PHYSICS 8802.01 : SET # 4 Due 27th September, 2016

1. (8 pts)
(a) Use Young Tableau methods to determine the decomposition of

$$6 \otimes 10 = ??$$

"6" and "10" stand for SU(3) sextet and decuplet respectively. Do the calculation in two ways, once $6 \otimes 10$ with "a"s and "b"s placed in the sextet Young Tableau, then again from $10 \otimes 6$ with "a"s etc. placed in the decuplet Young Tableau.
Check that the product of dimensions on the LHS matches the sum of dimensions on the RHS.

(b) Repeat the same exercise for

$$\overline{6} \otimes 10 = ??$$

2. (4 pts)
(a) Make a Table (template given below) for the baryon octet that lists :
[name of baryon, quark content, I_3, S, B, Y, Q]

(b) Draw the $Y - I_3$ plane diagram for this octet.

3. (4 pts)
Work through the derivation of Halzen&Martin eqns.[2.51] and [2.52] and give an explanation in your own words.

4. (4 pts)
(a) Consider the charmonium ${}^1S_0$ (η_c) and ${}^3S_1$ (J/Ψ) states. What are the S, L and J quantum numbers of these mesons? Use them to fix J^{PC}.

(b)The "B" mesons are bound states of the b quark and an anti-light-quark (or vice versa). It is found that the lightest such B mesons have $J^P = 0^-, 1^-, 0^+, 1^+, 2^+$.
What are the S (total spin) and L (orbital angular momentum) quantum numbers for these 5 cases? You may assume that that lowest states have $L = 0$ followed by $L = 1$ states etc.
Why is the charge conjugation quantum number C irrelevant here ?
Note: it is possible that more than one combination of (S, L) leads to the same J^P.

Name of Baryon	Quark content	I_3	S	B	Y	Q