FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION - 2018
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

COMPUTER SCIENCE, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II** by selecting **TWO** questions from **EACH SECTION.**
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
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(vi) Extra attempt of any question or any part of the attempted question will not be considered.

PART-II
SECTION-I

Q. 2. **(a)** How many layers are in the TCP/IP stack? What are the names? **(4)**

(b) How digital evidences can be preserved from a crime scene. Write in details by taking examples of digital devices commonly used these days. **(4)**

(c) What are the responsibilities of Operating system kernel? **(3)**

(d) List down any four best practices for coding standards. **(3)**

(e) Why do modern processors use more power when their clock frequency is increased? **(2)**

(f) Ali is telling Ahmad that he is representing a -ve number and its most significant bit is 1, Ahmad immediately shouted you are representing numbers using 2's compliment. True or False. And why? **(2)**

(g) If time slice is of 50 milliseconds and context switch requires a microsecond, how many processes can the machine service in a second? **(2)**

Q. 3. **(a)** Write a program grade average calculator, User will input marks for five subjects and program will output the average of its marks. Print appropriate message on the base of its mark's average e.g.; Well done, Keep it up, Better luck next time etc. **(5)**

(b) Given that i,j,k,n & m are integer variables. Write a condition such that: **(2)**

i- hello is only printed when, any of the following conditions are met: i is twice the value of j, j is smaller than k and less than n, or m is negative.

```
inti,j,k,n,m; cin>>i>>j>>k>>n>>m;
 if(          )
 cout<<"hello";
```

ii. hello is only printed when i does not lies in the interval 6-9

```
inti; cin>>i;
    if(        )
    cout<<"hello";
```

(c) Write equivalent instruction to following instruction without the use of += operator: where w,z are integers. **(1)**

```
w+=2*z+4;
```

(d) Predict the values of variables a & b after every instruction **(2)**

```
integer a=5 b=6
a=(b++) + 3;
b=--a;
```

(e) Complete the code such that it prompts the user for +ve number n. Then displays the output.(whatever the value of n is)(HINT: instead of triangles of stars its triangles of increasing numbers)[marks **(5)**

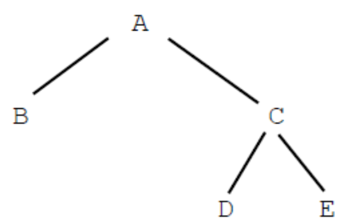
```
1 2 3 4 . . . n
1 2 3 4 ..n-1
. . .
. . .
1 2
1
```

```
for n=4 it will print
1 2 3 4
1 2 3
1 2
1
void main()
{
int n; cin>>n;
// your loops will go here

}
```

(f) In following code replace the character at pos^th location in the string st with the ,character ch. For example in string helloworld replacing 2nd character with i would result in hilloworld **(5)**

```
void main( )
{char st[15]; int pos; char ch;
int size=0;
cin>>st;
cin>>pos>>ch;
while(st[size]!='\0')
{
size++; // calculating length of current string
}
// write your code here

}
```

Q. 4. Consider the inheritance hierarchy shown below. Each part of this question is independent.



(a) In which class(es) would it make most sense to have protected members? Which class(es) would be able to access those protected members directly? **(5)**

(b) Which class(es) can access private members of class C directly? **(5)**

(c) Suppose class C contains a pure virtual function. Suppose we wish to instantiate objects of this hierarchy. Which class(es) are or could be abstract and which are concrete? **(5)**

(d) Consider the following list of classes: Car, SteeringWheel, Vehicle, Van, Minivan, AudioSystem, ParkingLot. Your task is to describe all of the *is-a* and *has-a* relationships between these classes. Include an inheritance hierarchy for all classes that fit. Fill in the table with *is-a* or *has-a* relationship while leaving the cells empty where no relation is applicable. **(5)**

	Vehicle	**Car**	**Van**	**Mini Van**	**Steering Wheel**	**Audio System**	**Parking Lot**
Vehicle							
Car	*is-a*						
Van							
Mini Van							
Steering Wheel							
Audio System							
Parking Lot							

SECTION-II

Q. 5. **(a)** What is dangling pointer? **(3)**

(b) What data structure would employ to build a text editor and why? **(5)**

(c) Random insertion of nodes into a binary search tree would result in what types of tree shape. Elaborate. **(7)**

(d) How would you modify a link list based queue so that first and last node can be accessed in a constant time regardless of data nodes in the queue? **(5)**

Q. 6. **(a)** Define balanced tree both for AVL and Binary search tree. **(4)**

(b) What is informed or heuristic search what type of algorithm is used to do such a search? **(6)**

(c) Differentiate between graph and trees. Which is special case of the other? **(5)**

(d) Explain what type of problems can be solved by genetic algorithm. **(5)**

Q. 7. **(a)** Outline the difference between software verification and software validation. **(4)**

(b) Give an outline of the unit testing process for verification. **(4)**

(c) Agile Development is a process that values responding to change over following a plan. Discuss three issues a Software Engineer should be mindful of when adopting this approach during software development. **(4)**

