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Study on Dynamic analysis of Grid Interactive of offshore wind and Marine Current Farm

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Abstract:-In day-to-day life due to growth of power demand worldwide. The use of conventional energy is increased and there is reduction in conventional resources. To fulfill the Demand, it is essential to increase the renewable resources like wind, tidal, solar etc. The energy which is sustainable means which is endless. The ocean has untapped energy resources in the form of tidal wave, geothermal, offshore wind etc. at different geographical locations.OWF combined with MCF, owing to their natural availability in close proximity, would become a new kind of integrated energy generation system in near future. Mainly there are TWO types of generators synchronous and asynchronous generator we use asynchronous generator because wind is not constant in offshore wind farm .There are FOUR types of generators used in offshore wind farm (OWF) which are named as:- Doubly fed induction generator (DFIG), Squirrel cage induction generator(SCIG) ,Wound-Rotor induction generator(WRIG) ,Permanent Magnet Synchronous generator (PMSG). And in our project, we have taken wind Energy as a source and our system is hybrid of offshore wind and marine-current farm connected to an onshore power grid via a high-voltage alternating current (HVAC) link. The performance of the studied offshore wind farm (OWF) is simulated by a doubly-fed induction generator (DFIG). DFIG system is a popular system in which the power electronic interface controls the rotor current to achieve the variable speed necessary for maximum energy capture in variable winds .while the operating characteristics of the studied marine current farm (MCF) are simulated by a squirrel-cage induction generator (SCIG).SCIG is attached to the wind turbine by means of a gearbox. The wind turbine is responsible for transforming wind power into kinetic energy .Both frequency-domain approach based on a linearized system model using Eigen value analysis and time-domain scheme based on a nonlinear system model subject to a disturbance condition are carried out. It can be concluded from the simulated steady-stated transient results that the proposed HVAC link can effectively stabilize the hybrid OWF and MCF under various disturbance conditions.
Keywords: OWF, MCF, DFIG, SCIG,Pitch Angle.

I. INTRODUCTION

India is 3 rd. largest consumer of renewable energy. Renewable energy is now on priority because there is maximum use of non-renewable energy so they are now came into depletion so India and other countries are now attracted towards renewable energy [1]so now we learned the Working of Offshore wind farm and marine current farm both works on Aerodynamic principle which state that, which work like a plane wing or helicopter rotor edge.[4]When Wind streams over the edge, the discuss weight on one side of the edge diminishes and another side with increment weight so which drive edges to move, and we studied the power formula of generator. We have taken generator which has work to change the Mechanical energy into electrical energy. We used asynchronous type of generator because it works on variable speed. Here we have used DFIG and SCIG type of generator. Here DFIG means that system is a popular system in which the power electronic interfaces control the rotor current to achieve the variable speed necessary for maximum energy capture in variable winds similarly SCIG means SCIG is attached to the wind turbine by means of a gearbox. The wind turbine is responsible for transforming wind power into kinetic energy. Presently there are two parts in generator stator side and rotor side before we were unable to collect the rotor side voltage presently it is conceivable with the assistance of DFIG ,so clarifying the stator side after that we have associated step up transformer which steps up the voltage since we are transmitting AC so there are numerous misfortunes in between at that point after we have associated a bus bar which is common point of collection of stator side and rotor side, so also rotor side is associated to step up transformer but in this extra there's back-to-back converter which matches The recurrence with the network and expels the strikes with that we get the voltage of rotor side at that point it is given to bus bar at that point bus bar change over different focuses to single point at that point that single point associated to step-up transformer at that point once more it Is associated to bus bar which presently changes over single point to different focuses one yield point is associated to framework and another associated to day by day loads and buyer. [4][5][7] and we studied the pitch angle and variation of pitch angle due to alter in speed and variations in voltage etc. and the rated speed of wind same for marine but here medium of source is water.

