This question paper contains 16 printed pages]

CODE : FS-17

COMPUTER ENGINEERING

Time : 3 *Hours* *Maximum Marks* : 200

Note :— (*i*) Question Number 2 in Part I and Question Number 5 in Part II are compulsory. The candidate has to answer at least *two* questions from each part including the compulsory one. One more question can be answered from any of Part I or Part II. In all *five* questions have to be answered. All questions carry equal marks.

(*ii*) Parts of same questions must be attempted together and not to be attempted in between the answers to other questions.

P.T.O.

Part I

1. (*a*) The four variable function *f* is given in terms of min-terms as :

$f(A, B, C, D) = \Sigma m\,(2, 3, 8, 10, 11, 12, 14, 15)$.

Using the K-map minimize the function in the sum of products form. Also give the realization using only two input NAND gates. 15

(*b*) Simplify the Boolean Expression to the minimum number of literals : 5

$$X' + XY + XZ' + XY'Z'$$

(*c*) Reduce the following Boolean Expressions to one literal : 5

$$A'B(D' + C'D) + B(A + A'CD).$$

(*d*) What do you understand by Polymorphism ? Write a program to overload the operator "<<" and ">>" so that it works on user defined objects. 15

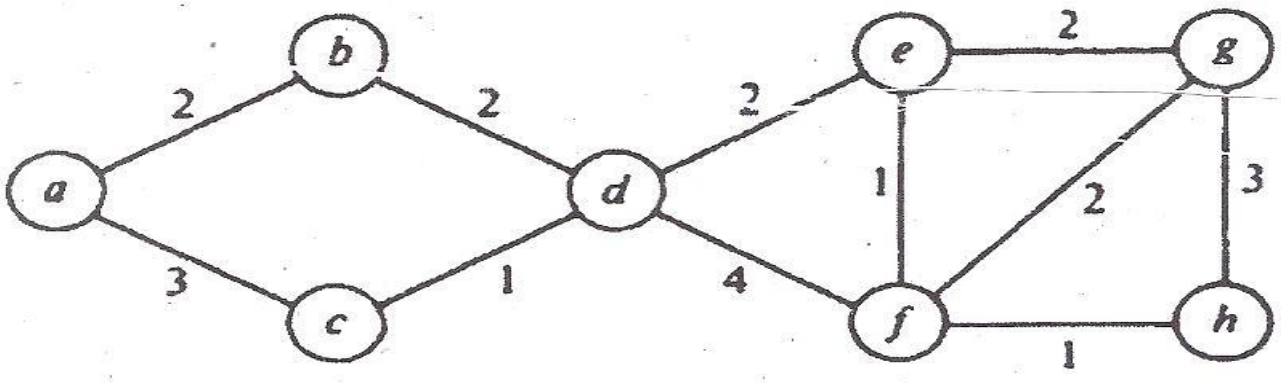
2. (*a*) A sorted double link list is given which contains duplicate data items. Write an algorithm which removes all duplicate data items from the list in one pass only. 10

(*b*) Construct an AVL tree by inserting the following elements in the order given below. Clearly show the rotation applied after each step :

65, 7, 40, 26, 16, 118, 92, 87, 120

After making the tree delete 65 and 16 and show the final tree. 15

(*c*) Apply DFS and BFS algorithm on the following graph and list the sequence of nodes that are visited. Assume *g* as the starting vertex. Show each step clearly. 15



P.T.O.

3. Given the following specifications of a CPU : 40

- 8 bit registers : Accumulator (AC), Address Register (AR), Program Counter (PC), Data Register (DR), Instruction Register (IR) and Temporary Register (TR, Not accessible to programmer)
- 256 byte Memory (word size = 1 byte)

Consider the following instructions :

Instruction	Instruction Code	Operation	Remarks
MVA	0000 0100	AC ← DR	The data stored in DR moves to AC
MVD	0000 0101	DR ← AC	The data stored in AC moves to DR

ADD	0000 0110	AC ← AC + DR	The contents of AC and DR move to ALU and result is stored back in AC
LDC	0000 0111 X	DR ← M[X]	The operand specified by the memory address X contained in the instruction moves to the DR
STA	0000 1000 X	M[X] ← DR	The data stored in DR moves to address X contained in the instruction

(*i*) Draw the complete instruction cycle flowchart showing the fetch, decode and execution states of all the instructions.

(*ii*) List the micro-operations involved in each state.

(*iii*) Design the hardwired control unit showing the generation of control signals.

4. (*a*) Remove any redundant FDs from the following sets of FDs : 10

(*i*) $XY \rightarrow V$, $ZW \rightarrow V$, $VX \rightarrow Y$, $W \rightarrow Y$, $Z \rightarrow X$

(*ii*) $A \rightarrow BC$, $AC \rightarrow Z$, $Z \rightarrow BV$, $AB \rightarrow Z$

(*b*) In a relation R(A, B, C, D, E, F, G, H, I, J) and the set of FDs : 10

$F = (A, B) \rightarrow A \rightarrow (D, E)$; $B \rightarrow F$;

$F \rightarrow (G, H)$; $A \rightarrow I$; $H \rightarrow J$

(*i*) What is the key of R ?

