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Question Paper Code : 40543

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

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. How an embedded system is different from a traditional general-purpose computer?
2. Why is requirement analysis considered a critical step in embedded system design?
3. What are the various profiles of ARM Cortex Processor?
4. Distinguish between single and double-edged PWM.
5. What is the need of symbol table in assembler?
6. Differentiate between compiler and cross-compiler.
7. Define byzantine failure in the context of fault tolerance.
8. State the difference between sporadic and aperiodic task ? Give an example for each.
9. What is need for preemptive real time operating system?
10. What are the key reasons for choosing POSIX-compliant systems?

PART B — (5 × 13 = 65 marks)

11. (a) Explain in detail the top-down and bottom-up design methodologies in embedded system development with examples. Describe a scenario where a hybrid approach might be beneficial, and illustrate how the overall design flow changes with this approach.

Or

- (b) Apply the principles of the Model Train Controller to design an embedded control system for an automated warehouse where multiple robots coordinate to transport goods efficiently and safely. Explain how scheduling, collision avoidance, and real-time control can be handled?
12. (a) Explain the features of the LPC214x family of micro controllers and show how timer unit and PWM unit is used with appropriate examples.

Or

- (b) Describe the architecture of ARM9 and ARM Cortex-M3 with the block diagrams. Highlight their key features and explain the major architectural differences between them.
13. (a) Explain the various compilation process techniques. Demonstrate with dead code elimination to optimize the program with a code snippet.

Or

- (b) Outline the program energy level, power analysis and optimization. Illustrate with necessary diagrams about the program level performance analysis.
14. (a) (i) Estimate the techniques for allocating and scheduling tasks of processors to ensure that the deadlines are met. (7)
(ii) Criticize on reliability models for hardware redundancy. (6)

Or

- (b) With suitable diagrams, illustrate how clock synchronization works in real-time systems.
15. (a) Explain in detail how shared memory and message passing mechanisms are used for inter-process communication with examples?

Or

- (b) Develop an approach for cooperative multitasking with the help of a program. What would happen if the tasks are put into time handler?

PART C — (1 × 15 = 15 marks)

16. (a) Consider the following set of three independent real-time periodic tasks.

Task	Processing Time (ms.)	Period (ms)
T1	50	100
T2	10	30
T3	10	50

Check whether the task set can be feasibly scheduled using Earliest Deadline First (EDF) and Rate Monotonic Scheduling(RMS) algorithms.

Or

- (b) Using ARM processor instruction set, write a program to find the value of X such that the sum of the expression is ZERO: $X^3 - 6X^2 + 7X - 5$. The program should store the final result in a register.

Vol. 91, No. 4, December 1996, pp. 1151-1161

TABLE 1
Descriptive Statistics of the Data

Variable	Mean	Standard Deviation	Minimum	Maximum
Age	38.5	12.5	18	65
Gender	0.5	0.5	0	1
Marital Status	0.7	0.45	0	1
Education	12.5	1.5	9	16
Income	25,000	15,000	5,000	60,000
Health Insurance	0.8	0.4	0	1
Unemployment	0.05	0.22	0	1
Disability	0.02	0.15	0	1
Chronic Disease	0.1	0.3	0	1
Smoking	0.2	0.4	0	1
Alcohol Use	0.1	0.3	0	1
Exercise	0.3	0.5	0	1
Stress	4.5	1.5	1	7
Life Satisfaction	5.5	1.0	3	7

Note: The data are from the 1990 U.S. Census. The variables are defined as follows: Age is in years; Gender is male (1) and female (0); Marital Status is married (1) and not married (0); Education is in years; Income is in thousands of dollars; Health Insurance is private (1) and not private (0); Unemployment is unemployed (1) and employed (0); Disability is disabled (1) and not disabled (0); Chronic Disease is chronic disease (1) and no chronic disease (0); Smoking is smoker (1) and non-smoker (0); Alcohol Use is alcohol use (1) and no alcohol use (0); Exercise is exercise (1) and no exercise (0); Stress is stress (1-7); Life Satisfaction is life satisfaction (3-7).

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