

**ROYAL CIVIL SERVICE COMMISSION  
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2023  
EXAMINATION CATEGORY: TECHNICAL**

**PAPER III: SUBJECT SPECIALISATION PAPER FOR ELECTRONICS AND  
COMMUNICATION ENGINEERING**

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<b>Date</b>	: October 7, 2023
<b>Total Marks</b>	: 100
<b>Writing Time</b>	: 150 minutes (2.5 hours)
<b>Reading Time</b>	: 15 minutes (prior to writing time)

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**GENERAL INSTRUCTIONS:**

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A & SECTION B:
  - **SECTION A** has two parts: Part I - 30 Multiple Choice Questions  
Part II - 4 Short Answer QuestionsAll questions under SECTION A are COMPULSORY.
- **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions of your choice.
4. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
5. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating the Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part in a fresh page of the Answer Booklet.
7. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
8. Use of any other paper including paper for rough work is not permitted.
9. **You must hand over the Answer Booklet to the Invigilator before leaving the examination hall.**
10. This paper has **6 printed pages**, including this instruction page.

**GOOD LUCK**

**SECTION A**

**PART I: Multiple Choice Questions (30 marks)**

**Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g. 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.**

1. Which wireless communication standard is commonly used for short-range data exchange between devices like smartphones and Bluetooth speakers?
  - a) Wi-Fi
  - b) 4G LTE
  - c) NFC (Near Field Communication)
  - d) GPS
  
2. What does the abbreviation "FPGA" stand for in the context of electronics and digital design?
  - a) Fast Processor Graphics Array
  - b) Field-Programmable Gate Array
  - c) Frequency Phase Gain Amplifier
  - d) Fully Programmable General Adapter
  
3. Which component is used to amplify electronic signals?
  - a) Resistor
  - b) Diode
  - c) Transistor
  - d) Capacitor
  
4. Which of the following is a digital modulation technique commonly used in wireless communication?
  - a) AM (Amplitude Modulation)
  - b) FM (Frequency Modulation)
  - c) PSK (Phase Shift Keying)
  - d) PM (Phase Modulation)
  
5. What type of semiconductor material is typically used in the base region of a bipolar junction transistor (BJT)?
  - a) N-type
  - b) P-type
  - c) Insulator
  - d) Superconductor
  
6. What is the Nyquist theorem primarily concerned with in signal processing?
  - a) Signal-to-noise ratio
  - b) Frequency modulation
  - c) Sampling rate
  - d) Amplitude modulation

7. What is the Fourier Transform used for in signal processing?
  - a) To convert digital signals to analog signals
  - b) To analyze a signal in the frequency domain
  - c) To amplify weak signals
  - d) To demodulate AM signals
8. Which of the following is a common modulation technique used in mobile cellular communication?
  - a) Frequency Modulation (FM)
  - b) Amplitude Modulation (AM)
  - c) Phase Modulation (PM)
  - d) Quadrature Amplitude Modulation (QAM)
9. In an electrical circuit, what is the function of a resistor?
  - a) To store electrical energy
  - b) To amplify signals
  - c) To provide a path for current flow and control resistance
  - d) To convert AC to DC voltage
10. What is the primary purpose of a diode in a circuit?
  - a) To amplify signals
  - b) To store electrical energy
  - c) To control resistance
  - d) To allow current to flow in one direction only
11. In a typical operational amplifier (op-amp), which input is considered the inverting input?
  - a) Non-inverting input (+)
  - b) Inverting input (-)
  - c) Output
  - d) Ground (GND)
12. In which programming language is the Arduino development environment primarily used for embedded electronics projects?
  - a) Python
  - b) C++
  - c) Java
  - d) Ruby
13. Which of the following is an example of a high-level programming language commonly used in signal processing and communication systems?
  - a) Assembly language
  - b) C
  - c) Binary code
  - d) Machine language
14. In Python, which library is commonly used for numerical and scientific computing tasks, making it useful in electronics and communications applications?
  - a) NumPy
  - b) matplotlib
  - c) TensorFlow
  - d) Django

15. Which programming paradigm is often used in digital signal processing (DSP) algorithms to manipulate discrete signals?
- Object-Oriented Programming (OOP)
  - Functional Programming
  - Procedural Programming
  - Logic Programming
16. Which programming language is widely used for developing Android applications, including those related to communications?
- Swift
  - Java
  - C#
  - Ruby
17. In the context of complex numbers, what is the square root of -1 often denoted as?
- j
  - $\pi$
  - e
  - i
18. What mathematical concept is used to describe the rate of change of a signal with respect to time in calculus?
- Derivative
  - Integral
  - Limit
  - Exponent
19. In communication systems, which mathematical transform is commonly used to analyse and manipulate signals in the frequency domain?
- Fourier Transform
  - Laplace Transform
  - Taylor Series
  - Differential Equation
20. Which of the following is NOT an electromagnetic wave?
- Visible light
  - Sound waves
  - Radio waves
  - X-rays
21. What is the speed of electromagnetic waves (such as light) in a vacuum?
- 3,000,000 meters per second
  - 299,792,458 meters per second
  - 186,000 miles per hour
  - 30,000 kilometers per second
22. In which part of the electromagnetic spectrum are microwaves typically found?
- Infrared
  - Ultraviolet
  - Radio
  - X-ray

23. Which property of an electromagnetic wave is responsible for determining its color in the visible spectrum?
- Frequency
  - Wavelength
  - Amplitude
  - Speed
24. Which type of power semiconductor device is typically used for high-frequency switching applications?
- Diode
  - Thyristor
  - IGBT
  - BJT
25. In a buck converter, the output voltage is \_\_\_\_\_ than the input voltage.
- Higher
  - Lower
  - Equal to
  - Unpredictable
26. Which of the following is a common application of a flyback converter?
- Voltage regulation
  - Current amplification
  - Isolation and voltage conversion
  - Power factor correction
27. What is the main advantage of using pulse-width modulation (PWM) in power electronics?
- Reduced switching losses
  - Lower output voltage
  - Decreased efficiency
  - Increased EMI
28. Which of the following communication technologies is commonly used for remote control and automation in power electronics systems?
- Bluetooth
  - Zigbee
  - NFC
  - GPS
29. What is the main advantage of using optical fibers for communication over traditional copper wires?
- Lower cost
  - Slower data transmission
  - Immunity to electromagnetic interference
  - Limited bandwidth
30. Which modulation scheme is commonly used in Wi-Fi (IEEE 802.11) communication?
- AM
  - FM
  - ASK
  - OFDM

**PART II – Short Answer Questions [20 marks]**

**This part has 4 Short Answer Questions. Answer ALL the questions. Each question carries 5 marks.**

1. What is attenuation explaining its effect on signals in relation to frequency and measurement units?
2. Explain multiplexing and its importance to communication networks.
3. Explain modem and its usage in networks.
4. Differentiate analog and digital communications channels.

**SECTION B: Case Study (50 marks)**

**Choose either CASE I or CASE II from this section. Each case study carries 50 marks.**

**CASE I**

Digital currency such as bitcoins are one of the new developments in the country and as an electronic engineer discuss how it was initially invented. Its differences and similarities in comparison to traditional money.

**CASE II**

AI is taking the world by storm, what do you know about AI and explaining its use cases with Pros and Cons.

**TASHI DELEK**