THE OPEN UNIVERSITY OF SRI LANKA

Faculty of Engineering Technology

Department of Electrical and Computer Engineering

**Mini Project Deliverable 01**

**Hospital Pharmacy Dispensing System**

**EEX5362 Performance Modelling**

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1. **System Identification: Hospital Pharmacy Dispensing System**

**System Description**

The Selected complex system is a **Hospital Pharmacy Dispensing System** serving a 400 – bed hospital. This pharmacy serves as a critical node in the healthcare delivery chain, processing prescription orders originating from four distinct clinical sources:

* **Emergency Department (ED)** – High-volume, time-critical orders
* **Intensive Care Unit (ICU)** – Complex, high-acuity medications
* **General Wards** – Scheduled inpatient medication rounds
* **Outpatient Clinic** – Routine ambulatory prescriptions

Prescriptions are currently processed using a First-Come-First-Served (FIFO) queuing discipline by **three full-time pharmacists.** The system exhibits measurable performance characteristics including:

* **Arrival rate variability** across departments
* **Diverse service times** based on medication type
* **Priority misalignment** between clinical urgency and processing order
* **Resource contention** under peak load

This system is complex due to:

* Multiple random arrival streams (Poisson processes)
* Variable service times (Uniform distributions)
* Finite server capacity (3 pharmacists)
* Clinical priority requirements conflicting with operational policy

The system is prone to **bottlenecks, queue instability, and safety-critical delays**, making it ideal for performance modelling.

1. **Performance Objectives**

The primary goal is to **model, analyse, and optimize the performance** of the pharmacy dispensing system with a focus **on patient safety, operational efficiency, and resources utilization**.

Specific Performance Objectives:

* **Minimize Emergency Wait Time** – Reduce average wait time for Emergency prescriptions ≤ 10 minutes (Clinical Target).
* **Maximize System Throughput** – Increase prescriptions processed per hour while maintain stability.
* **Identity and Eliminate Bottlenecks** – Determine root causes of queue growth and capacity saturation.
* **Optimize Resource Utilization** – Maintain pharmacist utilization between 80- 90% to balance efficiency and error risk.
* **Evaluate Intervention Strategies** – Compare priority queuing, express lanes, and staffing increases using simulation.
* **Ensure Queue Stability** – Prevent unbounded queue growth under realistic demand (arrival rate ≤ service capacity).

These objectives align with **healthcare quality metrics, patient safety standards,** and **operational sustainability**.