(*ii*) Decompose R into 2 NF and then 3 NF relations.

(*c*) What is locking ? What is the relevance of lock in DBMS ? How does a lock work ? 10

(*d*) A university registrar's office maintains data about the following entities : 10

(*i*) courses, including number, title, credits, syllabus, and prerequisites;

(*ii*) course offerings, including course number, year, semester, section number, instructor(s), timings, and classroom;

(*iii*) students, including student-id, name, and program; and

(*iv*) instructors, including identification number, name department, and title.

Further, the enrolment of students in courses and grades awarded to students in each course they are enrolled for must be appropriately modeled. Construct an E-R diagram for the registrar's office. Document all assumptions that you make about the mapping constraints.

Part II

5. (*a*) Argue with suitable reasons that which of the following languages is regular and why ? 10

(*i*) {wwR | w $\in$ {0, 1}+ }

(*ii*) {wwRx | x, w $\in$ {0, 1}+ }

(*iii*) {wxwR | x, w $\in$ {0, 1}+ }

(*iv*) {xwwR | x, w $\in$ {0, 1}+ }

Where wR stands for reverse of string 'w'.

(*b*) Simplify the following CFG showing all intermediate steps : 10

$S \rightarrow AB \mid aABa$

$B \rightarrow Bb \mid DD$

$M \rightarrow ABt$

$A \rightarrow aD \mid DB$

$D \rightarrow d \mid \varepsilon$

(*c*) Consider the following Context Free grammar : 10

$A \rightarrow A = = B \mid B$

$B \rightarrow C * B \mid C$

$C \rightarrow id$

Stating suitable reasons, identify the correct statement(s) : 10

(*i*) LL(1)

(*ii*) SLR(1)

(*iii*) Not LALR(1)

(*iv*) Not LR(1)

(*d*) Obtain the following entities from the below mentioned code snippet : 10

(*i*) Control Flow Graph

(*ii*) Dominator Tree

(*iii*) Natural Loops

```
1                A = B + C
2       L1:      t1 = A * B
3                t2 = t1/C
4       L4:      if t2 < W goto L2
5                M = t1 * k
```

```
6        L2:        t3 = M + 1
7                   H = I
8                   if t3 > H goto L3
9                   M = t3 - H
10                  if t3 ≥ 0 goto L4
11                  goto L1
12       L3:
```

6. (*a*) Consider the following set of processes, with the length of the CPU burst time given in milliseconds : 20

Process	Burst Time	Priority
P1	4	2
P2	3	1
P3	10	4
P4	6	2
P5	5	3

The process are assumed to have arrived in the order P1, P2, P3, P4, P5 all at time 0.

(*i*) Draw three Gantt charts that illustrate the execution of these processes using the following scheduling algorithms : FCFS, SJF and Round Robin (quantum = 2)

(*ii*) Calculate the turnaround time for each process for all the above mentioned algorithms.

(*iii*) What is the waiting time for each processes for each of the above mentioned algorithms.

(*b*) Explain the Banker's Algorithm using an example. 10

(c) Explain the concept of Paging in Memory management strategies. Also bring out the difference between segmentation and paging. 10

7. (a) Suppose a TCP connection has a window size of eight segments, an RTT of 800 milliseconds, the sender sends segments at a regular rate of one every 100 milliseconds, and the receiver sends ACKs back at the same rate without delay. A segment is lost, and the loss is detected by the fast retransmit algorithm on the receipt of the third duplicate ACK. At the point when the ACK of the retransmitted segment finally arrives, how much total time has the sender lost, compared to lossless transmission, if : 20

(*i*) The sender waits for the ACK from the retransmitted lost packet before sliding the window forwarded again ?

(*ii*) The sender uses the continued arrival of each duplicate ACK as an indication it may slide the window forwarded one segment ?

(*b*) An ISP is granted a block of addresses starting with 150.80.0.0/16. The ISP needs to distribute these blocks to 2600 customers as follows : 20

(*i*) The first group has 200 medium size business; each needs 128 addresses;

(*ii*) The second group has 400 small size business; each needs 16 addresses.

(*iii*) The third group has 2000 households; each needs 4 addresses.

Design the sub-blocks and give the slash notation for each sub-block. Find out how many addresses are still available after these allocations.

8. (*a*) Explain in detail about the working principle of TFT and Plasma panel display systems. 15

(*b*) Apply 3-D transformation to make the given tetrahedron ABCD rotate about the x-axis, making it erect with its base ABC resting on the x-z plane. Then magnify the resultant coordinates to four time of its size about a fixed point P(1, 1, 2). The point of the tetrahedron are :

A(0, 0, 0), B(2, 0, 0), C(1, $\sqrt{5}$, 0) and D(1, 1, 1). 15

(*c*) Quality and reliability are related concepts but are fundamentally different in a number of ways. Discuss them. 5

(*d*) Can a program be correct and still not be reliable ? Explain. 5