1. Please write down a mathematical expression based on basic mechanisms to estimate the energy needed to remove a unit of material for the manufacturing processes: a) milling, and b) electrical discharge machining. In each case, list additional factors in the production version of this process which also consume energy. Which process do you think will require the larger energy input per unit of material removed? Justify your answer.

2. (Part 1) Consider a manufacturing process with a raw material arrival rate of $\lambda$ and a processing time $1/\mu$. We are interested in the expected number of parts in the system (including the queue) call it “L”, the expected total time in the system (queue + process) call it “T” and the expected output rate, "e". Please plot $L$, $T$, and $e$ Vs $\lambda$ as it varies from 0 to $2\mu$; a) for a deterministic system and b) for a system with exponentially varying process times and arrival rates. Explain the difference between the deterministic and stochastic systems and how the number of parts in the system would evolve in time.

2. (Part 2) Consider the two systems above with $\mu = 1$ and $\lambda = .99$. Compare the expected average number of parts in the system for the deterministic system and for the exponential system.