Q1. Let $X$ be a continuous random variable (quality characteristic of interest in a process) with mean $\mu$ and standard deviation $\sigma$ (i.e. variance $\sigma^2$) and is normally distributed. Let $x_1, x_2, \ldots, x_n$ be a random sample of size $n$ form the process. Using this information, perform the following tasks:

a). For $n=1$ and $p=1$, provide $L$-sigma limits for Shewhart chart such that $ARL_0=370$. Assume known parameters case with $\mu_0=0$ and $\sigma_0^2=1$.

b). If the process variance remains stable at $\sigma_0^2$ but mean shifts to new level $\mu_1 = \mu_0 + \delta \sigma_0$. Write power expression for the Shewhart limits obtained in part (a).

c). Evaluate the power expression of part (b) for $\delta=0, 0.5, -0.5$, and interpret these results.

d). Convert the results of part (c) to the corresponding $ARL$ values and interpret the results.
e) Are there any assumptions for the validity of the results obtained in part (d)? Explain.

f) If the limits of part (a) are estimated based on limited number of subgroups, how it will affect the results in parts (c) and (d). No computations required here, just comments will serve the purpose.

g) If samples of size n=2 are available from the process, how it will affect the results in parts (c) and (d). No computations required here, just comments will serve the purpose.

h) If the process specifications are (-1, 0, 1), find process capability using an appropriate capability index. Justify your choice of the index and interpret your index value.

Q2. Let $X \sim N_p(\mu, \Sigma)$ and $x_1, x_2, \ldots, x_n$ be a random sample of size n from this process. Using this information, provide the control limit(s) of Chisquare control chart for n=1, p=2 and a false alarm rate of 0.0027.