

**SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE**

**Spring 2010
ENSC 427: COMMUNICATION NETWORKS**

**Final Examination
Friday, April 23, 2010**

Duration: 180 minutes. Attempt all problems. Questions are equally weighted.

Closed book and closed notes. PDAs, laptops, and wireless phones are not permitted. Simple calculators (with no graphing/programming functions) are permitted.

Please provide detailed answers and include diagrams, graphs, and tables, as needed. Expand all acronyms. Please write legibly. Illegible text will not be graded.

1. **Circuits-Switching Networks (25 points):**

- Provide the specification of the T-1 carrier system. List the T-1 data rate and justify the answer.
- What is the SONET hierarchy? List the OC-1 and OC-3 bit rates and justify the answer.
- Describe a model for a typical traffic process.
- Give the expression for the Erlang B formula.
- Describe the system where the formula may be applied.

2. Peer-to-Peer Protocols and Data Link Layer (25 points)

- What are ARQ protocols? Describe their major functions.
- Describe three ARQ protocols by using the flowing sequence of events diagrams. Clearly identify the frame and ACK numbers.
- What is the maximum window size in each case?
- What is the sliding window flow control?

3. Packet-Switching Networks (25 points)

- Show the network layers and protocol stacks and identify the end-to-end and the node-to-node layer operations.
- Describe routing. Identify the layer responsible for its implementation.
- What are routing tables and where are they stored?
- List and describe two main shortest-path routing algorithms.

4. **OPNET Tutorial: M/M/1/Queue (25 points):**

- Describe the M/M/1 queue, show the system diagram, and describe its components.
- Describe the main model parameters.
- Describe the process model attributes of the processor module.
- Describe the process model attributes of the queue module.
- List the statistics that you collected in the OPNET M/M/1 queue tutorial. Show graphs illustrating typical simulation results.