1. a) Find the quark wave-function (flavor only) for the mixed-antisymmetric baryon octet representations (the mixed-symmetric wave-functions were all given in your handout). Show that the two $\Sigma^0$ and the two $\Lambda^0$ states (one MS and one MA each) are all orthogonal to each other.

b) From the quark wave-function for the $\Lambda^0$, show that

$$I^+|\Lambda^0\rangle = 0$$
$$V^+|\Lambda^0\rangle = |p\rangle$$

so that the $\Lambda^0$ has $I=0$ and is also a part of the baryon octet ($J^P=1/2^+$).

2. Use Young Tableaus to find the quantities A, B, and C in

a. $4 \otimes 4 \otimes 4 = A \bigoplus B \bigoplus B \otimes C$

b. $8 \otimes 8 \otimes 8 = A \bigoplus B \bigoplus B \otimes C$

c. $4 \otimes 4 = A \bigoplus B$

d. $4 \otimes \bar{4} = A \bigoplus B$

3. In addition to the u,d,s quarks, there is a fourth quark c which makes the upper member of a (c,s) doublet (but note that I=0 for both c and s). Find all of the ground state baryons containing one and only one c quark and their quark wave-functions, with

a. $J^P = \frac{3^+}{2}$

b. $J^P = \frac{1^+}{2}$ (use only the MS octet representation)

Give the quantum numbers $I$, $I_3$, $S$, and $Q$ for each of these states.
4. From the quark wave-function for the mesons, prove that

   a. \( I^+ |\eta^8\rangle = 0 \) and \( V^+ |\eta^8\rangle = |K^+\rangle \)

   so that the \( \eta^8 \) has \( I=0 \) and belongs to the meson octet, and

   b. \( I^+ |\eta^1\rangle = 0 \) and \( V^+ |\eta^1\rangle = 0 \)

   so that the \( \eta^1 \) has \( I=0 \) and does not belong to the meson octet.

5. Find all of the ground state mesons containing one and only one c quark and their quark wave-functions, with

   a. \( J^p = 0^- \)
   b. \( J^p = 1^- \)

   Start from the properly symmetrized wave-functions

   \[ |\pi^+\rangle = \frac{1}{\sqrt{2}} (u\bar{d} + \bar{d}u) \text{ and } |\rho^+\rangle = \frac{1}{\sqrt{2}} (u\bar{d} - \bar{d}u). \]

   Give the quantum numbers \( I, I_3, S, \) and \( Q \) for each of these states.