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Automatic Generation Control of a Hybrid Power System using Fuzzy Logic Controller

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Abstract: A fuzzy logic is used for the controlling of an interconnected system's load frequency. To obtain the optimal values for the parameters of the system membership functions, fuzzy rules are combined. The proposed logic requires very less time as a result the speed and accuracy of the system are increased. Therefore, better will be the performance of the system. Simulations have been performed using Matlab.

I. INTRODUCTION

Due to transients there are some instabilities in a power system due to which load and generation will be imbalanced. For keeping the above balance the tie-line flow and frequency are controlled using prime mover governing system. It is known as AUTOMATIC GENE RATION CONTROL.

This has very important role in transients and also during normal operating conditions. During operation, AGC provides zero error in steady state and frequency is maintained within limits and can distribute the load equally on neighbouring units and also the power flow between the interconnected system is controlled

For an interconnected system, in order to get smooth operation all the above objectives should have to be achieved. The power flow between the interconnected systems and frequency control is constituted by AGC. There are so many control theories.

For obtaining optimal values for the parameters of controller, optimization techniques are developed such as evolutionary computational technique.

The operations and the complexity in the structure are increased because of the several changes like multiple sources of generating power and increment in the share of renewable energy accounted by the interconnected system. New algorithms and techniques are to be examined for AGC problem due to rise in the complexity.

A. Investigated System

A HVDC identical two area multi source thermal system is the AGC model considered for investigation. A gas, thermal, hydro units are provided in each area.

Hydro unit comprises hydro turbine, gas unit has gas turbine and thermal unit has reheat thermal turbine and governor. Among the two areas for flow of electric power, a Tie-Line is used for connection.

The deviation in power of a tie-line and frequency are monitored by control unit during unfavourable conditions as low perturbations the normal operating conditions are restored by the control unit Figure 1 represents two area model block diagram model. The area control errors for two areas are

$$ACE_1=B_1(\Delta F_1+\Delta P_{TIE1}/B_1)$$

$$ACE_2=B_2(\Delta F_2-\Delta P_{TIE2}/B_2)$$

frequency bias coefficients are represented by B_1 and B_2 and between area1 and area2, the error in flow of tie line power is represented as Δp_{tie1}, Δp_{tie2}.

where $B_1=(1+R_1D_1)/R_1$ AND $B_2=(1+R_2D_2)/R_2$

B. Fuzzy Logic

To implement fuzzy logic with real application the steps required are:

1) *Fuzzification* –Obtains fuzzy data, Membership Functions (MFs) from classical or crisp data .

