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Designing of Quick Switching System with Multiple Repetitive Group Sampling Plan Indexed through Quality Decision Region

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Abstract: Acceptance sampling plan is a statistical estimate often used in the inspections to decide whether to accept or reject a certain aspect of materials. Merging of acceptance sampling plans with switching rules in order to alter or change over from one to another plan is regarded as an Acceptance Sampling strategy. In the present study, we have developed a new sentence to design sampling strategy, based on the range of quality by adopting a new approach, termed as Decision Region Performance of the system. This approach was analyzed and compared with other equivalent plans. Adding necessary takes constructed and procedures were outlined, for the Quick Switching System Multiple Repetitive group sampling plan (QSSMRGS). We report, and throw a light on development of new measures, for designing sampling arrangement and evaluating and comparing its individual from other related plans.
Keywords: Acceptance sampling, Quick Switching System, Quality decision region, Multiple Repetitive Group Sampling plan.

I. INTRODUCTION

Acceptance sampling was widely used to test, aspect of the product towards reduction of variability in process and outcome where variation is measured by statistical methods. Statistical Quality Control is widely used in industry to ensure customer satisfaction due to mass. effecting of products and services, An important filed of SQC is Acceptance sampling which is either to accept or reject products of a lot under sample inspection when 100% inspection is not possible.

In this article presents a new Quick Switching Multiple Repetitive Group Sampling System as a reference plan using quality region.

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II. QUICK SWITCHING SYSTEM

Several authors have investigated and outlined the ideas and procedures in past decades. Dodge (1969) has proposed a sampling check plan with normal and tightened survey and was recognized as a three plans system. Romboski (1969) has demonstrated QSS, that when rejection comes in normal survey, due to its sudden switching in between normal and tightened plans, is represented as QSS. Tables constructed for the selection of modified QSS- by Soundarajan and Aruminayagam (1988). Consequently, Soundarajan and Vijayaraghavan (1989) have deciphered detailed procedure to enable Designing Multiple Deferred Sampling Plan -1. The procedure for selection of modified QSS plans indexed using different limits of quality was proposed and outlined by Suresh (1993). Jayalakshmi (2006) developed QSS-1 with various reference plans including Special Type Double sampling plan, Repetitive Deferred sampling plan and deferred sampling plan. In recent years, Suresh and Kaviyarasu (2008) have reported QSS-1 with Conditional Repetitive Group sampling plan as a reference plan indexed through using limits of quality. Romboski (1969) developed has tables for the selection of QSS-2 (n, c_N, c_T) system for given p_1, p_2, α, β. Followed by him Devaraj Armainayagam (1991) has suggested Quick Switching System with adequate references and applications. QSS-2 with Single Sampling Plan was Presented by Subramaniam (1990). Whereas Romboski (1969) introduced other new type indicated as QSS-3(n, c_N, c_T) and is a system represents simple sampling plan (n, c_N) *and* (n, c_T)which are normal tightened plans with c_N *and* c_T.

III. MULTIPLE REPETITIVE GROUP SAMPLING PLAN

In Quick Switching System, Concept Repetitive Group Sampling (RGS), Three Plan was established by Sherman (1965) that dealt with acceptance and rejection of a lot entirely based on the sample results of the same lot. Quick Switching Multiple Repetitive Group Sampling plan-3(QSMRGSP).

Shankar and Mahopatra (1993) have developed and introduced a new type of Repetitive Group Sampling Plan, commonly known to be conditional Repetitive Group Sampling plan, that deciphered that rejection of a lot, is in accordance with repeated sample outcomes, is sole dependent of a single sampling inspection system of the strait away preceding lots. Shankar and Joseph (1993) have developed and introduced another novel RGS plan as an extension of a conditional RGS plan reveals that acceptance or rejection of a lot, according to the repeated sample results that are associated with the outcome of inspection under the RGS inspection system of the forego lots. For our understanding and convenience , the proposed plan may be designated as Multiple Repetitive Group Sampling Plan (MRGS).

The authors such as Suresh and Saminathan (2007) have contributed a procedure to describe MRGS tabulated with MAPD and MAAOQ. Suresh and Kaviyarasu (2008) have stipulated the appeal for duplicating Quick Switching System with Conditional RGS plan indexed by using quality attributes. Jayalakshmi and Kaviyamani (2020) developed Designing Quick Switching Conditional Repetitive Group Sampling System indexed through Quality Decision Region using MATLAB program.

A. Conditions *for Application*

1) Constant production offers the results of past, present and future product lots are signs of a take up process.
2) Lots submitted considerably in their production order.
3) Inspection is by allocated with quality can be regarded as fraction non-conforming ‘p’.
4) Inspection has been performed for a stream of lots if successive and prior lots are accepted.

