1. (25 points.) Consider an M/M/3/10 queuing system equipped with one fast server with a service rate of \( \mu_1 = 5 \) customers/sec and two slow servers each with a service rate of \( \mu_2 = 3 \) customers/sec. Assume that the customer arrival rate \( \lambda \) is 15 customers/sec and a customer will always choose the fast server if it is available. Write an smpl simulation program for this M/M/3/10 queueing system to compute (1) the customer turned-away probability, (2) average number of customers waiting in the system (excluding the ones in service), (3) response time per client for those served by the fast server, (4) response time per client for those served by any one of the two slow servers, and (5) throughput. Make sure that the reported response time for those served by the fast server is within 95% level of confidence with 5% confidence accuracy based on the batch mean analysis method. Also report the confidence accuracy obtained from your simulation program. Show the smpl program source code and output.

2. (25 points.) A network topology with 7 components is shown above. Assume that components 1 through 7 all obey the exponential failure law, with the failure rates of \( 7 \times 10^{-5} \) hr\(^{-1} \), \( 6 \times 10^{-5} \) hr\(^{-1} \), \( 5 \times 10^{-5} \) hr\(^{-1} \), \( 4 \times 10^{-5} \) hr\(^{-1} \), \( 3 \times 10^{-5} \) hr\(^{-1} \), \( 2 \times 10^{-5} \) hr\(^{-1} \), and \( 1 \times 10^{-5} \) hr\(^{-1} \), respectively.

(a) (10 points.) write a Sharpe code based on a reliability graph model to compute the system reliability after 3 weeks of operation.

(b) (5 points.) Find the minimal path and minimal cut sets.

(c) (10 points.) Build a fault tree model based on the minimal path set identified in (b) and then write a Sharpe code based on your fault tree model to compute the system reliability after 3 weeks of operation. The answer obtained here should be the same as that obtained from part (a).