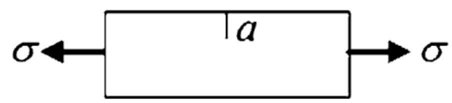
تکلیف سری پنجم مکانیک شکست موعد تحویل: سه‌شنبه ۹۸/۲/۱۷ در کلاس

1- Suppose that a single-edge crack in a plate grows from 2 to 10mm at a constant loading frequency of 0.020 Hz. The applied stress ratio and the maximum stress are zero and 403MPa, respectively. The material has a plane-strain fracture toughness of 80 $MPam^{1/2}$ and a crack growth behavior described by $da/dN = 3.68\text{x}10^{-12} (\Delta K)^4$. Here, da/dN and ΔK are in m/*cycle* and $MPam^{1/2}$ units, respectively. Determine the time it takes for rupture to occur. [Solution: t=3.87h].



2- If a large component is subjected to a cyclic loading under $\Delta\sigma$=300 MPa and R=0. The material behaves according to Paris law $da/dN = 2\text{x}10^{-8} (\Delta K)^{2.45}$, where da/dN and ΔK are in mm/*cycle* and $MPam^{1/2}$ units, respectively. Determine the plane-strain fracture toughness for the component to endure 37,627 cycles so that a single-edge crack grows from 2mm to a_c.

3- A steel plate containing a single-edge crack was subjected to a uniform stress range $\Delta\sigma$ at a stress ratio of zero. Fatigue fracture occurred when the total crack length was 0.03 m. Subsequent fatigue failure analysis revealed a striation spacing per unit cycle of $7.86\text{x}10^{-8}$ m. The hypothetical steel has a modulus of elasticity of 207 GPa. Predict (a) the maximum cyclic stress for a crack length of 0.01 m, (b) the striation spacing per unit cycle when the crack length is 0.02 m, (c) the Paris equation constants, and (d) the plane-strain fracture toughness.