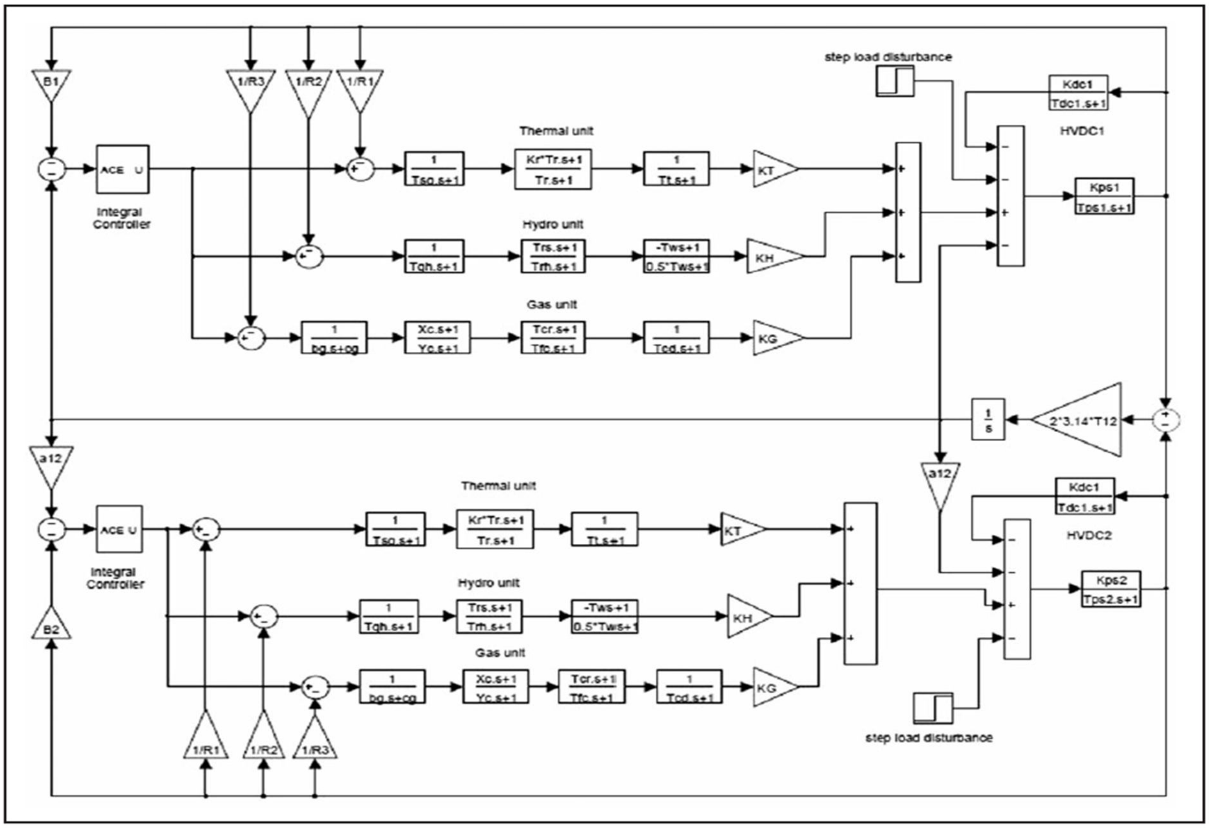

Figure 1. Hybrid Power System

2) *Fuzzy Inference Process* –In order to derive the output, it combine membership functions with control rules.
3) *De fuzzification* – During an application based on the present input, from lookup table output is picked, where look up table is one in which all the calculated outputs are stored which are calculated by several methods.

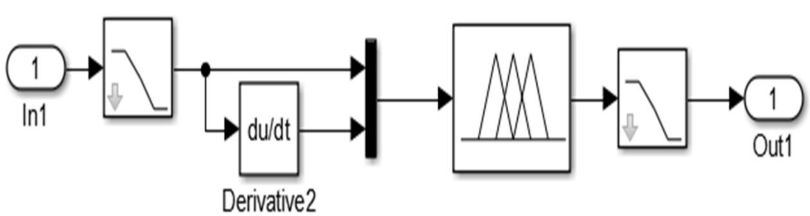

Figure2: Fuzzy logic.

Here for obtaining the optimal values of controller fuzzy logic is used as a result errors are mitigated and there will be reduction in peak over shoot, settling time.

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II. RESULT AND ANALYSIS

The considered system is a hybrid system which is linked by HVDC, by using fuzzy logic for the control of load frequency for the above system with operating conditions keeping as normal and also with change in parameters and hence the performance obtained is better than TID when compared.

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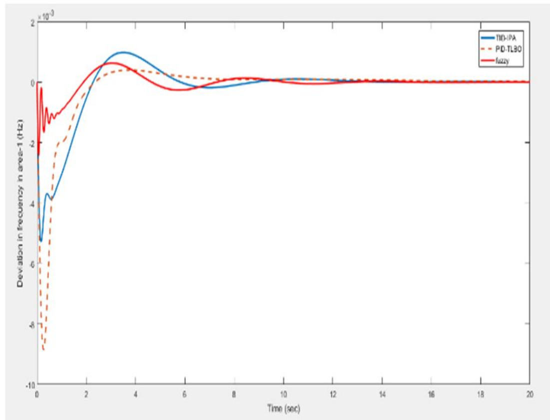

