CSE4709 / CSE5095 Networked Embedded Systems (FALL 2013)

Final Exam

Student Name: ____________

Student NetID: ____________

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**Question 1.1:** In real-time scheduling theory, what is the difference among periodic task, sporadic task and aperiodic task? (6 points)

**Question 1.2:** Given a synchronous task set of three periodic tasks: T1 = (1, 6, 6), T2 = (2, 8, 5) and T3 = (3, 12, 12), please construct the schedules for the task set from time 0 to time 24 under: (12 points)

(1) Rate-Monotonic Scheduling (RM)
(2) Deadline-Monotonic Scheduling (DM)
(3) Earliest-Deadline-First Scheduling (EDF)

**Question 1.3:** What are the average response time of all the jobs in EACH of the three constructed schedules? (12 points)
The above picture shows a typical setting of a WirelessHART industrial wireless sensor and actuator network.

**Question 2.1:** What are the key components in this system architecture and what are their main functions? (8 points)

**Question 2.2:** How WirelessHART network achieves real-time and reliability properties? Please describe the mechanisms applied in both the wireless stack and the network manager. (12 points)

**Bonus:** Centralized network architecture has scalability issue. Now if you are the architect, how shall you design a distributed network management mechanism to maintain end-to-end real-time communication for multiple flows? (10 bonus points)
**Question 3.1:** What are the drawbacks of the Empirical method described in the RADAR paper and what is the radio propagation model used in the RADAR paper? (10 points)

**Bonus:** The indoor localization system proposed in the RADAR paper is energy-hungry and not accurate. If you are the designer, how will you improve the energy efficiency and localization accuracy of the system? (10 bonus points)
**Question 4.1:** Why do we need the 6LoWPAN protocol? What is the difference between the 6LoWPAN protocol stack and TCP/IP protocol stack? (7 points)

**Question 4.2:** What are the key features of the 6LoWPAN protocol? (5 points)

**Question 4.3:** Please represent the following 128-bit IPv6 address in hexadecimal notation: (8 points)

```
0011 1111 1111 1110 1000 0000 1111 0000
0000 0000 0000 0010 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0001 0000
0000 0000 0000 0000 0000 0000 0000 0000
```
**Question 5.1:** Please construct the 6LoWPAN header (dispatch + HC1 header + HC2 header) using the stateless header compression mechanism, according to the following assumptions: (10 points)

1) The traffic class and the flow label fields are NOT zero;
2) Both the prefix and IID of the src IPv6 address are elided;
3) Both the prefix and IID of the dest IPv6 address are sent in-line;
4) The next header is UDP;
5) For simplicity, we don’t compress the src and dest UDP port, but we will compress the length;

**Question 5.2:** Why do we need the fragmentation mechanism in 6LoWPAN? What is the difference between the initial 6LoWPAN fragment and non-initial 6LoWPAN fragment? (10 points)