27-750 2016, Mid-term, take-home, version 2;
100 points
Available: 10 a.m. Saturday, 20th
Due: 11:59 p.m. Sunday, 21st

1. [10] In the formulae given in the lecture notes on volume fractions, the quantity $8100°^2$ is often found in relation to the subset of orientation space that spans 0 to 90° for all three Euler angles. Where does this quantity come from and why are the units degrees squared?

2. [30]
a) Plot inverse pole figures for the sample X and sample Z directions using Matlab (not MTEX) for the Copper, S and Brass components. Show the Matlab script that you used to generate the plots. You can extract Euler angles from the lecture notes. Apply cubic crystal symmetry and plot a full circle (because limiting the area to a single stereographic triangle is more difficult).
(b) Does it make any difference whether you apply sample symmetry or not?
(c) To clarify what the inverse pole figures show, make a PDF (or whatever format suits you) of your plot from part (a) and use a graphics program (or even just powerpoint) to trim it down to a single standard stereographic triangle; then identify the point that corresponds to each texture component in each plot. If you see anything other than three points in each of the two plots, then something is wrong.
(d) explain how your plots correspond to the (hkl)[uvw] specifications of the three texture components.

3. [20] Read the paper entitled "Stress hot spots in viscoplastic deformation of polycrystals" and answer the following questions. The document is available on Box as msms349293p16-proofs-ADR.pdf .

(a) What kind of plot is shown in Fig. 4 and why would a straight line correspond to a normal distribution?
(b) What is the "distance map" that is referred to in Fig. 8 and how is it calculated (pick any of the three variants depicted in the figure)?
(c) What does Fig. 10 tell us about the texture of the locations with high stress in the simulations that were carried out for this paper?
(d) Of the (von Mises) stress and strain-rate fields, which one shows the grain structure to some extent?
(e) Given that grain boundaries are understood to be barriers to slip (although no such provision was made in these simulations), it seems reasonable to expect high stresses next to grain boundaries. What was the counter-intuitive result with respect to stress levels adjacent to boundaries?

4. [20] Read the paper 1996-Acta-Baczynski-Jonas-Torsion-Textures.pdf (available in the Box folder), and answer the following questions.
(a) What does Fig. 15 tell us about the relative stability of different orientations?

(b) If you follow a horizontal line across the two upper sub-plots in Fig. 15 that passes through the points D1 and D2, what do you notice about the direction of change in orientation?
(c) If you arrive at point D1, say, and somehow the orientation is displaced slightly to the right (larger PHI1), will you return to point D1, or something else? Comment, as best you can, on whether the points D1 (top right) and D2 (top left) represent fully stable orientations under torsional deformation.
(d) What sample symmetry can you see in Fig. 11?

5. [10] Why is the spatial resolution in EBSD better at lower accelerating voltages (e.g., 10 kV) than at high values (e.g. 35 kV)?

6. [10] Explain in your own words how the voting scheme is used in the indexing of diffraction patterns in EBSD to arrive at a "confidence index". You are welcome to read papers outside the lecture notes.