II. LITERATURE SURVEY

A. *Step up Transformer*

Fig.1 Shows Step-up Transformer

When a transformer steps up voltage, current is stepped down. A step-up transformer at the power station steps up the voltage and consequently steps down the current. This means that the current flowing in the overhead cables is relatively small and can be distributed long distances across country.

B. *DFIG*

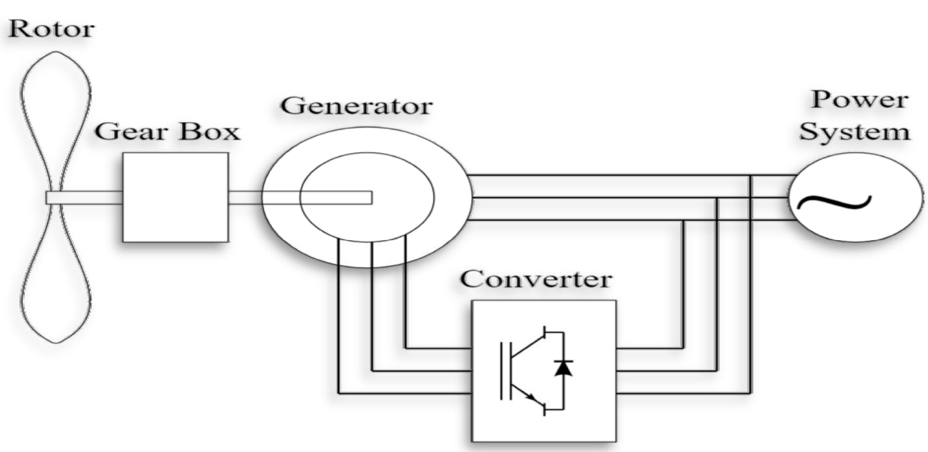

Fig.2 shows DFIG (Doubly Fed Induction Generator)

The doubly-fed induction generator (DFIG) system is a popular system in which the power electronic interface controls the rotor currents to achieve the variable speed necessary for maximum energy capture in variable winds

C. Block Diagram

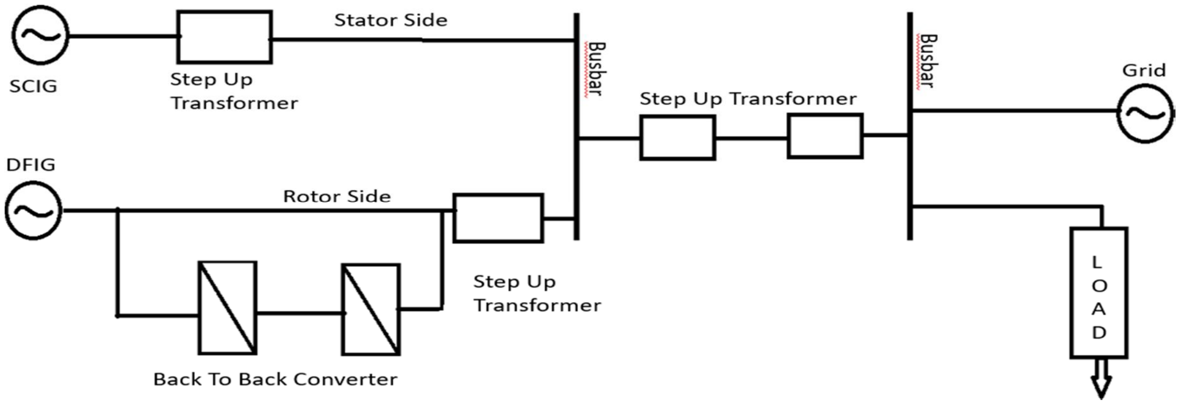

Fig. 3 Shows Simple Block Diagram of the Process

Fig 3 shows the block Diagram of offshore wind farm, here in diagram we can see that there are two generators on stator side and rotor side SCIG is connected on stator side and DFIG is connected on rotor side therefore DFIG is advance version of SCIG .therefore it was not possible to collect voltage of rotor side because it was minimum so it is now possible with the help of DFIG. in SCIG the produced electricity flows through step up transformer which step up the voltage then it is provided to busbar which is used as collector point whereas in DFIG same but here the difference is we have used back-to-back converter it has two advantages firstly it matches the frequency with the grid and it is also used to remove repulse in voltage. In block diagram there are step-up transformers because we are transmitting AC so there are many losses so to maintain the efficiency, we have added step-transformer at every step then with the help of busbar we divided it into two parts one is given to grid another to load or consumer.

