# ABSTRACT

Every single factory-made artifact necessitates a good life in terms of working and performance. In the automotive or aerospace sector, coating of the product plays an indispensable role in extending the life of the product. The coating of the product forms a protective surface and minimizes the wear and provides decorative appearance. Electroplating is one of the most real surfaces coating technology used widely in industries. This technique aids to produce abrasion and corrosion resistant coatings.

Electrodeposition of nano-sized particles with ceramic composite is a novel technology adopted in coating. The coatings made with Ni-$TiO_2$ provide higher hardness, higher corrosion resistance and lesser friction, wear for the coated products. It also provides improved results when compared with the products which are coated with conventional pure metallic coatings. It is a better alternative when compared with other coatings, particularly chromium coatings. However, there is no research work reporting coating of components with Ni- $TiO_2$ nano composites found in the literature arena. Hence there is a research gap in investigating the merits of coating the products with Ni-$TiO_2$ nano composites to enhance the pulse parameters. In order to fulfill this theoretical and practical gap, the doctoral work reported in this thesis was carried out.

In the research reported in this thesis, Pulsed electroplating in a Watt's bath of Ni- $TiO_2$, nanocomposites was carried out on EN8 Steel and A2 grade of Tool Steel. In this process, surfactant like ethonal or saccharin was not added to the electrolyte and the bath temperature was maintained at 50 °C. In order to achieve the number of trials the response surface methodology optimization technique was used from Design of Experiments. In this process,

the pulse plating parameters were enhanced to achieve coatings with enhanced properties. Maximum microhardness (302 HV) was obtained with respect to EN8 steel specimens by adopting pulse frequency of 40 Hz, duty cycle of 40 % and current density of 0.3 A/cm$^2$. Furthermore, the chemical composition, surface morphology, crystal structure, and the corrosion resistance of the optimized specimens of Ni- $TiO_2$ nanocomposite coatings were evaluated. This evaluation was carried out using Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD) techniques and with reference to ASTM D 3359-97 and ASTM B 117-07b Standards. The result obtained during this research work indicates that the coated product has enhanced pulse parameters, namely pulse frequency (Hz,) duty cycle (%), current density (A/cm$^2$). The electrolytes pH and stirring speed are the foremost parameters for increasing the hardness of the coatings. The friction and wear properties of the coating are further evaluated by using reciprocating friction monitor.