1. Indicate whether the following statements are true or false. Justify your answers.

a) Real-time CPS applications usually require a response within a very short time.
b) EDF scheduler has poor deadline predictability under overload conditions.
c) A guest OS abstracts H/W and provides an interface between H/W and hypervisor.
d) Managing the interactions between a guest OS and its applications is one of the key functions of a hypervisor.
e) Under a Type-1 para-virtualized hypervisor, the hypervisor directly interacts with the H/W and provides a virtual call API to interact with the guest OS.

1a) Real-time CPS applications usually require a response within a very short time.

→ False.

Justification: Real-time does not mean fast or in a very short time. It means within bounded time in the worst-case. So, the response times for such applications have to be guaranteed within a pre-defined deadline in the worst-case.

1b) EDF scheduler has poor deadline predictability under overload conditions.

→ True.

Justification: EDF has poor deadline predictability under overload, because once a process instance overloads, all subsequent process deadlines are in risk. This is because priorities are not fixed across instances (at the recurrent process level), unlike in RM/DM.

1c) A guest OS abstracts H/W and provides an interface between H/W and hypervisor.

→ False.

Justification: A **host OS** abstracts H/W and provides an interface between H/W and hypervisor under type-2 virtualization. The guest OS interacts with the hypervisor and provides services to the applications running on it.

1d) Managing the interactions between a guest OS and its applications is one of the key functions of a hypervisor.

→ False.

Justification: Managing the interactions between the guest OS and the H/W is the key function of a hypervisor. It does so through its virtual machine management framework. The interactions between the guest OS and its applications are completely independent of the hypervisor.

1e) Under a Type-1 para-virtualized hypervisor, the hypervisor directly interacts with the H/W and provides a virtual call API to interact with the guest OS.

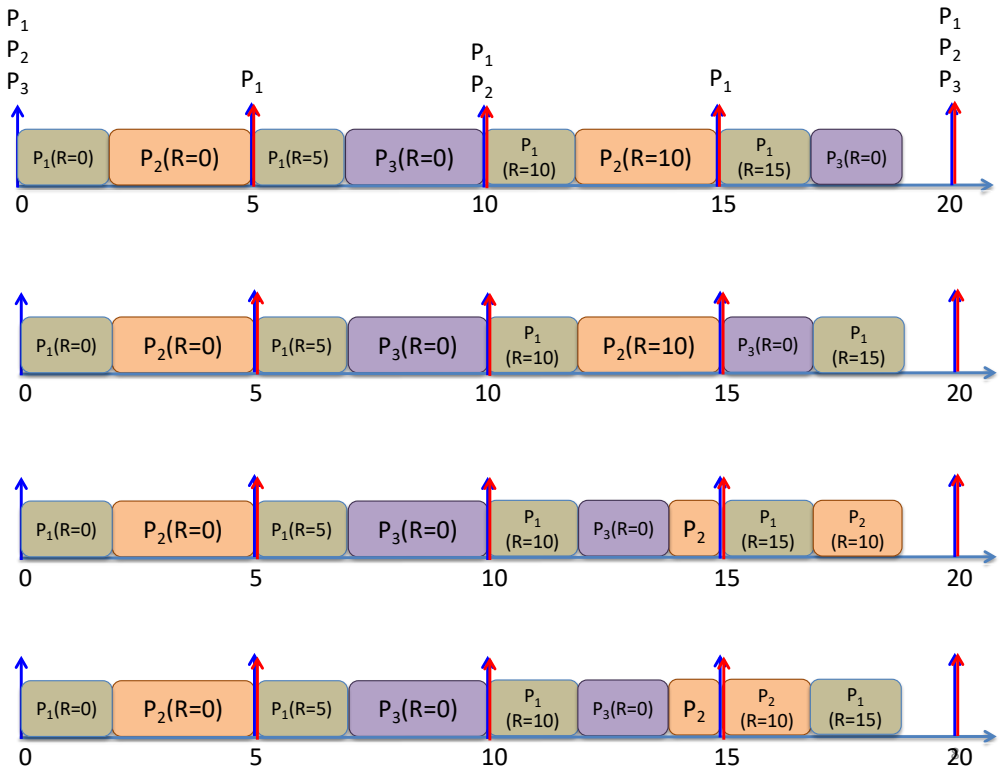
→ True.

Justification: Under Type-1 or bare metal virtualization, the hypervisor interacts directly with hardware. Since the hypervisor is also para-virtualized, not all of the H/W instructions are virtualized. Therefore, the guest OS needs to be modified to interact with the hypervisor and this interaction will use the virtual call API.

2. Consider the following set of periodic real-time processes:

P1<5, 2, 5>
P2<10, 3, 10>
P3<20, 5, 20>

Construct all possible schedules for this process set under the earliest deadline first (EDF) scheduling strategy. Is this process set schedulable under EDF?



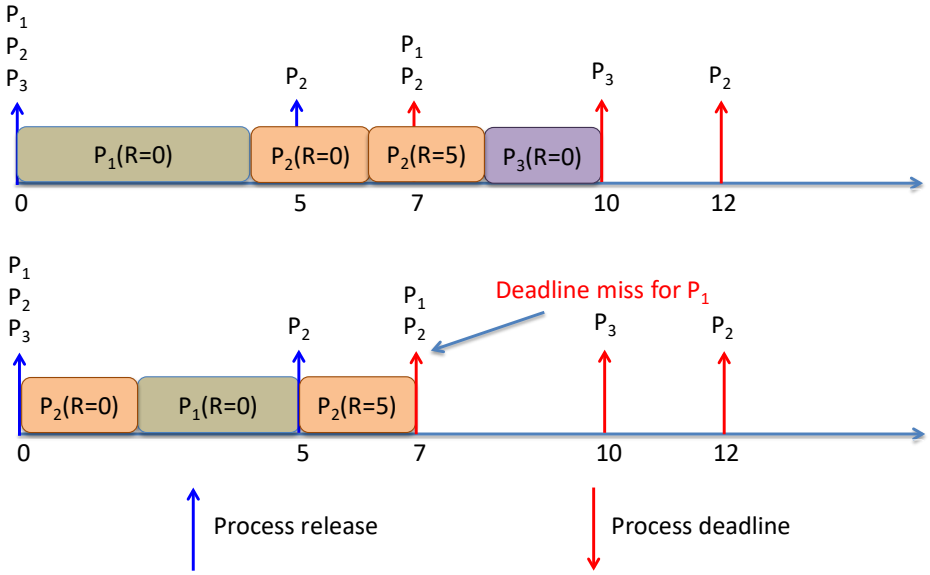
- There are four possible schedules under EDF
  - Tie break between P_1(R=15) and P_3(R=0)
  - Tie break between P_2(R=10) and P_3(R=0)
  - Tie break between P_1(R=15) and P_2(R=10)

- Deadline is met under all the above schedules; the process set is therefore schedulable under EDF

3. Consider the following set of periodic real-time processes:

P_1<10, 4, 7>
P_2<5, 2, 7>
P_3<10, 2, 10>

Construct **all possible** schedules for this process set under the deadline monotonic (DM) scheduling strategy. Is this process set **schedulable** under DM?



- There are two possible schedules under DM (tie break between P_1 and P_2)
- Deadline is missed under one of them; the process set is therefore not schedulable under DM