**MEC-E8001 Finite Element Analysis; Formulae**

**GENERAL**

**Displacement:** 

**Rotation (small):** 

**Coordinate systems:** 

**Stress-strain:** , 

**Elasticity matrices:** , , 

, 

, 

**Strain-displacement:** , 





**PRINCIPLE OF VIRTUAL WORK**

, 

**Bar (x):** , , , 

, 

, 

**Torsion (x):** , , 

**Bending (xz):** , 

,  where .

**Bending (xy):** , ,

,  where 

**Thin-slab (xy):**

, 

, ,

, 

, , 

**Bending (xy):**

, 



 where 



**Solid:**



, 

, , 

**APPROXIMATIONS (some)** , 

**Quadratic:** ,  (bar)

**Cubic:** , beam xz-plane bending)

**Linear:** , , 

**VIRTUAL WORK EXPRESSIONS** 

**Rigid body/point force:** 



**Bar:** , 

, 

, 

, 



**Torsion:** , 



**Bending (xz):**

, 



 where 

**Bending (xy):**

, 



 where 

**CONSTRAINTS**

**Frictionless contact:** 

**Joint:** 

**Rigid body (link):**  , .

**MATHEMATICS**

**Polar representation:** , , , 

**Eigenvalue decomposition:** 

**Matrix function:** If , then 

**Newton’s method:** If , then 

**Taylor series:**  

**TIME INTEGRATION (free vibrations)**

**Crank-Nicholson:** , 

**Disc. Galerkin:** , 