T73S02 Session 22 Homework – Fatigue Crack Growth

Mentor Guide K&S Questions:-

1.8 Discuss the mechanism of fatigue crack growth and how it can be modelled. Define the terms Paris Law and fatigue threshold.

1.9 Summarise the possible environmentally assisted crack growth mechanisms and their potential interaction with fatigue.

5.29 Describe in principle how a probabilistic fracture mechanics assessment may be carried out.

Additional questions on fcg: The following questions used to be in the MG but seemed to have been dropped. However, I would like you to address them...

(a) Define the fatigue threshold for crack growth, and explain its physical basis.

(b) Discuss how the Paris law for fatigue crack growth might be modified for near-threshold cycling.

(c) Discuss how the Paris law for fatigue crack growth should be modified when plasticity occurs in the cycle. Define how the combined effects of fatigue crack growth and stable tearing are assessed.

Numerical/Mathematical Questions:-

An edge cracked plate is subject to a load cycle between a remote applied tension of 50 MPa and a remote applied compression of 30 MPa. The plate is 10mm wide and contains an initial crack 5mm deep in an aged 316ss weld. The Paris law of R66 (10.12) provides an upper bound for fatigue, which should be assumed. The plate is bending unrestrained.

(a)What is the (upper bound) crack growth per cycle over the first few cycles?

(b)How many cycles will fail the plate? (lower bound). Note that numerical integration is essential to get this right.