Satellite Navigation Techniques and Applications
Assignment #6 Spacecraft Power

1) Spacecraft Power Budget

a) Given the following load and duty cycle information, calculate the power margin in daylight for the following mission.

Loads:
- Payload: 4.5 Watts, duty cycle = 30% in daylight, 0% in eclipse.
- Transceiver: 6 Watts, duty cycle = 10%
- AOCS System: 2 Watt, duty cycle = 100%
- Command and Data Handling: 0.5 Watt, duty cycle = 100%
- Power Electronics: 0.3 Watt, duty cycle = 100%

Batteries: Total Capacity: 30 Watt-hours
Solar Arrays: **Provide 9 Watts in Sunlight.**
Orbit: **95 minutes, 35 minutes of Eclipse**

Battery charging efficiency is 90%.
Battery to load losses are 10%
Solar arrays to loads loss is 5%
Assume payload is not operated in eclipse.

2) Solar Array Sizing

For the questions below, assume the following parameters:

Transfer Efficiency, Arrays to Loads = 0.95
Transfer Efficiency, Arrays to Batteries to Loads = 0.8
Solar Cell Efficiency: 200 Watts per square meter.
Sun indecent on the solar arrays at a average 45 degree angle, theta = 45 degrees
Inherent Degradation of the Solar Cells = 0.8
Solar Cell Degradation Per Year = 4%
Mission Lifetime = 8 years.

a) For the system in question 1, calculate the size of the solar arrays needed to provide the required power for the spacecraft.

3) Programming Exercises

Add the following capability to your satellite simulation.

a) Model the system parameters and operations profile from question 1 on the satellite and add battery charge as a system telemetry point.

The Battery should charge during sunlight and discharge during eclipse. The battery should completely re-charge every orbit.