Team B: PCB Power Distribution Board Analysis

1. State the efficiency of each of your regulators. For linear regulators, it is simply [1 – ((Vin - Vout)/(Vin))]. Switching regulators will state a nominal efficiency in their datasheets.

3.3V Linear Regulator: $\eta = 100 \times \left(1 - \frac{24-3.3}{24}\right) = 13.75\%$

5V Linear Regulator: $\eta = 100 \times \left(1 - \frac{24-5}{24}\right) = 20.83\%$

12V Linear Regulator: $\eta = 100 \times \left(1 - \frac{24-12}{24}\right) = 50\%$

2. State the input power used for each subsystem at maximum rated output.

3.3V Sub-System Output Power: $P = IV = 1A \times 3.3V = 3.3W$

5V Sub-System Output Power: $P = IV = 1A \times 5V = 5W$

12V Sub-System Output Power: $P = IV = 2A \times 12V = 24W$

Motor Sub-System Output Power: $P = IV = 10A \times 24V = 240W$

$Total\ Subsystem\ Output\ Power = 272.3W$

3.3V Sub-System Input Power: $P = \frac{3.3}{0.1375} = 24W$

5V Sub-System Input Power: $P = \frac{5}{0.2083} = 24W$

12V Sub-System Input Power: $P = \frac{24}{0.5} = 48W$

Motor Sub-System Input Power: $P = \frac{240}{1} = 240W$

$Total\ Subsystem\ Input\ Power = 336W$

3. State the total system efficiency at maximum rated output.

Total System Efficiency: $\eta = 100 \times \frac{Output\ Power}{Input\ Power} = 100 \times \frac{272.3}{336} = 81.04\%$