

1. [2] Suppose power consumption model of a machine is $P=20+80*f^3$ with $0 \leq f \leq 1$, calculate the critical frequency at which energy consumption is minimum.

Ans: $f_c = \text{cuberoot}(p_m/2 * \alpha) = \text{cuberoot}(20/[2*80]) = 1/2 = 0.5$

2. [2+3] Describe and solve : $P \mid \text{out-tree}, p_j \mid C_{\max}, p_j \in \mathbb{N}$ and $p_j < 20$

Ans=Critical path algorithm or highest level first algorithm is 2 optimal. Calculate priority based on level and do LS.

As **pmtn** is not mentioned, it cannot be solved optimally, otherwise each task can be converted to series of unit execution time tasks (assuming task pre-emption at integer boundary) and solve out-tree in pseudo $N' (= \sum p_j)$ polynomial time.

More rigorous approach : $P \mid \text{tree (in/out)}, p_j, \text{pmtn} \mid C_{\max}$ can be solved optimally in polynomial time.

3. [2] Write reason behind the optimality EDF scheduler for scheduling real time tasks on uniprocessor.

ANS: As EDF uses dynamic priority and the priority can change every instant of time based on least laxity of available tasks, it achieves optimality

4. [2] Write two fundamental differences container vs virtual machine.

ANS: VM is full or hypervisor/HAL level virtualization whereas container is OS level virtualization. Overhead of OS level virtualization is very low but can only cater to tasks requiring the same guest OS as the host OS.

5. [2] Given a Data Center with power consumption for storage, network, server, lighting, power converter, chiller and HVAC are 10, 30, 36, 3, 15, 90 and 10 (in kW) respectively. Calculate **the Power usage effectiveness** and **Data center infrastructure efficiency**.

ANS: $P_{IT} = 10+30+36=76$, $P_{nonIT}=3+15+90+10=118$

$PUE = (P_{it} + P_{nonIT}) / P_{IT} = 194 / 76 = 2.552$

$DCIE = (1/PUE) * 100\% = 39.175\%$