the state diagrams of
- (i) Throttle position sensing
 - (ii) Injector pulse width
 - (iii) Spark advance angle. Briefly comment on the system torting. (15)

