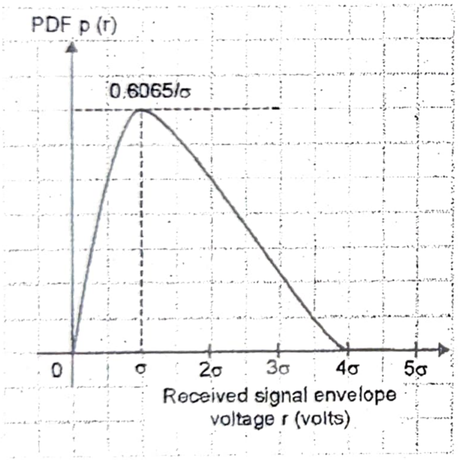
- It is a graph of elapsed time in milliseconds on the x-axis versus the received signal strength in decibels on the y-axis as shown.

PDF of Rayleigh distribution :

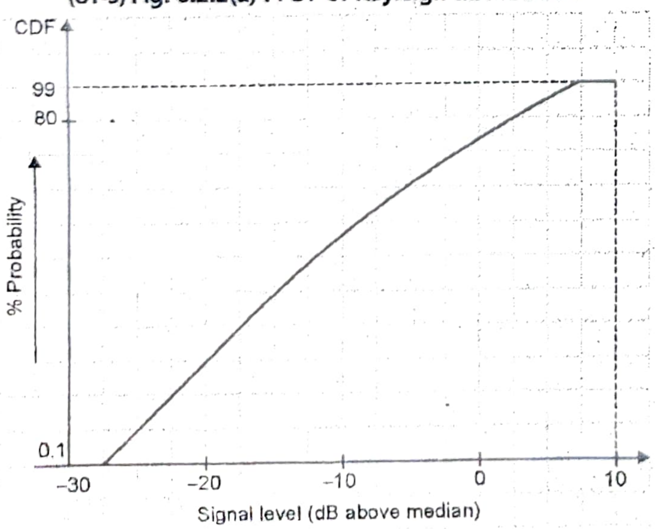
- PDF that is probability density function of Rayleigh distribution can be expressed using the following expression.

$$p(r) = \begin{cases} \frac{r}{\sigma^2}\exp\left(-\frac{r^2}{2\sigma^2}\right) & (0 \le r \le \infty) \\ 0 & (r < 0) \end{cases} \quad \textbf{(OT-11)}$$

- where σ is the RMS value of the received voltage signal before envelope detection and σ^2 is the time average power of the received signal before envelope detection.
- Rayleigh PDF and CDF are as shown in Fig. 6.2.2(a) and (b) respectively.



(OT-3) Fig. 6.2.2(a) : PDF of Rayleigh distribution



(OT-4) Fig. 6.2.2(b) : CDF of Rayleigh distribution

CDF of Rayleigh distribution :

- The CDF (Cumulative Distribution Function) of Rayleigh distribution is used for obtaining the probability that received signal envelope does not exceed the specified value R.
- The CDF the Rayleigh distribution is expressed as follows :

$$P(R) = \Pr(r \le R) = \int_0^R P(r)\,dr = 1 - \exp\left(-\frac{R^2}{2\sigma^2}\right)$$

The mean value :

- The mean value r_{mean} of Rayleigh distribution is given by,

$$R_{mean} = E[r] = \int_0^\infty r p(r)\,dr = \sigma\sqrt{\frac{\pi}{2}}$$

$$\therefore R_{mean} = 1.2533\,\sigma$$

Variance :

- The variance of Rayleigh distribution is given by sigma square.
- It represents the ac power in the signal envelope which is given by,

$$\sigma_r^2 = E[r^2] - E^2[r]$$

$$= \int_0^\infty r^2 p(r)\,dr - \frac{\sigma^2\pi}{2}$$

$$\therefore \sigma_r^2 = \sigma^2\left(2 - \frac{\pi}{2}\right)$$

$$\therefore \sigma_r^2 = 0.4292\,\sigma^2$$

Rms value :

- The rms value of the envelope is the square root of the mean square value, or $\sqrt{2}\,\sigma$ where σ is the standard deviation of the original complex Gaussian sigma prior to envelope detection.
- We can obtain the median value of r by solving the following expression :

$$\frac{1}{2} = \int_0^{Median} p(r)\,dr$$

- Hence the median value of r is obtained as follows :

$$r_{mediam} = 1.177\,\sigma$$