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## Roshan Jaiswal-Ferri

%Section - 01

%Aero 446 HW3: 4/25/25

## Workspace Prep

```
%warning off
format long           %Allows for more accurate decimals
close all;            %Clears all
clear all;            %Clears Workspace
clc;                  %Clears Command Window
```

## Vars

```
%Subsystem      Power (W)
Payload = 138;
Structure = 3;
Thermal = 10;
Power = 5;
TTC = 36; %used for up and downlink
OBC = 5; %On Board Computer
ADCS = 30;

contPower = Structure + Thermal + Power + OBC;

%orbit parameters
```

---

```
p = 90*60; %period in seconds
dT = 67; %day temp in C
eT = -65; %Eclipse temp in C
dl = 1/3; %amt of time spent in eclipse
dli = 2/3;
Xd = 0.8;
Xe = 0.9;
Se = 1366; %w/m^2

%solar cell
cellArea = 0.06*0.05; %m
powDens = 135.3; %mw/cm^2
n0 = 0.302; %std efficiency at 28 C
Voc = 0.99; %volts
Tcoeff = -6.7*10^-3; % V/deg C
Fp = 1; %assume packing fraction of 1 since unlisted
```

## Problem 1

### Question 1.1

```
Tc = (Tcoeff/Voc);

disp(['Solar Cell Temp coefficient: ', num2str(Tc*100), ' %/C'])
disp(' ')

Solar Cell Temp coefficient: -0.67677 %/C
```

### Question 1.2

```
Td = p*dli;
Te = p*dl;

%account for eclipse
Je1 = contPower*Te; %energy in joules
Je2 = TTC*3*60; %energy in joules for 3 min downlink
Je3 = ADCS*30; %joules for 30sec ADCS activation night
Je = Je1 + Je2 + Je3;

%account for daylight
Jd1 = contPower*Td;
Jd2 = Payload*2*60; %joules for payload for 2 min per orbit
Jd3 = ADCS*30; %joules for 30sec ADCS activation day
Jd = Jd1 + Jd2 + Jd3;

Po = orbitPower(Je,Jd,Te,Td,Xe,Xd); %power for each orbit

disp(['Avg s/c power required per orbit: ', num2str(Po), ' W'])
disp(' ')


```

---

## Question 1.3

```
n = n0*(1+Tc*(dT-28)); %using day temps
Jd = Se*n*Fp*cellArea*Td; %power in joules
Pe = Jd/p;

disp(['Avg power generated per orbit per cell: ', num2str(Pe), ' W'])
disp(' ')

Avg power generated per orbit per cell: 0.6073 W
```

## Question 1.4

```
cellCount = ceil(Po/Pe);
disp(['Cells needed to supply power: ', num2str(cellCount)])
disp(' ')

Cells needed to supply power: 83
```

## Question 1.5

```
arrayA = cellCount*cellArea/2;
disp(['Area required per panel: ', num2str(arrayA), ' m^2'])
disp(' ')

Area required per panel: 0.1245 m^2
```

## Question 1.6

```
% These solar cells are adequate for a box-panel type s/c because the
% panels are relatively small while generating enough power to stay
% operational. They also function properly within the required temperature
% range.
```

## Question 1.7

```
% Potential improvements to the power system of this spacecraft could
% include powering the ADCS for less time or using one that uses less power
% over a similar activation time. Other suggestions would be to increase
% data storage on the space craft to allow for less frequent downlinks.
```

## Problem 2

### Question 2.1

```
% The recent and sad death of the opportunity mars rover was because of a
% dust storm covering the solar panels in dust and lowering power input so
```

---

```
% much that it ran out of battery. By switching to a RTG NASA eliminated a
% variable that was out of their control and directly addressed the
% previous point of failure. Now they can control their power input and do
% not have to rely on the sun which could be covered. RTGs will also
% increase the lifespan of the rover, which has been shown to be pretty
% long.
```

## Question 2.2

```
% You can use capacitors or batteries to handle the peak loads of a system
% while making sure to size the solar array for appropriate power
% generation.
```

## Question 2.3

```
% Peak to peak power means energy is stored during low demand and matched
% at high demand. This is useful because it allows you to store extra power
% and can improve the efficiency of the system.
```

## Question 2.4

```
% Solar panels will have better performance coming out of an eclipse
% because their operating temperature will generally be cooler and closer
% to the optimal performance temp. The temperature differential slowly
% rises over the day time of the orbit and decreases efficiency.
```

## Question 2.5

```
% Solar panel degradation is definitely worse in LEO because of earth's
% atmosphere-components like a lot of AO, outgassing/particulates in the
% higher atmosphere. They will also go through many more thermal cycles in
% LEO which can cause fatigue.
```

## Problem 3

```
% 1) False
% 2) False
% 3) True
% 4) False
% 5) True
```

## Functions

```
function [power] = orbitPower(Je,Jd,Te,Td,Xe,Xd)
    c1 = Je/Xe;
    c2 = Jd/Xd;
    power = (c1 + c2) / Td;
end
```

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*Avg s/c power required per orbit: 49.8681 W*

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