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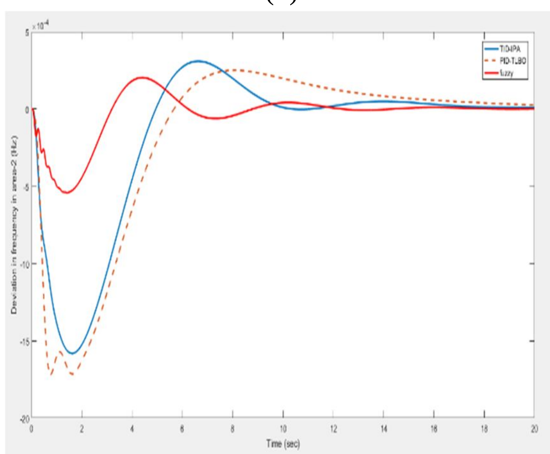

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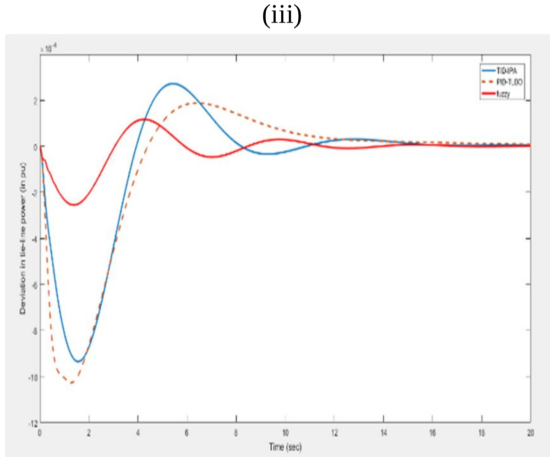

FIG 3: At nominal values, Deviation in (i) frequency in first area. (ii) Frequency in second Area (iii) Tie-line power.

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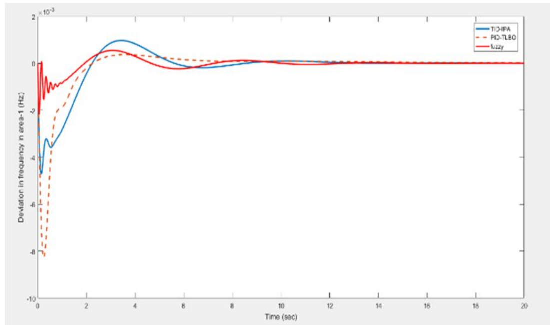
Where, TID-IPA represents Tilt Integral Derivative Control using Interior Point Algorithm and PID-TLBO represents Proportional Integral Derivative Control using Teaching Learning based Optimization.

(i)



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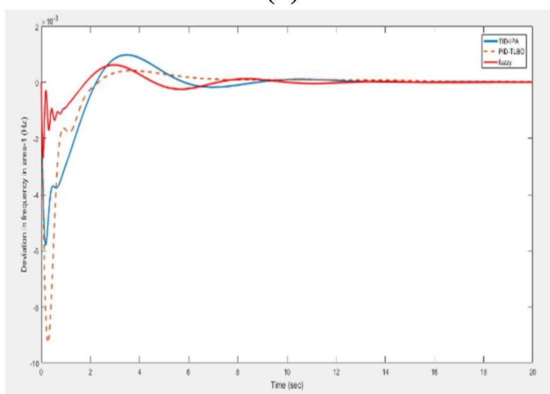

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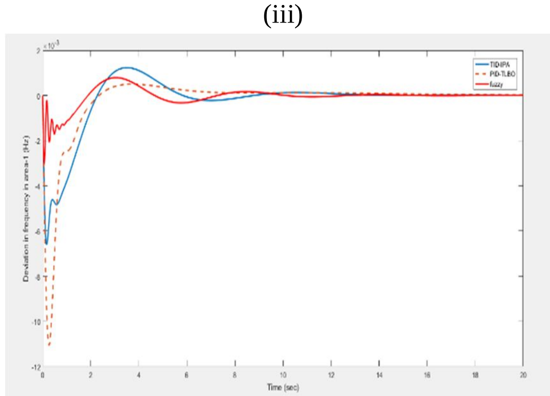

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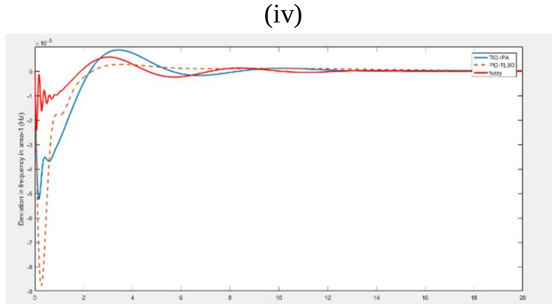

Fig 4: Deviation in frequency in First Area due to 25% increment in (i)FBF (ii) T_c (iii) P_{load} (iv) Synchronizing co-efficient.