D. Circuit Diagram

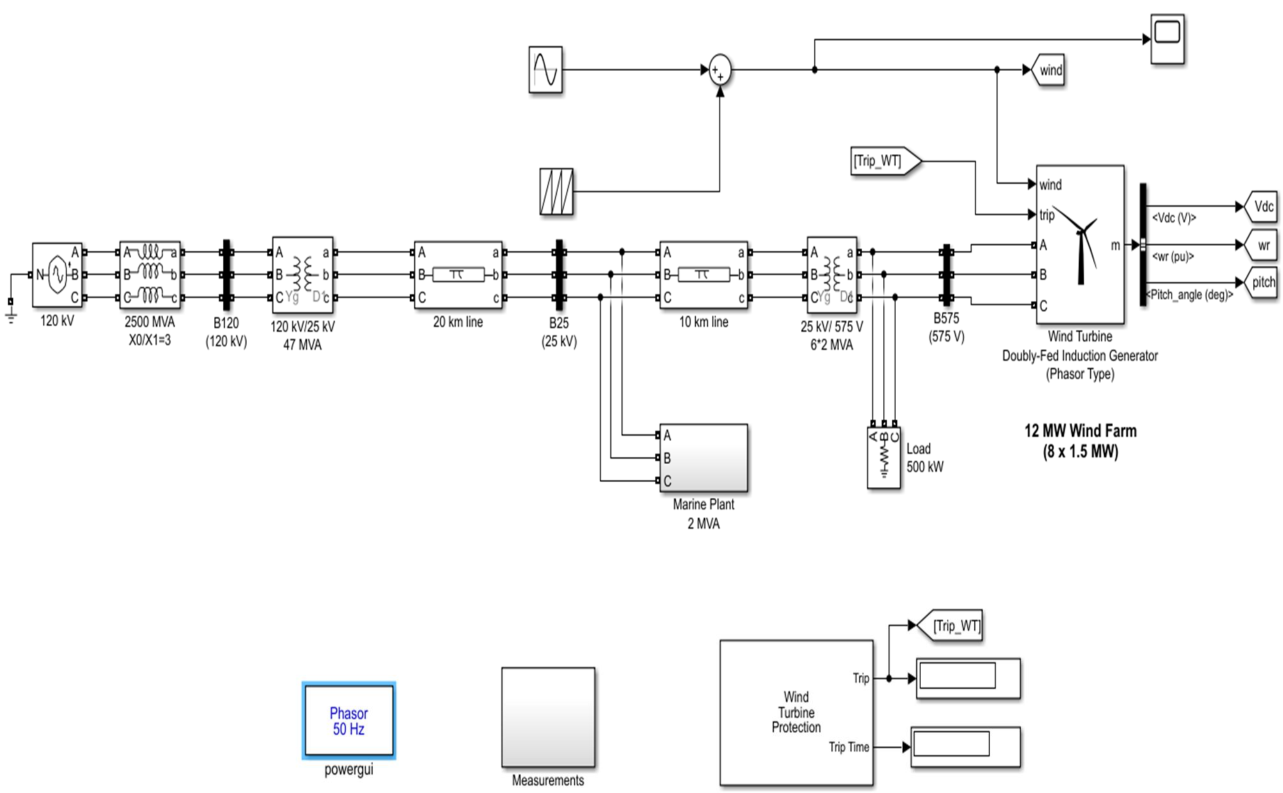

Fig.4 Simulation diagram of OWF and MCF In Matlab

E. DFIG-BASED OWF Modeling

The mechanical power Pm captured by variable speed offshore wind turbine can be expressed asfollows:

