# Introduction to Particle Accelerators

# LONGITUDINAL BEAM DYNAMICS

# TUTORIAL 2 QUESTIONS

1. Calculate the synchrotron tune for LHC at injection and flat top energy, 450 GeV and 7000 GeV, with the following parameters: harmonic number = 35640, Vmax= 6 at injection and 16 MV at flat top, slip factor as calculated in a previous exercise. Compare the result with the betatron tune, Qx = 64.31. Compare the result in terms of betatron and synchrotron frequencies knowing that the revolution frequency is 11 kHz
2. Complete the table for SPS: with injection energy for protons 26 GeV, flat top 450 GeV, Vmax at injection

|  |  |  |
| --- | --- | --- |
|  | Protons | Pb82 |
| Einj (GeV) | 26 | 17 |
| Eft (GeV) | 450 |
| Frev inj (kHz) |  |  |
| Frev ft (kHz) |  |  |
| Vmax inj (MV) | 2 | 1.7 |
| Vmax ft (MV) | 7 | 7 |
| hinj |  | 4653 |
| hft |  | 4620 |
| Qx inj | 20.23 | 26.38 |
| Qx ft | 20.05 | 26.26 |
| Qsynchrotron inj |  |  |
| Qsynchrotron ft |  |  |
| fbetatron inj (Hz) |  |  |
| fbetatron ft (Hz) |  |  |
| fsynchrotron inj (Hz) |  |  |
| fsynchrotron ft (Hz) |  |  |