Department of Mechanical Engineering
Indian Institute of Technology New Delhi
I Semester -- 2023 – 2024

MCL 721 *AUTOMOTIVE PRIME MOVERS*

PROBLEM SET – 1: Estimation of Needs of A Vehicle

Problem Statement 1: Ford Classic 1.6 Duratec LXi is a utility car which uses a petrol engine as a power plant. Following are the technical details of the vehicle:

Dimensions	
Length (mm)	4282
Width (mm)	1686
Height (mm)	1468
Ground Clearance (mm)	168
Kerb Weight (KG)	1110
Tyre size	175/65R14

Gear Number	Gear Ratio	Vehicle Speed[Km/h]
1	3.461	0-24
2	1.896	24-40
3	1.241	40-64
4	0.911	64-75
5	0.756	75+

Compute and develop following characteristic curves:

- Total resistance force on the vehicle Vs vehicle speed.
- The powering engine torque Vs vehicle speed.
- Ideal Engine Cycle work Vs vehicle speed.

Problem Statement 2: . An Audi A3 35 TDI Premium Plus car has the following specifications.

- ✓ Length-4458mm
- ✓ Width-1796mm
- ✓ Height-1416mm
- ✓ Ground clearance-165mm
- ✓ Wheel base-2637mm
- ✓ Front tread-1555mm
- ✓ Rear tread- 1526mm
- ✓ Gross weight-1890kg

- ✓ Front head room-1006mm
- ✓ Rear head room-924mm
- ✓ Tyre-205/55 R16
- ✓ Seating capacity-05
- ✓ Max power-143bhp@3500-4000rpm
- ✓ Max torque-320Nm@1750-3000rpm
- ✓ Acceleration- 0-100 kmph in 8.6 seconds

For the head wind velocity of 5-15 kmph at 5kmph step, for gradability between 3-15% at 3% step,

a) Determine the net resistance forces under steady operation between 30kmph to 120 kmph at 10kmph step.
b) Determine the effect of acceleration on the net resistance and vehicular power requirement if the vehicle is accelerating at 50%, 75% and 100% of the rated acceleration.
c) Evaluate the engine speed and torque at all the conditions in (a) and (b) by presuming a fixed gear ratio of 0.96 and gear box ratio of 0.72 and 1.21.
d) Suggest a combination of maximum head wind velocity and maximum gradability that the engine can overcome at maximum power condition.
e) If the vehicle operates an average between 40 to 70 kmph speed, 20-40% of the rated acceleration, 2-10 kmph of head wind velocity and 1-3% of gradability, what is the utilization in % of the rated engine capacity in a map format?