Question 1. Mark the correct statements:

1. (a) The feasibility analysis problem for periodic real-time tasks with period = relative deadline is coNP-hard in the strong sense.
   (b) EDF is an optimal preemptive scheduling policy.
   (c) If problem $P \leq Q$ and problem $Q \leq R$, then $Q \leq P$ as well (symmetry)
   (d) If a given hybrid task set is feasible under preemptive EDF scheduling, then the processor utilization $U$ satisfies $U \leq 1$.

2. (a) The worst-case execution time $C_i$ of a task depends on the scheduler.
   (b) Two jobs of an aperiodic task cannot be released arbitrarily close to each other.
   (c) If tasks $\tau_i$ and $\tau_j$ share some resource, then job $J_{i,k}$ cannot always preempt $J_{j,\ell}$.

3. (a) Static scheduling is mandatory for off-line scheduling.
   (b) On-line scheduling takes scheduling decisions solely before the system is run.
   (c) A clearvoyant scheduling policy can predict all future task release times.

Question 2.

Fill in the missing word(s).

1. Consider two non-idling schedules $S$ and $S'$ of the same task set $T$. Then, the processor is idle at time $t$ in $S$ iff ________________

2. The earliest release time of job $J_{i,j}$, $j \geq 1$, of a sporadic task $\tau_i$ with sporadicity interval $T_i$ is ________________

3. Any hybrid task set with $\forall i : D_i \geq T_i$ is feasible under preemptive EDF scheduling if and only if the processor utilization $U$ satisfies ________________

Question 3.

Write readable!

1. List two different real-time task dependencies.
2. Give an upper bound formula for the contribution of a periodic task $\tau_i$ with period $T_i$, arbitrary relative deadline $D_i$ and release jitter $J_i$ to the processor demand in the time interval $[t_1,t_2]$. 
Answer Key for Exam A

Question 1. Mark the correct statements:

1. (a) The feasibility analysis problem for periodic real-time tasks with period = relative deadline is coNP-hard in the strong sense.
(b) EDF is an optimal preemptive scheduling policy.
(c) If problem \( P \leq Q \) and problem \( Q \leq R \), then \( Q \leq P \) as well (symmetry)
(d) If a given hybrid task set is feasible under preemptive EDF scheduling, then the processor utilization \( U \) satisfies \( U \leq 1 \).

2. (a) The worst-case execution time \( C_i \) of a task depends on the scheduler.
(b) Two jobs of an aperiodic task cannot be released arbitrarily close to each other.
(c) If tasks \( \tau_i \) and \( \tau_j \) share some resource, then job \( J_{i,k} \) cannot always preempt \( J_{j,\ell} \).

3. (a) Static scheduling is mandatory for off-line scheduling.
(b) On-line scheduling takes scheduling decisions solely before the system is run.
(c) A clearvoyant scheduling policy can predict all future task release times.

Question 2.

Fill in the missing word(s).

1. Consider two non-idling schedules \( S \) and \( S' \) of the same task set \( T \). Then, the processor is idle at time \( t \) in \( S \) iff \( \text{it is idle in } S' \).

2. The earliest release time of job \( J_{i,j}, j \geq 1 \), of a sporadic task \( \tau_i \) with sporadicity interval \( T_i \) is \( \sqrt{(j-1)T_i} \).

3. Any hybrid task set with \( \forall i : D_i \geq T_i \) is feasible under preemptive EDF scheduling if and only if the processor utilization \( U \) satisfies \( U < 1 \).

Question 3.

Write readable!

1. List two different real-time task dependencies.

   Answer:
   - Postcedence relations among tasks
   - Resource sharing

2. Give an upper bound formula for the contribution of a periodic task \( \tau_i \) with period \( T_i \), arbitrary relative deadline \( D_i \) and release jitter \( J_i \) to the processor demand in the time interval \([t_1, t_2]\).

   Answer: The contribution is 0 if \( D_i < t_2 - t_1 + J_i \) and otherwise

   \[
   \left( 1 + \left\lfloor \frac{t_2 + J_i - D_i - t_1}{T_i} \right\rfloor \right) \cdot C_i.
   \]

1