Das & Ferbel refers to the textbook “Introduction to Nuclear and Particle Physics”, 2nd Ed, by A. Das and T. Ferbel

Syllabus: Read: Brush up on relativistic mechanics for problem 9.3 from a suitable text and/or Appendix A. Review Chapter 9.

1. Problem 9.3

2. Draw the quark flow diagram for the $\beta$ decay of the neutron (see your lecture notes). Since the W boson is involved (in a virtual or “off-shell” manner), this is a weak reaction. Now draw diagrams for the following reactions.
   a) Delta resonance production: $p\pi^+ \to \pi^0\Delta^{++}$ (annihilate a $d$ quark pair and create a $u$ pair).
   b) $\beta$ decay $D^0 \to K^-e^+\nu_e$.
   c) $D^0$ hadronic decay: $D^0 \to K^-\pi^+$ (Tricky! Sink the $W$ in the $\beta$ decay above internally and create a $u$ pair).
   d) Charge exchange $p\pi^- \to n\pi^0$ (exchange quarks)
   e) Meson production in (high energy) pp scattering: $pp \to pp\pi^0$ (create a $u$ or a $d$ pair, i.e. the $\pi^0$).
   f) Classify the above reactions as being weak or strong, give reasoning.