Module 4: Assignment

Low Voltage System of an EV

Submitted by:

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You are a systems engineer working for a leading automotive company specializing in electric vehicles (EVs). Your team is responsible for evaluating and optimizing various aspects of EV performance, including duty cycle analysis, telematics, sensor calibration, and electrical system design. As part of your responsibilities, you need to calculate and analyze several key parameters related to EV operation and performance.

Tasks to be Performed:

1. Duty cycle

Given:
Output voltage (V out) = 12 V
Input voltage (Vin) = 24 V

Solution:
Formula:
$D = Vout/Vin$
$= 12/24$
$= 0.5$ or 50%

Therefore, the Duty cycle (D) of the buck converter is 0.5, or 50%.

2. Total Cost of Ownership

Given:
Fixed Vehicle Costs (FVC):
Lease Payments = Rs. 550 per month
Insurance = Rs. 120/month
Licenses = Rs. 29/month
Permits = Rs. 17.50/month
Registration = Rs. 19.67/month

Variable Vehicle Costs (VVC):
Fuel = Rs. 0.18 per kWh
Tolls = Rs. 80 per month
Maintenance = Rs. 88.78/month

Solution:
Formula:

Total Cost of Ownership = Fixed Vehicle Costs + Variable Vehicle Costs

Calculate Fixed Vehicle Costs (FVC):
FVC = Lease payments + Insurance + Licenses + Permits + Registration
$= 550+120+29+17.50+19.67$
$= 736.17$

Calculate Variable Vehicle Costs (VVC):
VVC = Fuel + Tolls + Maintenance
$= 0.18+80+88.96$
$=168.96$

Total Cost of Ownership = Fixed Vehicle Costs + Variable Vehicle Costs
$$= 736.17 + 168.96$$
$$= 905.13 \text{ per month}$$

Therefore, the Total Cost of Ownership for the electric car is Rs. 905.13 per month.

3. The scale factor of the Inertial Measurement Unit (IMU):
Given:
Output voltage change of the IMU: From 1.5 volts to 3.0 volts
Corresponding acceleration change: From 3 m/s^2 to 6 m/s^2

Solution:
Formula:
S.F = change in output/change in input
$$= 1.5 - 3.0 / 3 - 6$$
$$= 0.5 \text{ \%}$$

Therefore, the Scale factor (SF) of the accelerometer is 0.5 %.

4. Electrostatic Charge

Given:
Charge of electron (e) = 1.6 x 10^-19 C
Number of electrons (n) = 5 x 10^6

Solution:
Formula:
Q = ne
$$= (5*10^6) * 1.6*10^{-19}$$
$$= 8*10^{-13}$$

Therefore, the Electrostatic Charge is 8*10^-13.