CHAPTER 5
CONCLUSION AND FUTURE WORK

5.1. CONCLUSION

This thesis is dedicated to the improvement of the Pulse Density Modulation to regulate the output power of resonant power converters for induction heating applications. After the reviewing of the power converter topologies, it has been found that series resonance inverter with parallel resonance tank circuit most suitable for induction heating application as the inverter current is naturally commutated even through a resonance load or via a forced commutation LC circuit. The proposed three stages feedback control is used to regulate the inverter output power.

The system proved to have the following advantages:

1. The system always operates at the unity power factor, and it is capable of controlling the load power without losing the continuous ZCS feature, which allows the operation of IGBTs at higher switching frequency with reduced switching losses and electromagnetic noises.
2. The presented control strategy reduced the effect of nonlinear and discrete output power characteristics of the PDM system, which provides a smooth power regulation.
3. Automatic start-up operation was achieved without using an external starting circuit (Load Resonant Generator). At start-up, the phase error signal fed to phase detector PD circuit, which reduce it to zero at steady state.
4. The step response of the system is satisfactory where the output power is able to follow the reference power with acceptable settling time, overshoot and steady state error.
5. PDM technique eliminates the need for manual tuning (Swept Frequency Generator) of the suitable frequency for required power level and provides more accurate and effective means of closed loop power control. In addition, it provides maximum power transfer to the load at all times.
6. A simple control circuit is needed in PDM-based heating system.

5.2. RECOMMENDATIONS FOR FUTURE WORK

- The Pulse Density Modulation Controller Implementation. This recommendation involves the implementation of the proposed PDM controller, which can be applied to various practical applications, such as small induction heaters and welding equipment.
- Application of the Pulse Density Modulation Controller on half bridge inverters may be considered as a future suggestion, as the half bridge topology may be more benefited in a small power rating applications such as induction cooker.
- Since the induction heating is an application for wireless energy transfer (WET), the PDM controller could be used as a controller for wireless battery charging applications. This system is designed to deliver power efficiently from a stationary primary source to one or more movable secondary loads over relatively large air gaps via magnetic coupling. Reducing the stress on the switching devices and switching losses using PDM strategy will increase the efficiency of WET system.
- A study of the effect of materials deformation and changing materials characteristics using induction heating with PDM control.