# Homework day 3

## Problem 1

## S. Prestemon (Unit 4 and Unit 7)

#### 3 points

Given the parameters of the cables used in the LHC main dipole (see table below), compute

* Pitch angle(*ψcable*)
* Cable compaction (*kcable*)
* Keystone angle (*ϕcable*)
* Narrow edge packing factor (*πd/2tin*)
* Filling factor (*κ*)

|  |  |  |  |
| --- | --- | --- | --- |
| **Strand** |  | **Inner layer** | **Outer layer** |
| Diameter | mm | 1.065 | 0.825 |
| Cu to SC ratio |  | 1.65 | 1.95 |
|  |  |  |  |
| **Cable** |  |  |  |
| Number of strands |  | 28 | 36 |
| Mid-thickness | mm | 1.900 | 1.480 |
| Thin edge | mm | 1.736 | 1.362 |
| Thick edge | mm | 2.064 | 1.598 |
| Width | mm | 15.100 | 15.100 |
| Pitch length | mm | 115 | 100 |
| Radial insulation | mm | 0.150 | 0.150 |
| Azimuthal insulation | mm | 0.120 | 0.130 |

## Problem 2

## S. Prestemon (Unit 4 and Unit 7)

#### 3 points

Let’s imagine that the LHC Inner layer cable of the previous exercise carries a current of 12000 A. Compute

* Jsc
* Je
* Jo

## Problem 3

## S. Prestemon (Unit 4 and Unit 7)

#### 3 points

Explain the advantages/reasons of using a multi-strand twisted cable in a superconducting accelerator magnet.

## Problem 4

## E. Todesco (Unit 15 and Unit 16)

#### 5 points

A sector dipole has 50 mm coil width and 450 A/mm2 overall current density.

1. Estimate the magnetic field in the bore ; *(1 point)*
2. Assuming a 20% margin on the loadline, a filling factor of 0.3, what is the requirement on the superconductor in terms of superconductor current density/field on the critical surface ? Consider a ratio of peak field/bore field equal to 1. *(1 point)*
3. Repeat the previous computation, assuming a ratio peak field/bore field equal to 1.04. *(1 point)*
4. Assuming that the slope of the superconductor critical surface is 400 A/mm2/T, compute using the factor *X* (see slides 7.22 to 7.29) the increase of the loadline margin if the filling factor is increased from 0.3 to 0.33. *(2 points)*