Lecture 6: Problems

1. Sketch the spatial modes for a ring filled with six evenly-spaced bunches.

2. Discuss the impact on the growth rates of the resistive-wall instability of operating just below or just above an integer tune. Explain the difference between operating just below or just above an integer tune in terms of the physical properties of the resistive-wall wake, and the beam modes.

3. Assuming fixed values for:
   - the number of bunches in the damping ring;
   - the bunch charge;
   - the vacuum chamber beam-pipe radius;
   - the vacuum chamber conductivity;
   - the beta functions;
   - the fractional part of the tune;

   how does the resistive-wall growth rate (i.e. the rate for the fastest mode) scale with the circumference of the lattice?

4. A damping ring is constructed with sections as follows:

Section	Total length	Beam-pipe radius
Arc	5000 m	4 cm
Straight	800 m	3 cm
Wiggler	400 m	2 cm

   Estimate the relative contribution of each section to the resistive-wall growth rate, assuming a circular cross-section vacuum chamber with the same conductivity in each case.

5. To suppress the development of electron cloud in the vacuum chamber of the positron damping ring, it is proposed to coat the aluminium vacuum chamber (electrical conductivity 35×10^6 Ωm) with a thickness of 100 Å of titanium nitride (electrical conductivity 4×10^6 Ωm). Discuss any impact this may have on the resistive-wall instability.