**First day:**

1. Using

\[ if_{abc} = 2\text{Tr} \left( t^c [t^a, t^b] \right) \]  

show that \( f_{abc} \) is anti-symmetric with respect to any pair of indices.

2. Prove the Fierz identity

\[ \delta^i_j \delta^l_k = \frac{1}{N} \delta^i_l \delta^j_k + 2(t^a)_i (t^a)_j \]  

3. Use the Fierz identity to derive the Casimirs \( C_F \) and \( C_A \).

4. Show that

\[ t^a t^b t^a = -\frac{1}{2N} t^b \]  

and draw the corresponding colour diagram.

5. Simplify

\[ if_{abc} t^a t^c \]  

and draw the corresponding colour diagram.

6. Prove the following identity

\[ [t^a, [t^b, t^c]] + [t^b, [t^c, t^a]] + [t^c, [t^a, t^b]] = 0. \]  

Use now the above identity to prove the Jakobi identity

\[ f_{abc} f_{cde} + f_{bce} f_{ade} + f_{cae} f_{bde} = 0 \]

7. Visualize the Jakobi identity using colour diagrams.

8. Produce a \( q \bar{q} \) pair via a vector current. Check that coherent radiation off the \( q \) and \( \bar{q} \) cancels when \( q \bar{q} \) are produced by a colour singlet source (photon \( \rightarrow q \bar{q} \)) and adds up into radiation off a gluon in the case of a \( g \rightarrow q \bar{q} \) splitting process.