Operating Characteristics of Queue System

(1) Queue Length (L_q) : The average no. of customer in the queue waiting to get service. This excludes the customers being served.

(2) System Length (L_s) : The average no. of customers in the system including those waiting as well as those being served.

(3) Waiting time in the queue (W_q) : The average time for which a customer has to wait in the queue to get service.

(4) Waiting time in system (W_s) : The average total time spent by a customer in the system from the moment he arrives till he leave the system. It is taken to be the waiting time plus service time.

Traffic Intensity (or utilization factor) : denoted by ρ.

It is the proportion of time a server actually spends with the customers.

It is the ratio of mean arrival rate and mean service rate.

$$\text{Traffic intensity } (\rho) = \frac{\text{Mean arrival rate}}{\text{Mean service rate}}$$

$$\boxed{\rho = \frac{\lambda}{\mu}}$$

The unit of traffic intensity is Erlang.

Transient state and steady state : A system is said to be in a transient state when its operating characteristics are depending on time.

A steady state system is the one in which the behaviour of the system is independent of time. Let $P_n(t)$ denote the probability that there are n customers in the system, at time t. Then in steady state,

$$\lim_{t \to \infty} p_n(t) = p_n \quad \text{(independent of } t\text{)}$$

$$\Rightarrow \quad \frac{d p_n(t)}{dt} = \frac{d p_n}{dt}$$

$$\Rightarrow \quad \lim_{t \to \infty} p_n'(t) = 0$$