B. *Operating Procedure*

1) Inspect under normal inspection using the Quick Switching System Multiple Repetitive Group sampling Plan with parameters n, u_1, u_2 .If a lot is rejected , Switch to tightened Inspection (Step 2)
2) Under tightened inspection, inspect using the Quick Switching System Multiple Repetitive Group sampling Plan with parameters n, v_1, v_2 . If a lot is accepted, switch to normal inspection.

C. *Operating Characteristics function*

The Quick Switching Multiple Repetitive Group Sampling plan -1

$$P_a(p) = \frac{P_a (1 - P_c)^i}{(1 - P_c)^i - P_c P_a^{\,i}}$$

Where $P_a = \sum_{x=0}^{c_1} \frac{e^{-np} (np)^x}{x!}$

$$P_r = 1 - \sum_{x=0}^{c_2} \frac{e^{-np} (np)^x}{x!}$$

$$P_c = e^{-np} \left[\sum_{x=0}^{c_2} np^x / x! - \sum_{x=0}^{c_1} np^x / x \right]$$

$$P_a(p) = \frac{P_T}{1 - P_N + P_T} \tag{1}$$

$$P_N = \frac{\left[1 - \sum_{x=0}^{u_2} e^{-np} (np)^x / x! - \sum_{x=0}^{u_1} e^{-np} (np)^x / x!\right]^i}{1 - \sum_{x=0}^{u_2} e^{-np} (np)^x / x! + \sum_{x=0}^{u_1} e^{-np} (np)^x / x! \left[\sum_{x=0}^{u_1} e^{-np} (np)^x / x!\right]^{i-1}} \tag{2}$$

$$P_T = \frac{\left[1-\sum_{x=0}^{v_2} e^{-np}(np)^x/x! - \sum_{x=0}^{v_1} e^{-np}(np)^x/x!\right]^i}{1-\sum_{x=0}^{v_2} e^{-np}(np)^x/x! + \sum_{x=0}^{v_1} e^{-np}(np)^x/x!\left[\sum_{x=0}^{v_1} e^{-np}(np)^x/x!\right]^{i-1}} \quad \textbf{(3)}$$

Quick switching system Multiple Repetitive Group Sampling Plan -2

$$P_a(p) = \frac{P_N P_T^2 + P_T(1-P_N)(1+P_T)}{P_T^2 + (1-P_N)(1+P_T)} \quad (4)$$

$$P_N = \frac{\left[1-\sum_{x=0}^{u_2} e^{-np}(np)^x/x! - \sum_{x=0}^{u_1} e^{-np}(np)^x/x!\right]^i}{1-\sum_{x=0}^{u_2} e^{-np}(np)^x/x! + \sum_{x=0}^{u_1} e^{-np}(np)^x/x!\left[\sum_{x=0}^{u_1} e^{-np}(np)^x/x!\right]^{i-1}} \quad \textbf{(5)}$$

$$P_T = \frac{\left[1-\sum_{x=0}^{v_2} e^{-np}(np)^x/x! - \sum_{x=0}^{v_1} e^{-np}(np)^x/x!\right]^i}{1-\sum_{x=0}^{v_2} e^{-np}(np)^x/x! + \sum_{x=0}^{v_1} e^{-np}(np)^x/x!\left[\sum_{x=0}^{v_1} e^{-np}(np)^x/x!\right]^{i-1}} \quad \textbf{(6)}$$

Quick Switching System Multiple Repetitive group Sampling Plan -3

$$P_a(p) = \frac{P_N P_T^3(1-P_T) + P_T(1-P_N)(P_T^2 + P_T + 1)}{P_T^3 + (1-P_N)(P_T^2 + P_T + 1)} \quad \textbf{(7)}$$

$$P_N = \frac{\left[1-\sum_{x=0}^{u_2} e^{-np}(np)^x/x! - \sum_{x=0}^{u_1} e^{-np}(np)^x/x!\right]^i}{1-\sum_{x=0}^{u_2} e^{-np}(np)^x/x! + \sum_{x=0}^{u_1} e^{-np}(np)^x/x!\left[\sum_{x=0}^{u_1} e^{-np}(np)^x/x!\right]^{i-1}} \quad \textbf{(8)}$$

$$P_T = \frac{\left[1-\sum_{x=0}^{v_2} e^{-np}(np)^x/x! - \sum_{x=0}^{v_1} e^{-np}(np)^x/x!\right]^i}{1-\sum_{x=0}^{v_2} e^{-np}(np)^x/x! + \sum_{x=0}^{v_1} e^{-np}(np)^x/x!\left[\sum_{x=0}^{v_1} e^{-np}(np)^x/x!\right]^{i-1}} \quad \textbf{(9)}$$