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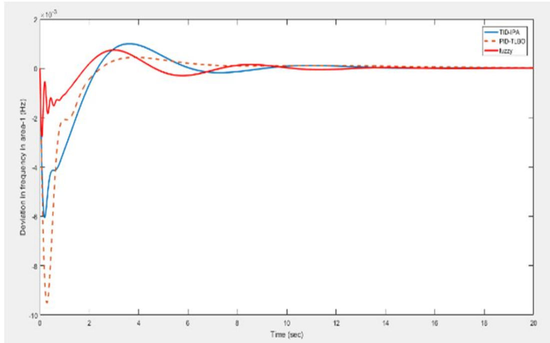
(i)



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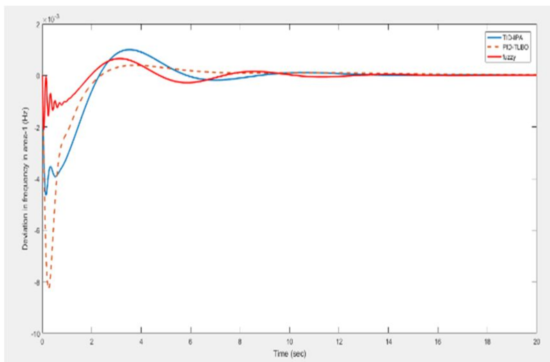

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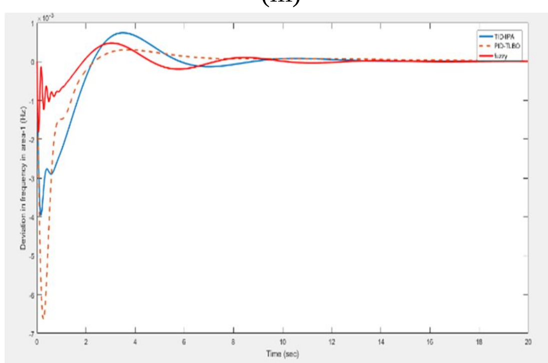

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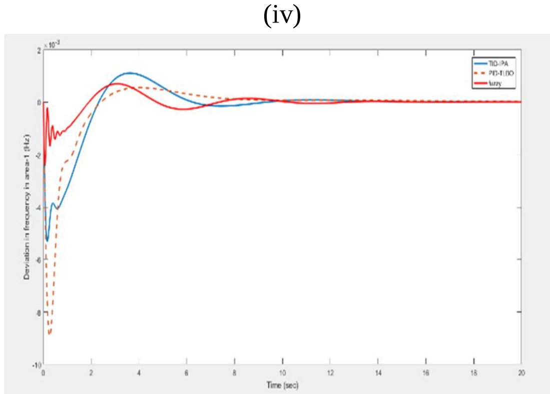
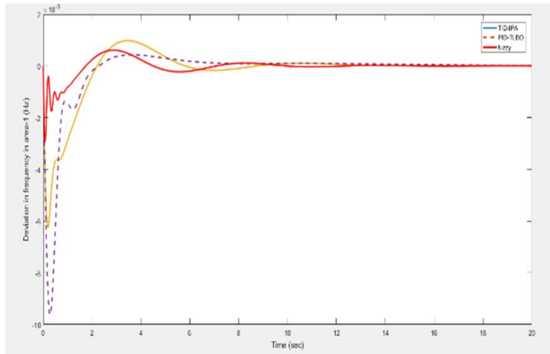


Fig 5: Deviation in frequency in first Area due to 25% decrement in (i) FBF (ii) Tc (iii) Pload (iv) Synchronizing co-efficient

(i)



