|| 26- 28th March, 2021 ||

INTER IIT TECH MEET'21

IIT Guwahati

MID PREP EVENT

(250 Points)

BOSCH'S ELECTRIC VEHICLE SIMULATION

India represents the fourth largest automobile market in the world and the second-largest two-wheeler market. It is also a country with massive dependency on oil imports, with a USD 112 billion oil import bill in FY19. Pollution in many Indian cities has reached alarming levels. All these factors combined, make a strong case for EV adoption in India.

The electric vehicle (EV) market in India is expected to hit over 63 lakh unit mark per annum by 2027, according to a report by India Energy Storage Alliance (IESA).

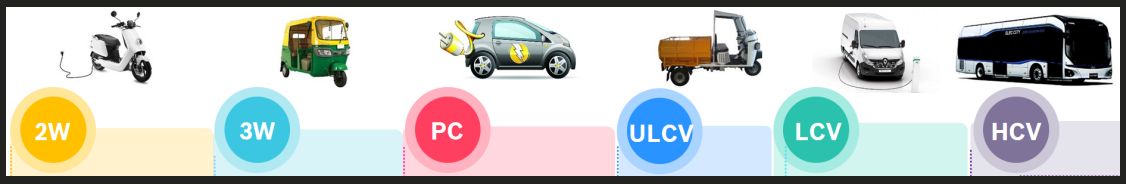
BOSCH

PROBLEM STATEMENT:

The problem statement is broadly divided into 5 stages/components.

1. Vehicle selection:

Choose a vehicle segment – 2W / 3W / Passenger car/ LCV / Bus. Find appropriate and practical design parameters.



(Each participant can choose one of the above segments and work on the below steps. However, segment diversity across proposals will be appreciated)

2. Performance Baselining :

For the identified segment arrive at target performance parameters like max power @ rated speed and max torque @ target speed achieve stated performance requirements like

-Time to reach a particular speed (say 60 or 100km/h) from rest

-Time taken for acceleration for overtaking (say from 40km/h to 80 km/h)

-Maximum vehicle speed (and chosen reducer/transmission ratio)

-Target gradeability (say 15%)

-Auxiliary loads like HVAC, lighting, infotainment etc.

(all values mentioned above are only for reference. The participant may chose his targets and make necessary assumptions wherever required for. E.g. Gross vehicle weight, rolling friction, drag coefficient, wheel radius, transmission ratio etc.. but must provide the rationale for choosing a target value for all assumptions)

-Braking distance (100kmph ->0) & recuperation targets

BOSCH

PROBLEM STATEMENT:

3. Modeling & Analysis:

The participant should develop a simulation in MATLAB Simulink and show the results of the achieved target performance parameters of the vehicle and the output power /torque at respective speeds of the motor to achieve the vehicle performance requirements.
Use the forward simulation model (Eg: with driver model (PI controller based for eg)). Model at max performance. Corrections can be suggested for taking thermal performance or derating into account

4. Electric Drive Dimensioning:

Propose a Design of a High-Efficiency Permanent Magnet Synchronous Motor (PMSM) and Inverter System (and proposals to maximize the efficiency of the motor and inverter).

-For Motor, Identification of internal resistances, inductance (Ld values), excitation magnetic flux of the proposed PMSM. Determination of efficiency curves under loaded conditions. Desired to have a lookup table for the parameter of interest.

-For the inverter, including a selection of appropriate switching strategies/frequencies for optimizing efficiency, performance, and harmonics reduction. Arrive at the inverter specifications including electrical speciations including system voltage, peak RMS current, etc

5. Battery Dimensioning and Optimization :

With the assumed vehicle parameters (in step 2) above, run a simulation in MATLAB with the chosen motor and inverter (in step 4) to arrive a target Battery size (xx kWh) for an assumed target range (say 200kms) while driving in any of the standard driving cycles like FTP 75, MIDC, NEDC, WLTC etc (to arrive at average energy per driving cycle in Wh/km)

6. Design your E/E Architecture:

Propose an electrical architecture of the vehicle including all key components required in an electric vehicle. And target specifications of key components.

BOSCH

RESULTS AND PRESENTATION:

-Create a 15 min presentation (PPT or video) that guides the judging panel through your work. The presentation will be followed by a set of technical questions from the judges to evaluate your work.

-Please back up your proposal details for all steps mentioned above with relevant assumptions made, simulation models, and results.

Workaround :

(if unsuccessful in step 4, for step 5, based on the target performance of the vehicle, select a suitable commercially available motor and inverter with published performance/efficiency characteristics (across the operating range) available on the internet.

**Evaluation Criteria would be released soon.

A maximum of 8 participants (per team) shall be awarded participation /merit certificate.

BOSCH