1) Quality Decision Region (QDR)

It is an interval of quality ($p_1 < p < p^*$) in which product is accepted at engineer's quality average The quality is reliably maintained up to p^* (MAPD) and sudden decline in quality is expected. This region is also called Reliable Quality Region (RQR).Quality Decision Range is denoted as $d_1 = (p^* - p_1)$ is derived from probability of acceptance

$$P_a(p_1 < p < p^*) = P_a(p) = \frac{P_a(1-P_c)^i}{(1-P_c)^i - P_c P_a^i} \quad \text{for } p_1 < p < p^*$$

$$P_a = P[d \le c_1] = \sum_{x=0}^{c_1} \frac{e^{-x} x^r}{r!}$$

$$P_c = p[c_1 < d < c_2] = \sum_{r=0}^{c_2} \frac{e^{-x} x^r}{r!} - \sum_{r=0}^{c_1} \frac{e^{x} x^r}{r!} - \sum_{r=0}^{c_1} \frac{e^{-x} x^r}{r!}$$

$$P_a(p) = \frac{P_T}{1 - P_N + P_T}$$

$$P_N = \frac{\left[1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! - \sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! + \sum_{x=0}^{u_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

$$P_T = \frac{\left[1 - \sum_{x=0}^{v_2} e^{-np}(np)^x / x! - \sum_{x=0}^{v_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{v_2} e^{-np}(np)^x / x! + \sum_{x=0}^{v_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{v_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

Similarly we can Calculate the Quality Decision Region for QSSMRGS 2 and QSSMRGS 3.

2) Probabilistic Quality Region (PQR)

It is an interval of quality $(P_1 < p < p_2)$ in which product is accepted with a minimum probability 0.10 and maximum probability 0.95 Probabilistic Quality Range denoted as $d_2 = (P_2 - P_1)$ is derived from probability of acceptance

$$P_a(p) = \frac{P_T}{1 - P_N + P_T}$$

$$P_N = \frac{\left[1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! - \sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! + \sum_{x=0}^{u_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

$$P_T = \frac{\left[1 - \sum_{x=0}^{v_2} e^{-np}(np)^x / x! - \sum_{x=0}^{v_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{v_2} e^{-np}(np)^x / x! + \sum_{x=0}^{v_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{v_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

Similarly we can calculate the Probabilistic Quality Region for QSSMRGS 2 and QSSMRGS

3) Limiting Quality Region (LQR)

It is an interval of quality $(p^* < p < p_2)$ in which product is accepted with a minimum probability 0.10 and maximum probability at engineer's quality average. Limiting Quality Range denoted as $d_3 = (p_2 - p_*)$ is derived from probability of acceptance

$$P_a(p) = \frac{P_T}{1 - P_N + P_T}$$

$$P_N = \frac{\left[1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! - \sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! + \sum_{x=0}^{u_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

$$P_T = \frac{\left[1 - \sum_{x=0}^{v_2} e^{-np}(np)^x / x! - \sum_{x=0}^{v_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{v_2} e^{-np}(np)^x / x! + \sum_{x=0}^{v_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{v_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

Similarly we can Calculate the limiting Quality Region for QSSMRGS 2 and QSSMRGS 3

4) Indifference Quality Region (IQR)

It is an interval of quality $(p_1 < p < p_2)$ in which product is accepted with a minimum Probability 0.50 and maximum probability 0.95. Probabilistic Quality Range denoted as $d_0 = (p_0 - p_1)$ is derived from probability of acceptance

$$P_a(p) = \frac{P_T}{1 - P_N + P_T}$$

$$P_N = \frac{\left[1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! - \sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! + \sum_{x=0}^{u_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

$$P_T = \frac{\left[1 - \sum_{x=0}^{v_2} e^{-np}(np)^x / x! - \sum_{x=0}^{v_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{v_2} e^{-np}(np)^x / x! + \sum_{x=0}^{v_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{v_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

Similarly we can Calculate the Indifference Quality Region for QSSMRGS 2 and QSSMRGS 3

Quick Switching System Multiple Repetitive Group Sampling Plan -1

5) For specified QDR and LQR Table 2

For used to construct the plans when the QDR and LQR are specified. For any given values of the QDR (d_1) and LQR (d_3), one can find the ratio $T_1 = d_1/d_3$ which is a monotonic increasing function. Find the value in **Table 2** under the column T_1 which is equal to or just less than the specified ratio. Then the corresponding values value of c_N and c_T v are noted. From this, one can determine the parameters c_N, u_1, u_2 and c_T, v_1, v_2 for the Quick Switching Multiple Repetitive Group Sampling Plan-1.