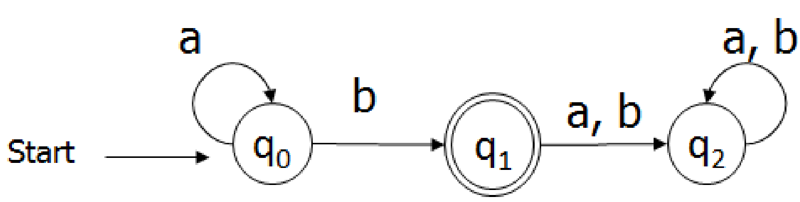
(d) What type of project is not suited to incremental methods? **(4)**

(e) Outline the difference between Black box and White box testing. **(4)**

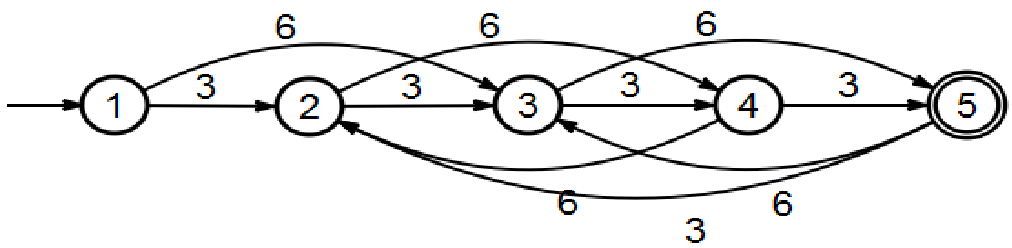
Q. 8. **(a)** What is the difference between lexers and parsers? **(5)**

(b) Write a grammar (BNF) for the language of palindromes. **(5)**

(c) Here DFA is given for the language L find the DFA for L^2 **(5)**



(d) Convert the following DFA to a RE: **(5)**



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PART – II
SECTION – A

Q. No.2. (A) Briefly describe the functionality of the following CPU special-purpose registers: Instruction Register (IR), Memory Data Register (MDR) and Program Counter (PC). **(8)**
(B) Differentiate between Address, Data and Control bus. **(6)**
(C) Discuss instruction pipelining in the context of fetch-decode-execute cycle. **(6)**

Q. No.3. (A) Differentiate between hub, bridge, switch and router. **(8)**
(B) Discuss how Network Address Translation (NAT) works and why is it useful? **(6)**
(C) Elaborate the working of multiplexing/de-multiplexing at the transport layer. **(6)**

Q. No.4. (A) There are three processes P_A, P_B and P_C and three resources R_A, R_B and R_C. Resources R_A and R_B have one instance each while resource R_C has two instances. P_A is holding one instance of R_C and has requested for R_A. Process P_B is holding R_A and has requested for R_B. R_B is allocated to P_C which has also requested an instance of R_C. Represent the scenario with a resource allocation graph. Discuss whether there is a deadlock or not? If yes, which processes are blocked? **(8)**
(B) In the context of Paging, consider the case where memory addresses are 32 bits i.e. 20 bits Virtual Page Numbers and 12 bits of offset. How many virtual pages are there and what is the size of each page? Given the virtual address 0x7589, find the virtual page number and offset. If the respective page table entry contains 0x900DF, find the physical address. **(6)**
(C) In the context of I/O management, differentiate between Pooling and Interrupts. **(6)**

Section – B

Q. No.5. (A) Given two relations ***R*** and ***S***, where ***R*** contains ***M*** tuples, ***S*** contains ***N*** tuples, and ***M*** >***N*** > ***0***, give the minimum and maximum possible sizes (in tuples) for the resulting relation produced by each of the following relational algebra expressions. **(8)**
i. $R - S$
ii. $R \cup S$
iii. $R \cap S$
iv. $R \bowtie S$

(B) Elaborate the concepts of super key, candidate key and foreign key with examples. **(6)**
(C) Discuss the difference between physical data independence and logical data independence. **(6)**

Q. No.6. (A) Differentiate between image sampling and quantization. Discuss how these concepts relate to spatial and intensity resolutions. **(8)**

(B) In the context of image smoothing, discuss the differences between mean and median filters. **(6)**

(C) For the image 'X' shown in Figure 1, show the result of applying the given morphological operators. Assume zero padding for border pixels. **(6)**

i. Dilation of X by structuring element [1 1 1].
ii. Erosion of X by structuring element $[1\ 1\ 1]^T$
iii. Dilation of X by a 3x3 structuring element containing all ones.

0	0	0	0	0	0	0	0
0	1	1	0	0	1	1	0
0	1	1	1	1	1	1	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	1	1	1	1	0	0
0	0	0	0	0	0	0	0

Q. No.7. (A) Perform histogram equalization on the 8-bit image shown in Figure 2. **(8)**

5	5	5	5	5
10	10	10	10	10
30	30	30	30	30
100	100	100	100	100
100	100	100	100	100

(B) For the 3x3 image shown in the following, apply the horizontal and vertical Sobel operators and compute the magnitude of gradient at the central pixel with intensity value 50. **(6)**

5	5	5
5	50	5
5	5	5

(C) In the context of compression, differentiate between coding, spatial and temporal redundancies. **(6)**

Q. No.8. (A) Elaborate the concept of three tier architecture with reference to presentation, business logic and data access layers. **(8)**

(B) Differentiate between XHTML and XML. **(6)**

(C) Discuss Agile and Water Fall methodologies in the context of web application development. **(6)**

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