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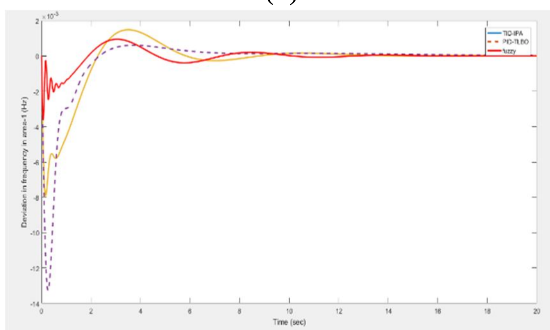

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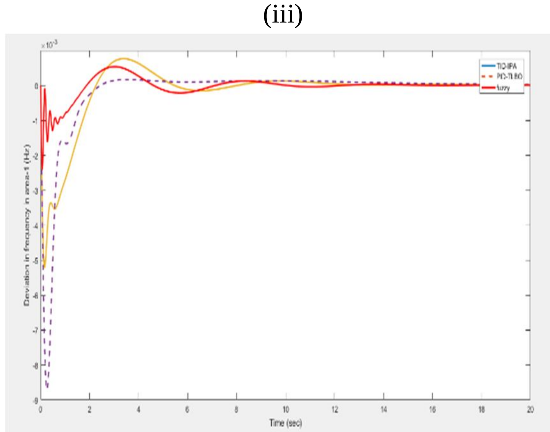

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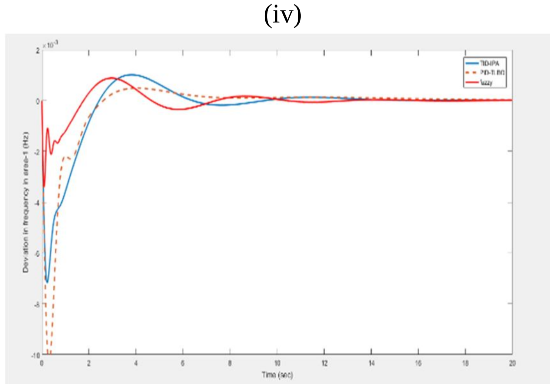
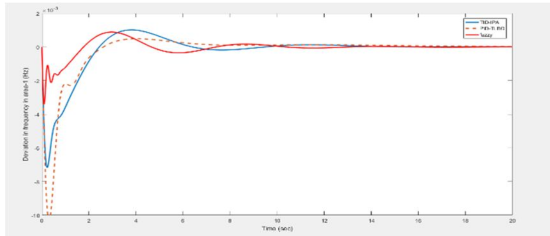


Fig 6: Deviation in frequency in First Area due to 50% increment in (i) FBF (ii) Tc (iii) Pload (iv) Synchronizing co-efficient.

(i)



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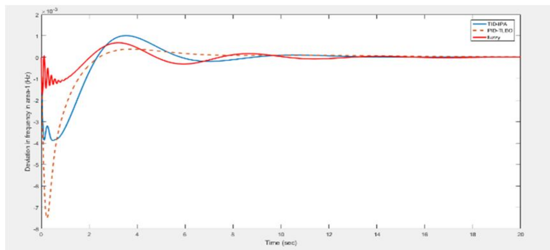

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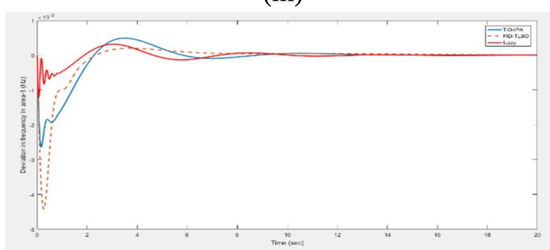

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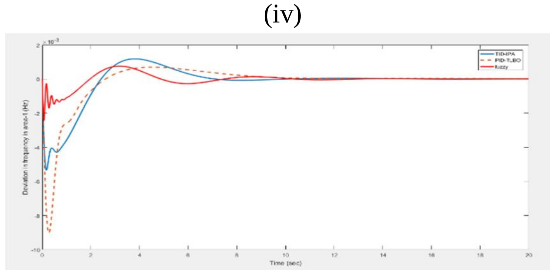

Fig 7: Deviation in frequency in Area-1 due to 50% decrement in (i) FBF (ii) Tc (iii) Pload (iv) Synchronizing co-efficient.

