

# Electrical and Electronic Engineering, Information Engineering

(Information for the entrance examinations held in August 2021)

- Examinees are requested to choose and answer 2 problems out of the following 6 problems.
- The keywords for each problem are listed below. Note that they represent significant concepts in each area, and that they DO NOT necessarily indicate the range of possible questions.

## 1. Electromagnetism

- Electric charges and electrostatics
- Dielectrics
- Currents
- Magnetic fields
- Magnetic substances
- Electromagnetic induction
- Maxwell's equations
- Electromagnetic wave

## 2. Electrical Circuits

- Linear circuits:
  - Direct-current and alternating-current circuits
  - Transient response and Laplace transform
  - Frequency response and Fourier transform
  - Transmission line
- Electronic circuits and transistor circuits:
  - Small-signal equivalent circuits
  - Amplifiers and oscillators
  - Transfer function and feedback

## 3. Information (I)

- Information theory
  - Information sources and communication channels
  - Mutual information, entropy, channel capacity
  - Source coding
  - Channel coding
- Signal processing

- Fourier transform
- Sampling theorem
- Z-transform and digital filters
- Modulation and demodulation

#### **4. Information (II)**

- Logic circuits
  - Boolean algebra
  - Combinational logic circuits
  - Sequential logic circuits
- Algorithm and programming
  - Search and sort
  - Data structure
  - Control structure

#### **5. Solid-State Physics**

- Basics of quantum mechanics and statistical mechanics
  - Schrödinger equation
  - Eigenenergy, eigenstate (eigenfunction)
  - Fermi-Dirac statistics
- Properties and applications of semiconductors
  - Band structures
  - Electrical and optical properties
  - pn junction and Schottky junction
  - MOS structure

#### **6. Control and Electric Energy Engineering**

- Control engineering
  - Basics of transfer function and state space methods
  - Time and frequency responses
  - System stability and stability criteria
  - Design of feedback controller
- Electric energy engineering
  - Electric energy and power
  - Single-phase AC and three-phase AC
  - Electromechanical energy conversion