

Department of Electrical and Computer Engineering
University of Manitoba

Ph.D. Candidacy Examination in Telecommunications
Written Examination Regulations: Effective May 2024¹

1. The goal of this examination is to test a candidate's knowledge of fundamentals in the broad area of communication theory and systems. A candidate must answer **4 problems** (see next page). Each problem is worth 25 % of the total mark and the candidate is expected obtain a passing mark for every problem answered.
2. A candidate must register for the written examination at the start of the semester (deadline for which is to be set by the department). At this time, the candidate must also submit to the department office, *two* problem topics (chosen from the list given below, in consultation with your Ph.D. advisor) that you wish to be examined on. *In addition to the two mandatory topics, only these two problems will appear in the exam you receive.*
3. All students registered for the candidacy exam in a given semester shall receive the same written exam paper.

The problems shall be prepared by a committee consisting of at least **two** faculty members.

- The duration of the examination will be **3 hours**.
- The examination will be **closed-book**. No printed material is allowed. However, the candidates are allowed to bring a **single** letter size, **hand-written** formula sheet. Photocopies are not allowed.
- A non-programmable calculator is allowed. No other electronic devices are permitted.

¹Updated November 2024.

List of Problem Topics

In order to obtain a passing grade for the candidacy exam, a candidate must obtain a passing mark for each of the 4 problems answered.

The following two problems are mandatory.

Problem 1: Probability theory and Bayesian Inference

Chapter 3, *Digital Communication Systems*, Simon Haykin, 2014 Edition, John-Wiley.

Problem 2: Stochastic Processes

Chapter 4, *Digital Communication Systems*, Simon Haykin, 2014 Edition, John-Wiley.

Choose any 2 from the following list.

Problem 3: Information Theory

Chapter 5, *Digital Communication Systems*, Simon Haykin, 2014 Edition, John-Wiley.

Problem 4: Conversion of analog signals into coded pulses

Chapter 6, *Digital Communication Systems*, Simon Haykin, 2014 Edition, John-Wiley.

Problem 5: Signaling over AWGN channels

Chapter 7, Sections 7.1-7.8 and 7.12-7.14, *Digital Communication Systems*, Simon Haykin, 2014 Edition, John-Wiley.

Problem 6: Error Control Coding

Chapter 10 *Digital Communication Systems*, Simon Haykin, 2014 Edition, John-Wiley.

Sections 10.1-10.8 and 10.11-10.12 up to page 649, excluding extrinsic information.

Section 10.14, up to page 672, excluding probabilistic decoding of LDPC codes.

Problem 7: Queueing Theory

Chapter 8, *Principles of Communications Networks and Systems*, Nevio Benvenuto and Michele Zorzi (Editors), John-Wiley and Sons (2011).

Problem 8: Data Link Layer

Chapter 9, *Principles of Communications Networks and Systems*, Nevio Benvenuto and Michele Zorzi (Editors), John-Wiley and Sons (2011).

Problem 9: Transport Layer and Network Layer

Chapters 3 and 4, *Computer Networking: A Top-Down Approach*, James F. Kurose and Keith W. Ross, 6th Edition, Pearson (2012).