In this paper, the mathematical model for variable speed frequency controlled induction motor under steel losses effect and eddy current effect is developed. This model can be applied when driven by variable speed drives, when the machine has impedance unbalance or subjected to certain forms of unbalance power supply. Nowadays, variable speed frequency controlled with induction motors are using in transportation, pumps, compressors, ventilators, machine tools, hybrids or electrical vehicles, etc. When they are used, this is an important role to be correct finding the parameters in the stator windings during the condition of the inverter unbalance output voltages for motor designing. This model can be used with the inclusion of unbalance power supply but also considered the computational economy of the complex variable models.

This work presents the numerical method for finding the lumped circuit model parameters of the variable speed frequency controlled induction motor. If electrical transients could be interpreted in terms of parameters of a physical model, and then the cause of the impending failure might be identified. When the variable speed frequency controlled induction motors are used, the advantages of these devices obtained but the technical problems can be encountered. This work describes the way that can solved the disadvantages and technical problems and can be effectively used the advantages. Over the years, the various problems are encountered in the industrial zone when the designing ordinary induction motors with constant voltage and frequency (uncontrolled) are used. These problems are temperature effect (at low frequency or at low speed), insulation breakdown effect and saturation effect. The next important point is uncontrolled induction motor are running in the transient state at starting condition but running in steady state in other time. However, the variable speed drives (controlled) induction motors are running in the transient state every time. So, the particular designing of induction motor with variable speed frequency controlled induction motor was done. This design can be made to optimize and to obtain best efficiency in a certain frequency range and a certain voltage range. Old model like α-β, d-q and u-v can guarantee for the steady state condition but not for the dynamic state condition. To accurate the dynamic state, it can be guaranteed from the transient analysis. In this thesis, the best and simplest numerical method for determining the real phase values (voltage, flux linkage) of the stator is developed, since the vector control of variable speed frequency controlled induction motor demands these values as the feedback parameters. Finally the mathematical model with the saturation effect and steel losses is developed especially for variable speed frequency controlled induction motor for this purpose.

In this paper, the following approaches are used for developing mathematical model of induction motor including steel losses effect and eddy current

1. In our mathematical model we use there phase abc to obtain the real phase values (such as voltages and currents) for stator and don’t want to transform them form one coordinate system to another for control purpose.
2. In our mathematical model we use two phase coordinate system alpha,beta for rotor to simplify the differential equations because when we include the steel losses and eddy current effects to this model, it will help us to obtain a neat and tidy solution.
3. From the existing systems, we normally used the coordinate system alpha-beta to analyze the induction motor transient characteristics. However in case of inverter-fed induction motor, this model is not appropriate to use. Because we need to transform the parameters form one coordinate system to another. Even more this model did not include the steel losses and eddy current effects. But we must study these old models first to get the idea and theory to develop the new system.
4. In our study, the derivations of old models are not complete in literature. So we decided to derive the system of equations for our own. We used very simple and basic theories, such as circuit theories and Faraday’s laws to derive the equation. Later we consider the space phasor model and applied in our mathematical modeling.
5. To include the steel losses effect in our model, we made two approaches. In first approach, we modified the equivalent circuit by adding steel losses resistance Rc. In second approach, we modified the vector equation of stator voltage by adding voltage drop by steel losses in stator winding (\*Rm).
6. To include the eddy current losses effect in our model, we added the three closed circuits with steel losses resistance Rc and steel losses inductance Lc to each of the stator phase winding. As a result three differential equations are added to our model to include the effects of steel losses.

At present, one of the important tasks of the mathematical theory of electrical machines is the creation of the generalized mathematical model.There is different approaches of the solution of mathematical model. But our final model can be used for this purpose without doubt as we already verified the results with well known data from the standard models.