FBF-Frequency Bias Factor
Pload-Operating Load Conditions
Tc-Turbine Constant

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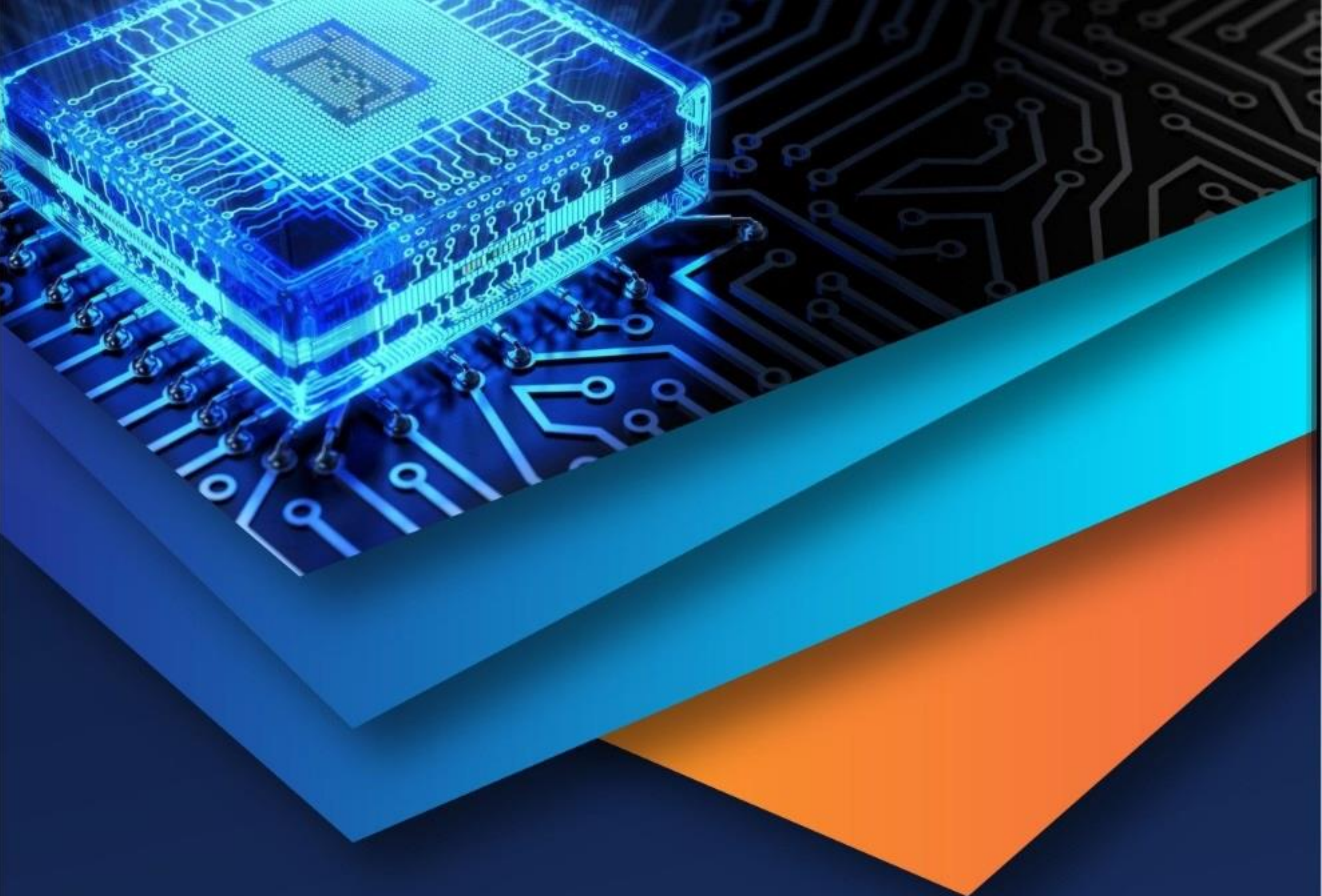

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