Module 2: Assignment

Vehicle Fundamentals

Submitted by:

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Problem Statement:

You are a mechanical engineer working for a leading automotive manufacturer specializing in hybrid vehicles. Your team is responsible for evaluating the performance and efficiency of various vehicle components to optimize fuel consumption and overall vehicle performance. You have been assigned a project to analyze and calculate several key parameters related to the powertrain and efficiency of a new hybrid vehicle model.

Tasks to be Performed:

1. Engine mechanical efficiency

Given:
Mechanical work output = 12000 kJ
Energy input from fuel = 35000 kJ

Solution:
Formula:
Engine mechanical efficiency = (mechanical work output / energy input from fuel) * 100%
= (12,000/35,000) *100%
= (0.34) *100%
=34%

Therefore, the mechanical efficiency of the engine is 34%.

2. Brake Power of the Engine

Given:
Engine speed (N) = 3000 rpm
Torque (T) = 250 Nm

Solution:
Formula:
Brake power of the engine = $(2 * \pi * N * T) / 60000$
= (2*3.14*3000*250)/60000
=78.53 kw

Therefore, the brake power of the engine is 78.53 kw.

3. Torque Transmitted from the Clutch

Given:
Coefficient of friction (μ) = 0.3
Normal force (W) = 500 N
Radius of clutch (R) = 0.1 m

Solution:
Formula:
$T = \mu * W * R$
= (0.3*500*0.1)
=15 Nm

Therefore, the torque transmitted through the clutch is 15 Nm.

4. Transmission Efficiency

Given:
Input power =180 kw
Output power =150 kw

Solution:
Formula:
Efficiency = (output power / input power) *100%
= (180/150) *100%
=83.33%

Therefore, the transmission efficiency is 83.33%.

5. Propeller Shaft Turning Speed

Given:
Engine rpm=4000 rpm
Gear ratio =3.5

Solution:
Formula:
Propeller RPM = Engine RPM / Gear Ratio
=4000/3.5
=1142.85 rpm

Therefore, the propeller shaft turning speed is approximately 1143 rpm.

6. Differential Gear ratio

Given:
Number of teeth on ring gear = 45
Number of teeth on pinion gear = 15

Solution:
Formula:
Differential Gear Ratio = Number of teeth on ring gear / Number of teeth on pinion gear
= 45/15
= 3

Therefore, the differential gear ratio is 3 and thus the differential gear ratio of 3 is equivalent to 3:1.

7. Degree of Hybridization

Given:
Motor power = 50 kw
Engine power = 120 kw

Solution:
Formula:
Degree of hybridization = (motor power / motor power + engine power) * 100 %
= (50/50+120) *100%
= 29.41%
Therefore, the degree of hybridization of the vehicle is 29.41 %.