Analog and digital technics 2021 spring (Technical Management course)

Question to study, part II.

1. Number systems. Binary and hexadecimal system and notation. Conversion between decimal, binary and hexadecimal notations. Arithmetical calculations with binary numbers (integers). Carry and borrow bit (flag bit). Bits and bytes. Binary prefixes (IEC 60027-2 A.2 and ISO/IEC 80000).
2. BCD coding and its uses. Coding of alphanumeric etc. characters: ASCII, Unicode.
3. Special codes. Gray code and similar ones and applications. Error correction principles. Parity bit. Hamming-distance.
4. Signed integer formats (sign-bit; 2's complement; offset binary). Fractional formats (trad.fraction; fixed point; floating point).
5. Voltage levels of logic states in some well-spread technologies (eg. TTL, CMOS levels) and in communication systems (eg. RS-232, I2C, USB, CAN). What is *hysteresis* in the voltage levels and the reason for using them.
6. Concept of serial and parallel transmission of binary data (serial and parallel cables). Differences pro and con. Examples.
7. Binary (logic) operators: NOT, AND, OR, XOR, NAND, NOR. Symbols of corresponding logic gates, truth-tables.
8. Logic operator identities (basic equations, transformations). DeMorgan identities. Creating all other operators from NAND only or from NOR only.
9. Concept of combinational and sequential logic circuits. Examples, uses.
10. Solving a problem using truth tables. Using Karnaugh map. Example with 4 variables. Explain the process.
11. 1 bit adder circuit with carry. How to create adder with more bits.
12. Flip-flops (sequential logic). RS, JK, T, D flip-flops and applications.
13. Example for creating a circuit that gives 1Hz clock signal from a higher frequency source by dividing frequencies. What frequencies can be used for original clock source? Why do we need to use the higher frequency (why can't / won't we create a 1Hz oscillator directly?)
14. Logic gates with hysteresis input and their use in debouncing a switch. Flip-flops for debouncing.
15. Tri-state and open-collector (open-drain) logic ports. Reasons and examples for their applications.
16. Delay (propagation) time in logic gates. Hazard caused by different delay times in different paths or improper circuit design and their elimination.
17. Concept of electronic memory. Cell sizes. Concept of *addressing* a memory, relation between number of bits in address (also *address bus width*) and memory size. Amount of memory we can address with popular or historical address bus sizes (16b, 20b, 24b, 32b, 52b).
18. Random Access Memory (RAM). What does *random* really mean here? Block diagram of a simple RAM IC, name and explain connections (data bus, address bus, read/write pin, enable/select pins, supply). RAM types (SRAM,DRAM) pro and con. Read-only Memory (ROM) concept and types.
19. FIFO memories (shift registers). LIFO memories (stack). Applications.
20. Multiplexers and demultiplexers/decoders. Applications.
21. Microprocessors. Basic block diagram of a generic processor. Brief explanation of operation (fetching instructions from memory, executing, write-back etc.) Special registers (program counter, stack pointer). Pointers and how they work in hardware.
22. Microprocessor features: interrupts; pipeline; cache.
23. General structure of a computer (ie. a PC). Bus system.
24. Microcontrollers. General differences from microprocessors. Typical integrated peripherials. Applications.