Example

For a company 1% defects are seen in QDR and 5% defects are seen in LQR. Then d_1=0.01 and d_3 = 0.05, $T_1 = d_1/d_3$ =0.2.Find the ratio taking value 0.2 Select value of T_1 equal to or just less than this ratio using Table 2. The value of T_1 is 0.2 which is associated c_N, $u_1 = 2$, $u_2 = 5$, c_T $v_1 = 1$, $v_2 = 3$ .Also nd_1 =0.476, $nd_3 = 2.0121$ corresponding $n = 48$, c_N, $u_1 = 1, u_2 = 5, c_T$, $v_1 = 1, v_2 = 3$.Thus we can calculate n. The parameters for the Multiple Quick Switching Repetitive Group Sampling Plan –I are (48, 2, 5, 1, and 3).Quick Switching System Multiple Repetitive Group Sampling Plan -2

Example:

For a company 1% defects are seen in QDR and 5% defects are seen in LQR. Then d_1=0.01 and d_3 = 0.05, $T_1 = d_1/d_3$ =0.2.Find the ratio taking value 0.24 Select value of T_1 equal to or just less than this ratio using Table 2. The value of T_1 is 0.24 which is associated $u_1 = 3$, $u_2 = 5$, c_T, $v_1 = 1$, $v_2 = 2$ .Also nd_1 =0.4194, $nd_3 = 1.7319$ corresponding $n = 42$, c_N, $u_1 = 3$, $u_2 = 5$, c_T, $v_1 = 1, v_2 = 2$.Thus we can calculate n. The parameters for the Multiple Quick Switching Repetitive Group Sampling Plan-II are (42,3,5,1,2).Quick Switching System Multiple Repetitive Group Sampling Plan -3

Example:

For a company 1% defects are seen in QDR and 5% defects are seen in LQR. Then d_1=0.01 and d_3 = 0.05, $T_1 = d_1/d_3$ = 0.2 .Find the ratio taking value 0.2 Select value of T_1 equal to or just less than this ratio using **Table 2**. The value of T_1 is 0.2 which is associated c_N, $u_1 = 2$, $u_2 = 4$, c_T, $v_1 = 1$, $v_2 = 3$ .Also nd_1 =0.42005, $nd_3 = 2.0605$ corresponding n =42, c_N, $u_1 = 2$, $u_2 = 4$, c_T, $v_1 = 1, v_2 = 3$.Thus we can calculate n. The parameters for the Multiple Quick Switching Repetitive Group Sampling Plan-III are (42,2,4,1,3).

IV. CONSTRUCTION OF TABLES

The expression for probability of acceptance of Quick Switching Multiple Repetitive Group Sampling System under the assumption of Poisson model,

$$P_a(p) = \frac{P_T}{1 - P_N + P_T}$$

$$P_N = \frac{\left[1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! - \sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^i}{1 - \sum_{x=0}^{u_2} e^{-np}(np)^x / x! + \sum_{x=0}^{u_1} e^{-np}(np)^x / x! \left[\sum_{x=0}^{u_1} e^{-np}(np)^x / x!\right]^{i-1}}$$

$$P_T = \frac{\left[1-\sum_{x=0}^{v_2} e^{-np}(np)^x/x! - \sum_{x=0}^{v_1} e^{-np}(np)^x/x!\right]^i}{1-\sum_{x=0}^{v_2} e^{-np}(np)^x/x! + \sum_{x=0}^{v_1} e^{-np}(np)^x/x!\left[\sum_{x=0}^{v_1} e^{-np}(np)^x/x!\right]^{i-1}}$$

$$\text{MAPD} = {d^2}\big/{dp^2}\, P_a(p) = 0$$

We calculated Quick Switching System with Conditional Repetitive Group Sampling System quality Levels.

Quality Decision Region is denoted as $d_1 = (p^* - p_1)$ is extracted from probability of acceptance

Probabilistic Quality Range denoted as $d_2 = (P_2 - P_1)$ is obtained from probability of acceptance

Limiting Quality Range denoted as $d_3 - (p_2 - p_1)$ is attained from probability of acceptance Indifference Quality Region denoted as $d_0 = (p_0 - p_1)$ is derived from probability of acceptance

Quick switching system Multiple Repetitive Group Sampling Plan 2, 3.Similarly same as for Quick Switching System Multiple Repetitive Group Sampling Plan 1.

