**Student Name:**

# ROBT 305 – Embedded Systems Quiz #4

Collect 6 out of 7 points. Please provide precise answers.

1. A race condition _**B**__ **(1 point)**

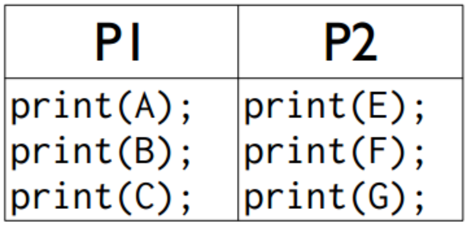
   A) results when several threads try to access the same data concurrently

   B**) results when several threads try to access and modify the same data concurrently**

   C) will result only if the outcome of execution does not depend on the order in which instructions are executed

   D) None of the above

2. Insert one or more semaphores (functions **wait()** and **signal()**) to satisfy the condition:
   Print F before printing B **(2 point)**

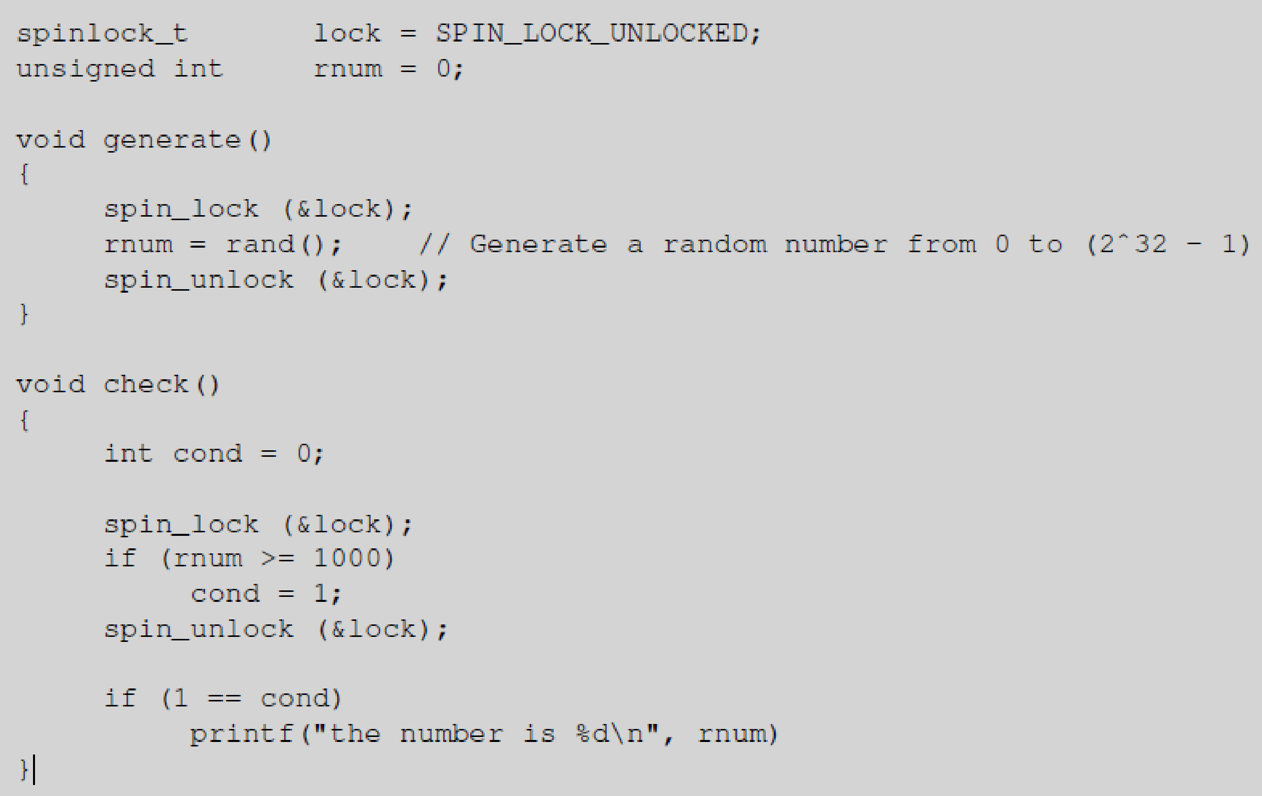


| PI | P2 |
|---|---|
| print(A); | print(E); |
| print(B); | print(F); |
| print(C); | print(G); |

S1 = 0

| P1: | P2: |
|---|---|
| Print(A); | Print(E); |
| Print(B); | Wait(S1); |
| Signal(S1); | Print(F); |
| Print(C) | Print(G); |

3. Several programs call the functions below in an arbitrary order. These programs share a single copy of the global variables lock and **rnum**. Can the call to **printf** ever print a number less than 1000? Explain **(2 points)**



```
spinlock_t          lock = SPIN_LOCK_UNLOCKED;
unsigned int        rnum = 0;

void generate()
{
     spin_lock (&lock);
     rnum = rand();     // Generate a random number from 0 to (2^32 - 1)
     spin_unlock (&lock);
}

void check()
{
     int cond = 0;

     spin_lock (&lock);
     if (rnum >= 1000)
          cond = 1;
     spin_unlock (&lock);

     if (1 == cond)
          printf("the number is %d\n", rnum)
}
```

**Yes, rnum is not protected by the lock in the printf function.**

4. Describe the differences between hard, soft and firm real-time embedded systems. **(1 point)**

**See lecture slides**

5. Define the response time of an embedded system **(1 points)**

**See lecture slides**