Chapter 7: Conclusion and future scope:

For hybrid electric vehicles (HEVs), Series-Series (SS) topology wireless power transfer (WPT) technology offers a possible solution to the problems with current techniques for power management and charging. We investigated the use of SS topology for WPT essentially in HEVs in this work and came to some important conclusions:

7.1 Conclusions:

- **High efficiency:** The simulation results shows that SS topology with square power pads exhibits larger efficiency than circular power pads. ANSYS simulation results of flux density distribution gives us idea for optimum distance between two coils. In this research 95.5% efficiency achieved which is as per standard validated.
- **Coupling coefficient:** Spiral coils presents higher coupling coefficient than helical coils for same misalignments. As misalignments increases the coupling coefficient difference becomes narrow.
- **2D contour plot:** It is concluded from 2D contour plots derived from ANSYS Electronics Desktops that, the hexagon like shapes provides ideal placement place for receiving pad because of highest level of mutual inductance presence.
- **Increased convenience:** By enabling wireless charging and eliminating the need for physical connections, WPT can improve the overall usefulness and convenience of HEVs. More convenience compared to wired charging.
- **Minimised environmental effect:** By lessening the requirement for fossil fuel use and greenhouse gas emissions, WPT technology, particularly when combined with SS topology, offers the potential to lessen the environmental effect of HEVs. Though it is delimitation of the research, it is mentioned here that power losses are reduced and to compensate these losses additional energy is being required which is produced by some conventional power plant. So by lower losses means lower fossil fuel required and hence minimised environment pollution effect.
- **Reduced maintenance:** WPT system has practically no moving parts and more solid-state components than conventional wired charging system. So less wear

and tear, friction, mechanical damage to sockets happens, and hence reduced maintenance.

- **3D analysis:** ANSYS Electronics Desktop software is used to design WPT coils and it has found very accurate and precise to implement in hardware prototype. We can analyse the misalignments in all the 3 directions and able plot 3-D images for magnetic field strength, magnetic flux density, coupling coefficient, self-inductance and mutual inductance. 3-D animation of misalignment with all electrical parameters can be recorded with the help of ANSYS Electronics Desktop. These analysis provides excellent results, which is used to decide the range in which receiver power pad gives maximum efficiency.
- **Electrical parameters:** ANSYS Twin Builder tool and hardware prototype is used to apply these electrical parameters and results in power electronics circuit and will be able to simulate and calculate electrical parameters like efficiency, power input and outputs, emf induced in receiving coils etc.
- **Overall conclusion:** Prototype and simulation results gives clear idea about efficient implementation of WPT for HEVs.

7.2 Future scope:

Future study and development in the field of WPT employing SS topology for HEVs is needed in a number of areas, including:

- **Efficiency improvement:** By optimising resonance frequencies, lowering losses in power electronics, and creating new materials, researchers may continue to work on enhancing the efficiency of SS-based WPT systems.
- **Usefulness and range:** The usefulness and range of HEVs might be further improved by looking into the viability of dynamic charging, which would allow the vehicle to receive electricity even as it is moving. This is especially true for long-distance trips.
- **Optimised performance:** SS-based WPT may be optimised for power distribution, load control, and grid stability with the aid of smart grid integration solutions, which also contribute to the overall sustainability of the energy environment.

- **Lowering expenses:** For SS-based WPT systems and components to be widely used, their price must be brought down. The study of economical manufacturing processes and components is necessary.
- **Compatibility:** To enable smooth charging across different HEV models, it will be crucial to provide compatibility across various SS-based WPT systems and standardise communication protocols.
- **EMI solution:** Further investigation is needed to solve electromagnetic interference problems and determine how SS-based WPT systems would affect other electronic components in the vehicle.
- **Environmental impact evaluation:** For sustainability concerns, it will be essential to carry out a thorough life cycle evaluation to analyse the environmental impact of SS-based WPT systems from production through end-of-life disposal.
- **Safety and regulations:** To enable the safe implementation of the technology, ongoing engagement with regulatory organisations is necessary to set safety standards and recommendations for SS-based WPT in HEVs.

In conclusion, WPT adopting Series-Series architecture for HEVs has tremendous potential to revolutionise the operation and charging of electric vehicle. Continuous research, development, and cooperation among industry players will be required as this technology develops in order to realise its full potential and hasten its adoption in the automobile industry.