$$P_m = \frac{1}{2} * \pi * r^2 * V^3 * \rho * \eta(1)$$

Whereρ and Vm are the density and Speed of wind, respectively, R is the radius of turbine, and C_p is the power coefficient of offshore wind turbine defined as follows

$$Cp(\psi, \beta) = C1(\frac{C2}{\psi} - C3 * \beta - C4 * \beta - C6)e^{\frac{-C7}{\psi}} \quad (2)$$

Where

$$\frac{1}{\psi} = \frac{1}{\lambda + C8 * \beta} - \frac{C9}{\beta^3 + 1}$$

And

$$\lambda = \frac{R*\omega}{V} \quad (3)$$

Here,

βw = the pitch angle of the turbine,
ω= the angular velocity of the turbine,
λ =the tip speed ratio of the turbine,
And,
c1–c9= the constant coefficients of Cp.

The model of wind speed is defined by Fourier series expression to generate a fluctuating current velocity from sinusoidal wave with different amplitude and frequency

$$Vw(t) = V0 + \sum_{i=1}^{n} AV0 \sin(\omega_1 t) \quad (3)$$

Where,

V0=the rated offshore wind speed,
A =the fluctuating wind amplitude
ω_1=fluctuating wind angular frequency
t= time.

F. SCIG Based MCF Modelling

The mechanical power Pm captured by a variable speed marine current turbine is expressed as follows:

$$Pm = \frac{1}{2} * \pi * r^2 * V^3 * \rho * \eta(4)$$

Where,

ρm= density of water(kg/m3)
Vm= velocity of water (m/s)
R =radius of marine current turbine (m)

III. RESULT

In this thesis we have shown various results of wind speed, pitch angle control, active power, and terminal voltage. Which are shown as in fig 5.1, 5.2, 5.3, 5.4? Therefore, the results are taken with different types of wind speed. Therefore Fig 5.1 shows the input with square waveform between 10 m/s to 12 m/s wind speed and hence its shows pitch angle zero and we get the power above 4 Mw.

Similarly, Fig 5.2 shows the input with square waveform between 12 m/s to 15 m/s wind speed which is above the rated speed of generator capacity hence the pitch angle varies and here we get the constant voltage.

Fig 5.3 shows the input with combination of square and sinusoidal waveform and here we pitch angle zero hence talking about power during some period we get constant power after that there is reduction in that.

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Fig 5.4 shows the input with sinusoidal waveform and other results are same as compared to Fig 5.3.

