Name:

Exam 2

1. Estimate the cycles (using stress-based fatigue) to failure for a part made from Aluminum 2024-T4 with $\sigma'_f = 131$ ksi, $b = -0.102$ and $E = 10.6$ Msi. Subjected to a loading block with 10 cycles of fully reversed 10 ksi, 5 cycles of $\sigma_{max} = 15$, $\sigma_{min} = 5$ ksi and one cycle of $\sigma_{max} = 12$, $\sigma_{min} = 0$ ksi per block. (20 pts.)

2. A part made from 7075-T6 aluminum has material properties of $E = 10.3$ (Msi), $\sigma'_f = 213$ (ksi), $b = -0.143, \epsilon'_f = 2.62, c = -0.619$. Find the transition life and comment on the appropriateness of fatigue analysis methods above and below this point. (20 pts.)

3. Many materials have a fatigue endurance limit, where repeated loads below a certain threshold can continue indefinitely without causing fatigue failure. Using crack propagation analysis, explain why this fatigue endurance limit exists. What prevents this from occurring in all materials? (20 pts.)

4. A wide, edge-cracked specimen ($\beta = 1.122$) with Paris law parameters $C = 10^{-9}$ and $n = 4$ has an initial crack length of $2a = 1$ in. The specimen is subjected to an $R = 0$ cyclic stress such that $\sigma_{max} = 20.0$ ksi. How long will the crack be after 500 cycles? (20 pts.)

5. Use the Boeing method to approximate the following variable amplitude load cycle for a material with $m_T = 25.8$, $p = 3.9$, $q = 0.6$, and $\mu = 0.1$. Recall that

$$Z = (1 - R)^q \qquad \text{for} R \geq 0$$
$$Z = (1 - \mu R)^q \qquad \text{for} R < 0$$

Would the way in which you count the load cycles affect the answer you get? Why or why not? (20 pts.)