Q.7 Which of the following is **TRUE**?

(A) Every subset of a regular set is regular.
(B) Every finite subset of a non-regular set is regular.
(C) The union of two non-regular sets is not regular.
(D) Infinite union of finite sets is regular.

Q.8 How many 3-to-8 line decoders with an enable input are needed to construct a 6-to-64 line decoder without using any other logic gates?

(A) 7 (B) 8 (C) 9 (D) 10

Q.9 Consider the following Boolean function of four variables:

$$f(w,x,y,z) = \sum(1,3,4,6,9,11,12,14)$$

The function is

(A) independent of one variable.
(B) independent of two variables.
(C) independent of three variables.
(D) dependent on all the variables.

Q.10 Consider a 4-way set associative cache consisting of 128 lines with a line size of 64 words. The CPU generates a 20-bit address of a word in main memory. The number of bits in the TAG, LINE and WORD fields are respectively:

(A) 9, 6, 5 (B) 7, 7, 6 (C) 7, 5, 8 (D) 9, 5, 6

Q.11 Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stored in a bit serial manner in a sector. The capacity of the disk pack and the number of bits required to specify a particular sector in the disk are respectively:

(A) 256 Mbyte, 19 bits
(B) 256 Mbyte, 28 bits
(C) 512 Mbyte, 20 bits
(D) 64 Gbyte, 28 bits

Q.12 The height of a binary tree is the maximum number of edges in any root to leaf path. The maximum number of nodes in a binary tree of height h is:

(A) $2^h - 1$ (B) $2^{h-1} - 1$ (C) $2^{h+1} - 1$ (D) 2^{h+1}

Q.13 The maximum number of binary trees that can be formed with three unlabeled nodes is:

(A) 1 (B) 5 (C) 4 (D) 3

Q.14 Which of the following sorting algorithms has the lowest worst-case complexity?

(A) Merge sort
(B) Bubble sort
(C) Quick sort
(D) Selection sort

Q.15 Consider the following segment of C-code:

```
int j, n;
  j = 1;
  while (j <= n)
      j = j*2;
```

The number of comparisons made in the execution of the loop for any $n > 0$ is:

(A) $\lceil \log_2 n \rceil + 1$ (B) n (C) $\lceil \log_2 n \rceil$ (D) $\lfloor \log_2 n \rfloor + 1$

Q.16 Group 1 contains some CPU scheduling algorithms and Group 2 contains some applications. Match entries in Group 1 to entries in Group 2.

Group 1	Group 2
P. Gang Scheduling	1. Guaranteed Scheduling
Q. Rate Monotonic Scheduling	2. Real-time Scheduling
R. Fair Share Scheduling	3. Thread Scheduling

(A) P-3; Q-2; R-1
(B) P-1; Q-2; R-3
(C) P-2; Q-3; R-1
(D) P-1; Q-3; R-2

Q.17 Consider the following statements about user level threads and kernel level threads. Which one of the following statements is **FALSE**?

(A) Context switch time is longer for kernel level threads than for user level threads.
(B) User level threads do not need any hardware support.
(C) Related kernel level threads can be scheduled on different processors in a multi-processor system.
(D) Blocking one kernel level thread blocks all related threads.

Q.18 Which one of the following is a top-down parser?

(A) Recursive descent parser.
(B) Operator precedence parser.
(C) An LR(k) parser.
(D) An LALR(k) parser.

Q.19 In Ethernet when Manchester encoding is used, the bit rate is:

(A) Half the baud rate.
(B) Twice the baud rate.
(C) Same as the baud rate.
(D) None of the above.

Q.20 Which one of the following uses UDP as the transport protocol?

(A) HTTP (B) Telnet (C) DNS (D) SMTP

Q. 21 to Q. 75 carry two marks each.

Q.21 How many different non-isomorphic Abelian groups of order 4 are there?

(A) 2 (B) 3 (C) 4 (D) 5

Q.22 Let *Graph(x)* be a predicate which denotes that x is a graph. Let *Connected(x)* be a predicate which denotes that x is connected. Which of the following first order logic sentences **DOES NOT** represent the statement: "*Not every graph is connected*"?

(A) $\neg\forall x\,(Graph(x) \Rightarrow Connected(x))$
(B) $\exists x\,(Graph(x) \wedge \neg Connected(x))$
(C) $\neg\forall x\,(\neg Graph(x) \vee Connected(x))$
(D) $\forall x\,(Graph(x) \Rightarrow \neg Connected(x))$

Q.23 Which of the following graphs has an Eulerian circuit?

(A) Any k-regular graph where k is an even number.
(B) A complete graph on 90 vertices.
(C) The complement of a cycle on 25 vertices.
(D) None of the above.

Q.24 Suppose we uniformly and randomly select a permutation from the 20! permutations of $1,2,3,\ldots,20$. What is the probability that 2 appears at an earlier position than any other even number in the selected permutation?

(A) $\frac{1}{2}$
(B) $\frac{1}{10}$
(C) $\frac{9!}{20!}$
(D) None of the above.

Q.25 Let A be a 4×4 matrix with eigenvalues $-5,-2,1,4$. Which of the following is an eigenvalue of $\begin{bmatrix} A & I \\ I & A \end{bmatrix}$, where I is the 4×4 identity matrix?

(A) -5 (B) -7 (C) 2 (D) 1