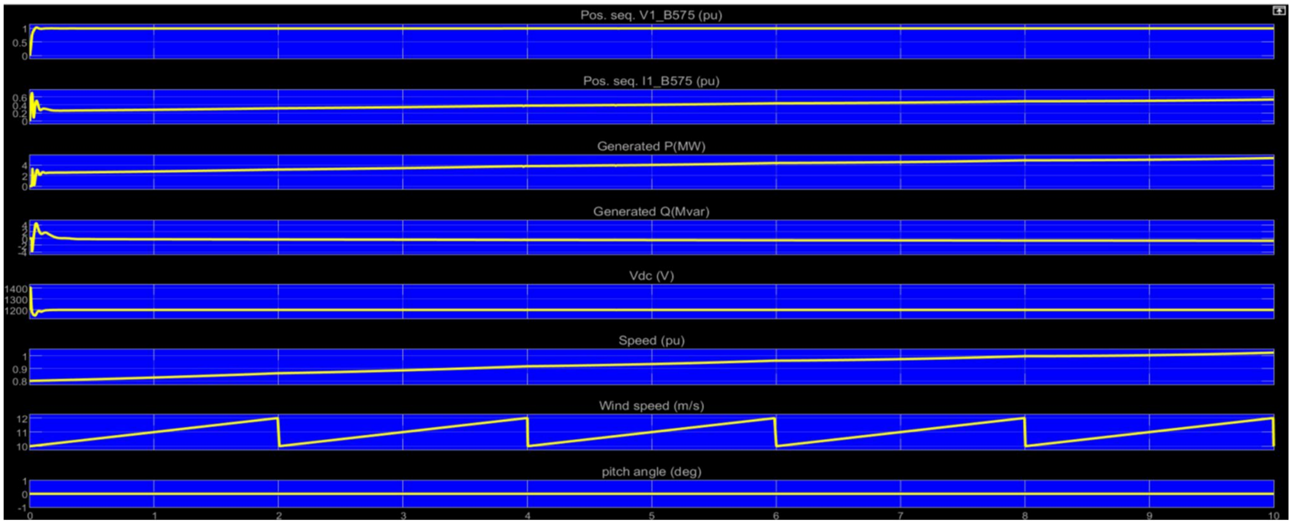

Fig. 5.1 wind speed variation before 12m/s

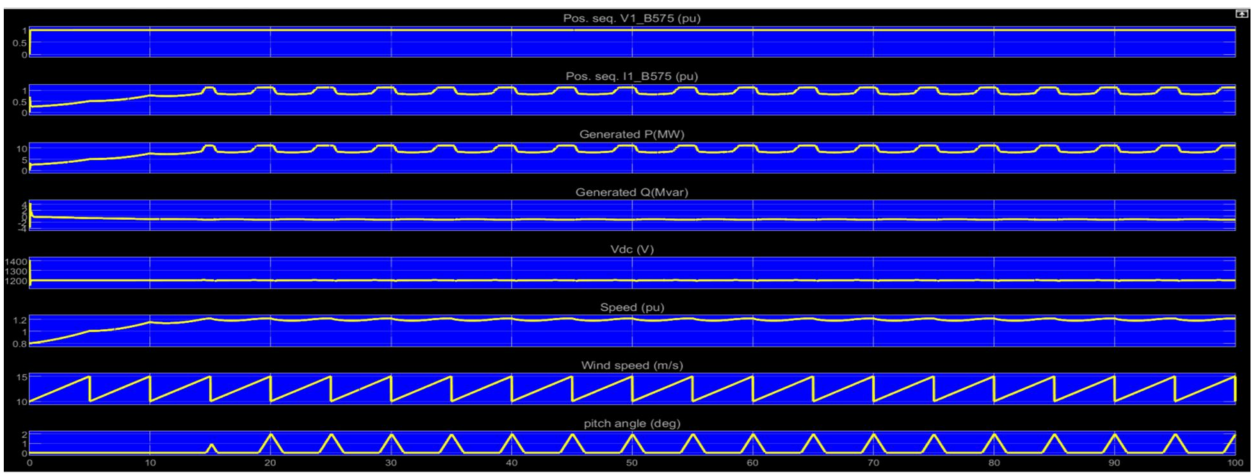

Fig. 5.2 wind speed variation above 12 m/s and pitch angle control

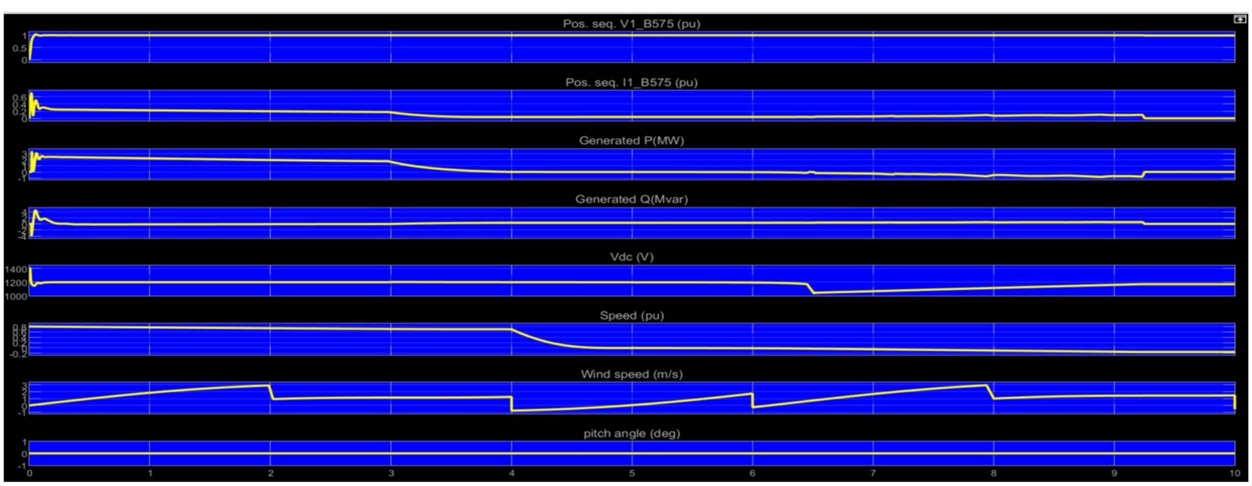

Fig 5.3 using 2 types of wind their variations

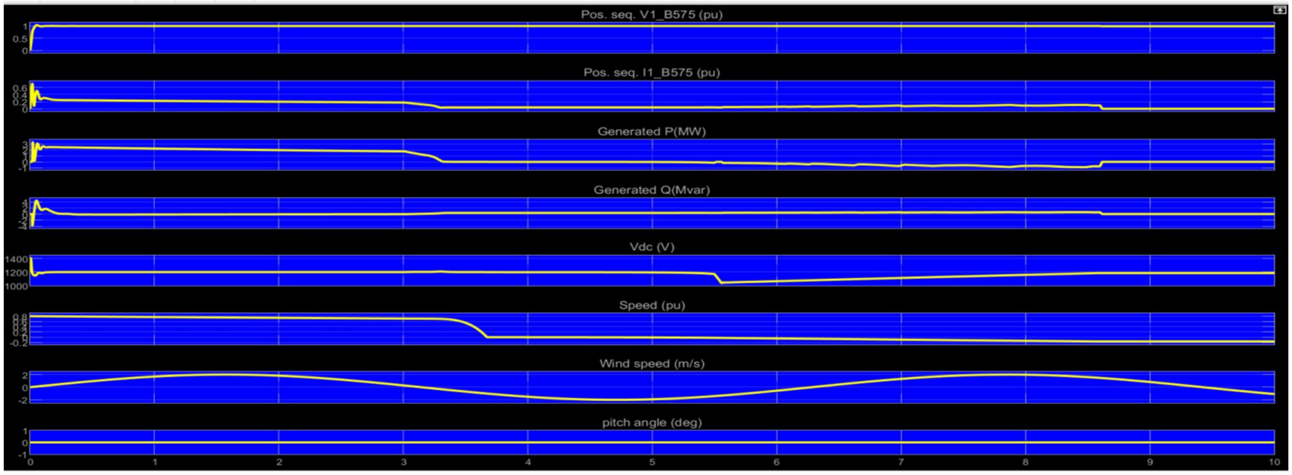

Fig. 5.4 variation with sinusoidal wind

IV. CONCLUSION

In This Thesis we have studied to Modeling and simulation of OWF and MCF Further we have analyzed the studied system under different wind and marine current speed. The Variable speed we consider below and above the rated speed. We analyze the pitch angle control of studied system at different speed.

The Power generation and terminal voltage variation due to uncertain wind speed have been shown. we considered DFIG based wind generator and SCIG based marine current generator To analysis the studied system . Thus, we analysis and simulated the studied system under different wind condition and generated response in terms of power, voltage and pitch angle.

