



Module 13: Assignment 1

Motors and Speed Control Methods

Problem Statement:

As an engineer in the electric vehicle industry, your role involves analyzing various components' performance to ensure efficient operation. You're tasked with calculating critical parameters to evaluate the effectiveness of these components within the electric vehicle system.

Tasks to be Performed:

1. Operating Speed of the Rotor:

Given:

- Synchronous speed of the rotor = 1500 rpm
- Slip speed = 50 rpm

Calculate the operating speed of the rotor.

2. Frequency of Rotor:

Given:

- Fractional slip = 0.03
- Supply frequency = 50 Hz

Calculate the rotor's current frequency.

3. Hall Voltage (V_H) Generated Due to Hall Effect:

Given:

- Drift velocity of the charges = 0.1 m/s
- Magnetic field component perpendicular to the direction of current flow = 0.5 T

Calculate the hall voltage (V_H).

4. Electromotive Force of DC Motor:

Given:

- Number of poles = 4
- Magnetic flux = 0.02 Wb
- The rotational speed of the motor's armature = 1500 rpm
- Number of armature conductors = 100

- Number of parallel paths in the armature winding = 2

Calculate the electromotive force (E_b).

5. Torque of a Three-Phase Induction Motor:

Given:

- Flux per stator pole = 0.03 Wb
- Rotor current at standstill = 10 A
- The angle between rotor emf and rotor current = 30 degrees
- Constant (k) = 0.5

Calculate the torque (T).

6. Switched Reluctance Motor: Stroke Angle:

Given:

- Number of rotor poles = 8

Calculate the stroke angle (θ_{st}).

7. Rolling Resistance Force:

Given:

- Coefficient of friction (μ) = 0.02
- Mass of the vehicle (m) = 1200 kg
- Acceleration due to gravity (g) = 9.8 m/s²
- Inclination angle (θ) = 4 degrees

Calculate the rolling resistance force (F_{rr}).

8. Aerodynamic Drag Force:

Given:

- Density of air = 1.2 kg/m³
- Vehicle frontal area = 5 m²
- Drag coefficient = 0.3
- Vehicle speed = 30 m/s

Calculate the aerodynamic drag force (F_{ad}).

9. Gradient Force:

Given:

- Mass of the vehicle = 2000 kg
- Acceleration due to gravity = 9.81 m/s^2
- Inclination angle = 5 degrees

Calculate the gradient force (F_{gr}).

10. Total Tractive Force:

Given:

- Rolling resistance force = 200 N
- Aerodynamic drag force = 120 N
- Gradient force = 80 N

Calculate the gradient force (F_{tt}).

11. Torque Exerted by the Motor:

Given:

- Total tractive effort = 500 N
- Rolling radius = 0.3 meters
- Gear ratio = 4

Calculate the gradient force (F_m).