

Unique Paper Code : ~~32513010023~~ 2513010023
Name of the Course : B.Sc.(H) Electronics (DSE)
Name of the Paper : Advanced Embedded System Design with ARM
Semester : VII
Duration : 3 hours
Maximum Marks : 90

Instruction for Candidates

There are seven questions in all, out of which you have to attempt any five questions
All questions carry equal marks
Sub-parts can be given
First Question is Compulsory.

1.
 - a. What are labels, directives, and mnemonics? Give examples
 - b. What is the importance of WFI (Wait for Interrupt) and WFE (Wait for Event) instructions.
 - c. Describe the LDR pseudo-instruction and its uses.
 - d. Define semaphore.
 - e. List differences between hard real-time and soft real-time OS.
 - f. What is context switching?

6X3=18
2.
 - a. Explain the debugging support features of the Cortex-M3, such as breakpoints, watchpoints, and instruction tracing. (6)
 - g. What is the memory mapping of ARM architecture? Explain role of MPU in ARM cortex M3. (6)
 - h. Describe the role of Special Registers in the Cortex-M3, such as the register R14; register R15, Program Status Register (PSR), PRIMASK, FAULTMASK, and BASEPRI. (6)
3.
 - a. What is interrupt latency? How are ISRs important in real-time systems? (6)
 - b. Explain in detail the working of software and hardware timers in RTOS. (8)
 - c. Compare cooperative and pre-emptive scheduling. (4)
4.
 - a. What are the primary functions of timers in an ARM processor? Explain the role of the prescaler in timer configuration. (6)
 - b. What is the purpose of the PINSEL and GPIO Direction Register registers, and how are they used to control pin functionality? (6)
 - c. How do you enable and control the clock for a specific GPIO port before it can be used? (6)
5.
 - a. Explain synchronization mechanisms used in RTOS: message queues, event flags. (10)
 - b. What is a system tick? Discuss producer-consumer problem in RTOS. (8)

6.
 - a. Explain with diagrams operation modes in ARM processor and how different levels in those modes use two stack pointers? (9)
 - b. Describe the differences between free-running, periodic, and one-shot timer modes. What is the behaviour of the timer in each mode after it reaches its zero count? (9)

7.
 - a. What is CMSIS? Explain CMSIS-Core architecture and its advantages.(10)
 - b. How does CMSIS help in standardizing peripheral access? (6)
 - c. What is the concept of mixed instruction set execution? (2)

7. a) Explain the basic principle of working of Magnetic Resonance Imaging. Discuss the role of the external magnetic field and radio frequency pulses in producing MRI signals. (3+5)
- b) Hydrogen (^1H) is the most commonly used nucleus in MRI. What property of hydrogen nuclei makes them particularly suitable for imaging soft tissues? (4)
- c) A proton has a gyromagnetic ratio, $\gamma = 2.68 \times 10^8 \text{ rad} \cdot \text{s}^{-1} \text{T}^{-1}$. If an MRI scanner operates at a magnetic field, $B_0 = 1.5 \text{ T}$, calculate the Larmor precession frequency (in MHz) of the proton. (6)