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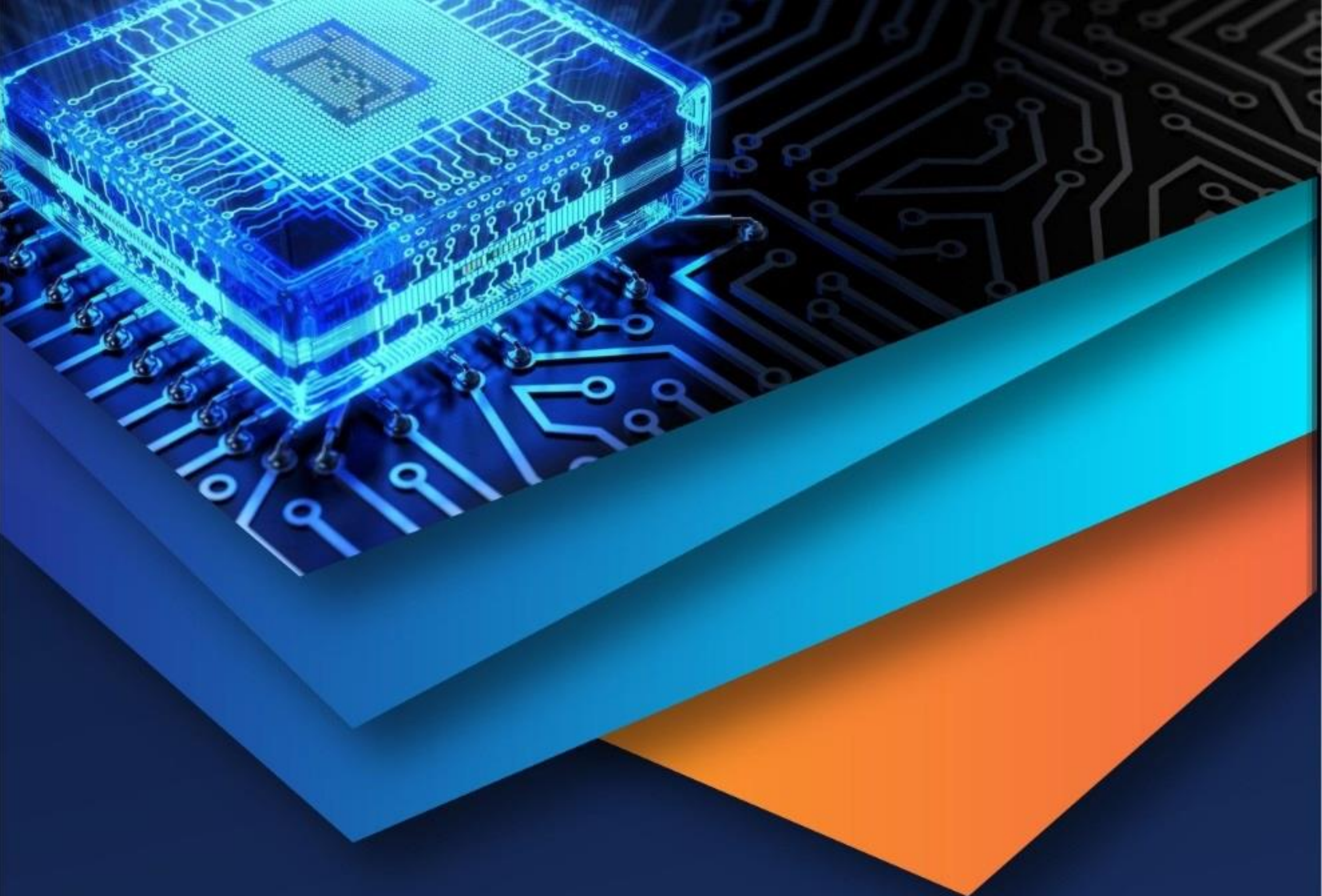

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