Seminar List & OutlineSyllabus:
Low Temperature Fracture Mechanics, T73S02

13	The three modes of K; Why the LEFM fields vary as 1/√r; Derivation of $K = \sigma\sqrt{\pi a}$ and $\sigma = K/\sqrt{2\pi r}$ illustrated for Mode III; The LEFM crack tip fields; Fracture toughness and the brittle fracture criterion;
14	Handbook solutions for K; Qualitative behaviour of K for different geometries and loadings; Relative magnitudes of K for part-penetrating and through-thickness cracks; Controlling dimension for semi-elliptic cracks; Controlling dimension for self-equilibrating stresses and through-cracks; Bueckner's principle; Weight function concept (reference solution method); Asymptotic K for deep cracks; Role of edge cracked plate in providing upper and lower bounds for cylinders; The effective SIF for through-cracks based on the average G; The SIF at the intersection of two perpendicular crack fronts: local and averaged; The SIF for a crack emanating from a notch radius; The SIF for a crack emanating from a sharp notch;
15	Derivation of the LEFM energy release rate in terms of the Ks; Effective K for multi-mode loading; Post-yield fracture mechanics: Graphical meaning of energy release rate: distinction between strain energy and complementary energy; Derivation of the contour integral for J from the energy release rate;
16	The derivation of J as an example of Noether's theorem; the physical meaning of its contour independence and the physical reason why this can break down in incremental plasticity. (J2 and J3, what does ABAQUS VCE mean?)
17	The HRR fields; why stress and strain vary as $r^{-1/n+1}$ and $r^{-n/n+1}$; When are crack tip fields of HRR form; Loss of constraint (validity); Ductile fracture(tearing) criterion; The failure assessment diagram as a J based fracture criterion; R6 Options 1, 2 and 3; The J_R tearing resistance curve and how a tearing analysis is conducted; Tearing instability;
18	Toughness testing; Why a K test is not possible for tough materials; Basics of J testing; Estimation formulae $J \approx \mu U / A$; Why η is ~1 in tension and ~2 in bending; Standard geometries (CTS, Charpy); Validity and size requirements; Valid tear length; Fatigue sharpening; Constraint; Side-grooving; multi-specimen method; Unloading compliance; DCPD, ACDP; Mechanisms of brittle fracture; mechanism of ductile fracture; Embrittling effects in service or in fabrication; Typical magnitudes of toughness
19	J estimation from reference stress; J for secondary stresses; The plasticity correction factor in R6; Difficulties with large secondary stresses, e.g. residual stresses; When do they really contribute to fracture?; Provision in R6 for displacement controlled loading: logic and distinction from secondary loading.
20	Contentious matters: What is the correct fracture parameter for reversed plasticity or cyclic loading? Yuebao/JEDI v ABAQUS. Does tearing really increase toughness, or does tearing decrease J? The plastic wake; Why is the lower shelf of toughness around 40 MPa√m or less? Warm pre-stressing.
21	Beyond the dominant crack tip field: quantifying constraint; T and Q stresses; Examples of high and low constraint geometries/loadings; The local approach(es)
22	Fatigue crack growth: derivation of the Paris Law; Derivation of the fatigue threshold stress intensity factor range; Partial closure and the effective SIF range
22B	Leak-before-break; proof test argument; strength mismatch assessments; crack arrest