1) (20 pts.) A failed structural part is made from 2024-T351 aluminum alloy. You have no knowledge of the temperature that the part actually experienced during its use. Describe what observations or testing could be done (if any) on the failed part to determine if high temperature contributed to the failure. How would either operating or exposure temperature affect the material. What temperature would cause a change? Be as specific as you can.

2) (10 pts.) Regarding fracture mechanics analysis, what is the difference between critical crack growth and stable crack growth? Give one example of each. Concise is good.

3) (20 pts)
   a) Briefly describe forging – what is it, why/how is it a useful manufacturing process (what sort of things are made from it, etc.).
   b) Briefly describe two (2) common defects that may result from a forging process.
   c) Describe the telltale signs of each of these two defects.

4) (20 pts) Briefly (a sentence or two each) explain each of the following (how they are formed and what they indicate). Include sketches.
   a) striations
   b) beach-marks
   c) ratchet-marks
   d) river-patter
   e) chevrons or herring-bone
5) (5 pts). Briefly explain (and give relevant page number in the “textbook”)
   a) if \( B > 2.5(K_{IC}/\sigma_{ys})^2 \) --- does this show the existence of plane strain?
   b) If \( B < 2.5(K_{IC}/\sigma_{ys})^2 \) --- does this show the existence of plane stress?

6) (25 pts) Resubmit your original midterm exam and address all question marks (correct the errors or provide better explanations). Note, I have placed “numbered question marks” on the exam, address each of those (by number). The original exam is available on the course web page should you want to download a hardcopy. I may have missed a few question marks (“?”) – **in all cases, make sure you have answered/do the following (either on the first exam or on this exam).**

Failure to resubmit you original midterm exam (as I’ve marked it up) will result in a ZERO ON THE MIDTERM!

Mid-term exam Problems 1 and 2) – be sure to state the 2 critical assumptions that should always be checked for the fracture mechanics problems we’ve worked with. If the assumptions are not valid, does that mean the answer is meaningless – or does the calculated answer still provide some useful engineering information – and if so, how so? If plane strain is not valid…so what? The answer will not be “the precise correct answer” but that doesn’t mean it’s useless. If LEFM is not valid, it tells us to take a different approach to determine “failure stress” (see the book).

Mid-term exam Problem 3) shown on next page.
Mid-term exam Problem 3) Be sure to identify with proper terminology and the significance (if any) of the six features identified by text below (if you didn’t on the first exam). Sketch these features in the “circle” provided below. Be sure to indicate the location(s) of the fatigue crack initiation, the direction of travel, and final single-cycle overload fracture surface.

1. Is this high cycle or low cycle fatigue failure? (yes, there is fatigue).
2. Large “step”
3. Many small “steps” around much of the edge
4. Small “dots” on much of the thread surface
5. “River like” appearance – is this definitively brittle fracture?
6. “Distinctly” different appearing fracture surface – what is this?