V. CONCLUSION

In this Paper New method for Quick switching system with Multiple Repetitive Group Sampling Plan indexed through Quality decision region is used. Quick Switching System with Multiple Repetitive Group Sampling Plan 1,2,&3 plan are considered in this paper for finding the quality Region. The Quality Decision Region idea has been proposed and executed as are replacement of determining deterministic quality level as boundary quality levels thus providing higher probability of acceptance. Study has strongly favored that construction and selection of performance measures for Quality Interval Sampling (QIS) inspection plan indexed through Quality Regions. Tables are simulated for various parameters and numerical illustration was given for the ease of understanding of the procedure.

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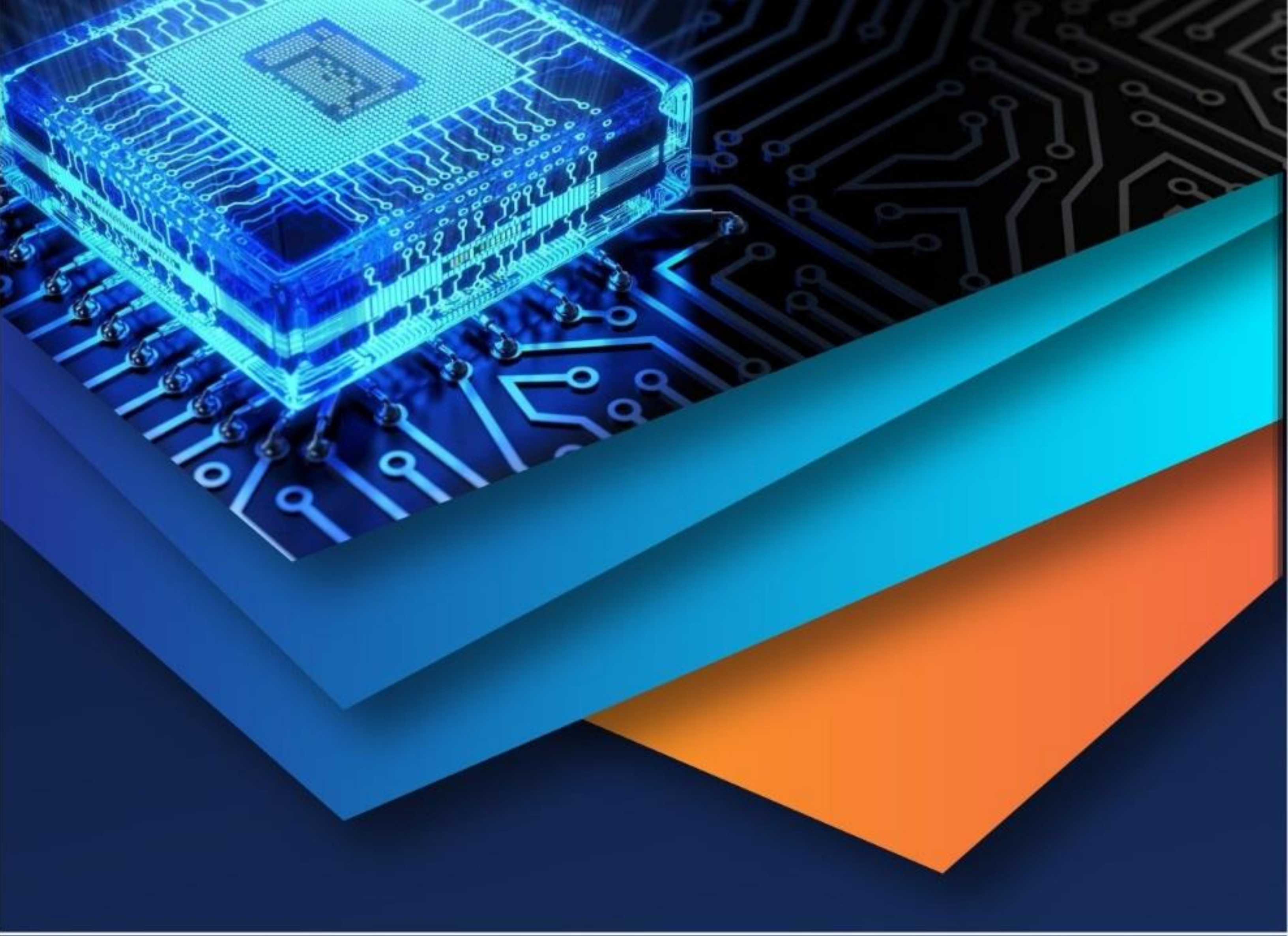

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