Server & Data Security

2023

HPSC

Time : 3 hours]

[Maximum Marks : 150

QUESTION PAPER SPECIFIC INSTRUCTIONS

(Please read each of the following instructions carefully before attempting questions)

(i) There are **eighteen (18)** questions, all printed in English only.

(ii) Candidate has to attempt any **fifteen (15)** questions in all.

(iii) Each question carry **ten** marks.

(iv) Word limit in questions, wherever specified should be adhered to.

(v) Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question will be counted even if attempted partly. Any page or portion of the page left blank in the question-cum-answer booklet must be clearly struck off.

(vi) Answer to the questions must be confined only to the space provided for each question. No extra/additional sheet will be provided.

(vii) Answer must be written in the authorized medium. No marks will be given for answers written in a medium other than the authorized one.

1. *(a)* Show that any finite integral domain is a field. 5

(b) A biased coin with probability of obtaining head equal to $p > 0$, is tossed repeatedly and independently until the first head is observed. Calculate the probability that the first head appears at an even numbered toss. 5

2. Show that a connected graph is bipartite if and only if all the cycles are of even length. 10

3. *(a)* Design a minimum state Definite Finite Automata (DFA) for the following language :

$$L = \{\, w \in \{0, \} \mid w \text{ has both an even number of 0's and an even number of 1's} \}$$ 5

(b) State whether the following statements are true *or* false. Give justifications :

(i) $0.\{a^i b^j c^k \mid i < j\} \cup 1.\{a^i b^j c^k \mid i < k\}$ is a DCFL (Deterministic Context-Free Language).

(ii) $\{a^i b^j c^k \mid i < j\} \cup \{a^i b^j c^k \mid i < k\}$ is a DCFL (Deterministic Context-Free Language). 5

4. Consider the following NFA. Draw the corresponding transition table for the NFA and then apply subset construction on the same. 10
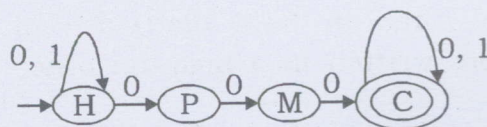

Figure 1. NFA for the above problem.

5. Suppose you are given an array $A[1..n]$ with n entries, with each entry $A[i]$ holding a distinct number. You are told that there is some index p between 1 and n, such that the values in the array entries decrease up to position p in A and then increase the remainder of the way until position n. Show how to find the index p by reading at most $O(\log n)$ entries of A. 10

6. (a) Give an expression for the minimum number of nodes, $S(h)$, in an AVL tree of height h. Also, prove that the expression is correct. 5

(b) Show how to implement a queue using two ordinary stacks so that the amortized cost of each ENQUEUE and each DEQUEUE operation is $O(1)$. 5

7. (a) Give 2's complement and 1's complement representations for the following (assume 8 bits machine) : 4

(i) -1

(ii) -0

(b) List out some major differences between the two representations. 6

8. Write a function in C programming language which reverses the input string s in place. To be precise, complete the following C-code :

```
#include<stdio.h>

#include<string.h>

void reverse(char s[ ])

{

    Complete this function

}

int main()

{

    char v[]="abcdefgh";

    reverse(v);

    printf("reverse of v is %s", v);

    return 0;

}
```

Output : reverse of v is hgfedcba. 10

9. Describe relational databases in detail along with examples.　　10

10. Consider the set of 7 processes whose arrival time and burst time are given in Figure 2. Assuming that the CPU scheduling policy is Shortest Job First (SJF), draw

Process ID	Arrival Time	Burst Time
P_1	0	8
P_2	1	6
P_3	2	4
P_4	3	1
P_5	5	2
P_6	6	1
P_7	7	3

Figure 2. Table for problem (10)

the Gantt chart. What is the waiting time of process P_2? Now assume that the CPU scheduling policy is Shortest Remaining Job First (SRJF). Again draw the Gantt Chart. Now what is the waiting time of the process P_2?

　　5+5=10

11. Write the major differences between transport layer and data link layer.

　　10

12. Suppose that the stop-and-wait protocol is used on a link with a bit rate of 64 kbps and 20 ms propagation delay. Assume that the transmission delay for the acknowledgement and processing time at nodes are negligible. Then what is the minimum frame size in bytes to achieve a link utilization of at least 50%?

　　10

13. Construct LL(1) parsing table for the grammar given below :　　10

$$E \rightarrow TE'$$
$$E' \rightarrow +TE' \,/\, \varepsilon$$
$$T \rightarrow FT'$$
$$T' \rightarrow *FT' \,/\, \varepsilon$$
$$F \rightarrow id \,/\, (E)$$

14. Consider the following recursive function :

```
int X(int N)
{
    if(N < 3)
        return 1;
    else
        return X(N− 1) + X(N− 3) + 1;
}
```

How many invocations of the function X are there, while evaluating X(X(5))? 10

15. Consider the below 9 bits register where the mantissa is normalized fraction which is denoted in signed magnitude form. The excess-8 (biased = 8) exponent is used along with mantissa to denote the floating point number. If the base of the system is 2, what is the value represented by $(605)_8$ in the below register? 10
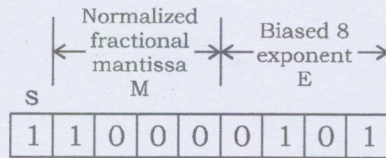
```
       | Normalized |
       |  fractional  | Biased 8  |
       |   mantissa   | exponent  |
   S   |      M       |     E     |
 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
```

Figure 3. 9 bits register containing $(605)_8$ for Q. No. (15).

16. Consider the following C code :

```c
#include<stdio.h>
void XYZ(char *s, char *t)
{
    while(*s++ = *t++);
}
int main()
{
    char s[] = "I am okay!";
    char t[] = "Fine";
    XYZ(s, t);
    printf("s=%s\n", s);
    printf("t=%s\n", t);
    return 0;
}
```

What is the output of this code? Explain precisely the function XYZ. 10

17. *(a)* What is regression testing? Explain how the use of automated tests and a testing framework such as *J* Unit simplifies regression testing. 5

(b) Write a scenario that could be used to help design tests for the wilderness weather station system. 5

18. What is defuzzification? Describe few strategies and analyze their main properties and interrelationships. 10

★ ★ ★