ABSTRACT.

This thesis consists of two parts: part 1 considers a queueing problem and part 2 reliability problems.

Queueing theory, which developed this century, mathematically models a queueing process so as to determine various system measures. Chapter 1 gives a review of the types of queues studied in the literature and chapter 2 studies two variants of a H.O.L. cut off, two server priority queue, in which a low priority customer can only commence service when both servers are free. This type of queue is useful when it is desired to reserve a server for high priority customers, due to their urgent need for service. In both models the arrival process of the high priority customer is a Poisson process and the service time is exponential. In model 1 the low priority customers also arrive in a Poisson process, but the service time distribution is general. The focus of the analysis is on an E event, which occurs whenever the first customer to arrive during an idle period, is a low priority customer. In model 2 there is an unlimited number of low priority customers waiting for service and their

service time is two stage Erlangian. The analysis is through generating function technique, and server utilization measures and the mean number of high priority customers waiting for service in the steady state are found. The change in these measures as the parameters of the distribution change is investigated numerically.

In the second part various redundant systems are considered. In a redundant system more units are made available than are required for performing the system's function. In standby redundant systems the redundant units are waiting to be put on line when required, and in parallel redundant systems all the units are on line, but the system can continue to function if a certain limited number of units fail. In both systems there can be the provision for the repair of failed units. In standby systems there must be a switching device to switch the offline unit on line when the online unit fails. Following Gnedenko et al (1969) this switching device can also fail. In chapter 4 two, two-unit standby, redundant repairable systems are analyzed for availability and reliability. The same repair facility is used for the units and the switching device; but because of the need to reorient between different types of servicing, the model assumes that after every switch repair, the repair facility reorients itself to repairing units. During this time the repair facility is unavailable for any repair and hence it is called dead time. This is a variant of the dead time modelled by Sarma (1982) and subsequently by Hines (1988) Chapter 4 then analyses a two unit repairable parallel system, in which the operating unit has three operating states. An expression for the mean number of repairs per unit time is also obtained.

Chapter 5 analyses for reliability a complex, non-repairable parallel redundant system, which could represent a power plant, using Boolean function technique. Numerical results are given when the lifetimes of the components follow exponential or Weibull distributions.