

A nonpipelined system takes 100ns to process a task. The same task can be processed in a 5-segment pipeline with a clock cycle of 20ns. Determine the speedup ratio of the pipeline for 100 tasks. What is the theoretical speedup that could be achieved with the pipeline system over a nonpipelined system?

Answer

$S = 4.81$, the speedup ratio

The theoretical speedup of the pipeline is 2080ns and could be determined by this formula
Time Taken of Pipe line System = $(k+n-1)*t_p$

Explanation

Given :

time for non-pipelined execution per task, $t_n = 100$ ns
time for 5 segment pipelined execution per task, $t_p = 10$ ns
number of stages in the pipeline, $k = 5$
number of tasks = 100

Required:

$S = ?$, speedup ratio

Solution:

First solve for the time of nonpipelined, t_n

$$\begin{aligned} t_n &= 100\text{ns} \times 100 \\ &= 10000\text{ns} \end{aligned}$$

Second, solve for time of 5 segment pipeline, t_p

$$\begin{aligned} \text{Time Taken Pipe line System} &= (k+n-1)*t_p \\ &= (5+100-1)*20 \\ &= 2080\text{ns} \end{aligned}$$

Then solve for speedup ratio, S

$$\begin{aligned} S &= t_n/t_p \\ &= 10000/2080 \\ \mathbf{S} &= \mathbf{4.81} \end{aligned}$$