



COMPUTER ENGINEERING

Time Allowed: Three Hours

Maximum Marks: 200

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Question Paper Specific Instructions

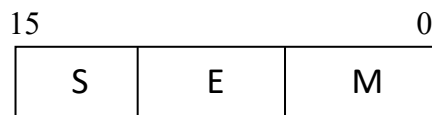
Please read each of the following instructions carefully before attempting questions:

1. There are 08 (eight) questions in all, out of which FIVE are to be attempted.
  2. Question Nos.1 and 5 are compulsory. Out of the remaining SIX questions, THREE are to be attempted selecting at least ONE question from each of the two Sections I and II.
  3. Answers must be written in legible handwriting. Each part of the question must be answered in sequence and in the same continuation.
  4. All questions carry equal marks. The number of marks carried by a question / part is indicated against it.
  5. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Answer Booklet must be clearly struck off.
  6. Unless otherwise mentioned, symbols and notations have their usual standard meanings. Assume suitable data, if necessary and indicate the same clearly.
  7. Re-evaluation / Re-checking of answer book is not allowed.
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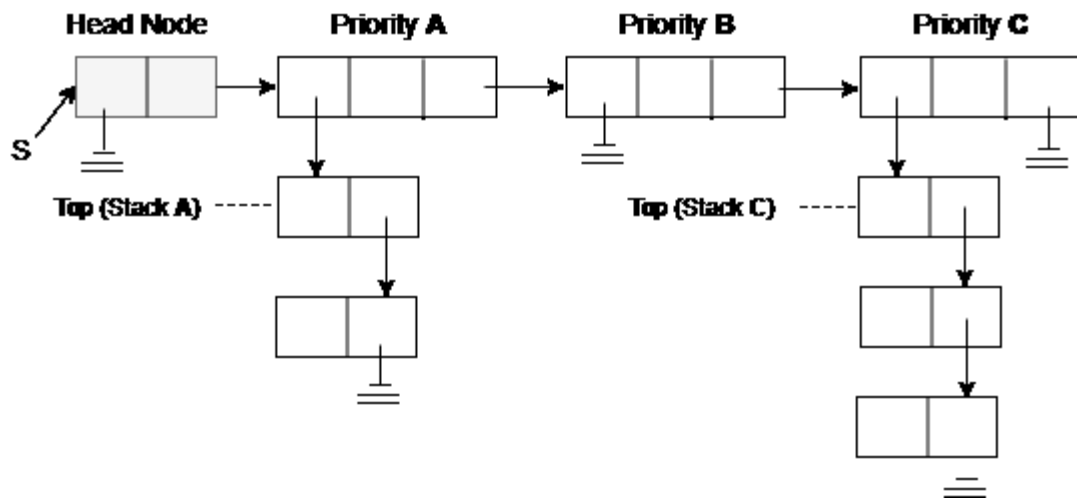
SECTION-I

1. (a) Consider following schema : (20)  
ENROLL (S#, C#, Section), S# is student number.  
TEACH (Prof, C#, Section), C# is course number.  
ADVISE (Prof, S#), Prof is Thesis advisor of S#  
PRE-REQ (C#, pre-C#), pre-C# is the prerequisite course.  
GRADE (S#, C#, grade, year)  
STUDENT (S#, Sname), Sname is student name.  
Solve the following queries in SQL.
  - (i) List of students taking courses with smith or jones.
  - (ii) List all students taking at least one course that their advisor teaches.
  - (iii) List those Professors who teach more than one section of the same course.

- (iv) List all students' number and course number.
  - (v) List the student number and course number who got grade A.
- (b) Suppose for a certain processor, a read request takes 100 nanoseconds on a cache miss and 10 nanoseconds on a cache hit. Suppose while running a program, it was observed that 80% of the processor's read requests result in a cache hit. Calculate the average read access time in nanoseconds. (10)
- (c) Consider the following 16-bit register represent a floating-point number where mantissa is normalized. Sign magnitude fraction exponent is in excess 16 form. Base of the system is 2. (10)



- (i) What is the size of the mantissa? Write the expression for the value based on the above notation?
  - (ii) What is the four-digit hexadecimal pattern which represents the value  $(-7.25)_{10}$  when used with the above notation?
2. (a) Consider the two label memory system with cache system time is  $10n$  sec. Main memory access time  $100n$  sec. It requires average access time at most  $30n$  sec. What is the minimum hit ratio of cache memory? (10)
- (b) What do you mean by a combinational circuit? How it is different from the sequential circuit? Design a combinational circuit with three inputs  $x, y, z$  and three outputs  $A, B, C$ . When binary input is 0, 1, 2, or 3, the binary output is one greater than an input. When binary input is 4, 5, 6 or 7, the binary output is one less than an input. (10)
- (c) What do you mean by normalization? Explain BCNF and 3NF on the basis of functional dependency with a suitable example. (10)
- (d) An abstract data type STACKLIST is a list of linked stacks stored according to priority factor viz. A, B, C etc, where A means the highest priority, B the next and so on. Elements having the same priority are stored as a linked stack. The following is the structure of the stack S. (10)



Create a STACKLIST for the following application of process scheduling with the processes having two priorities, viz. R (Real-time) and O (Online) listed within brackets.

1. Initiate process P1 (R)	5. Initiate process P5 (O)
2. Initiate process P2 (O)	6. Initiate process P6 (R)
3. Initiate process P3 (O)	7. Terminate process in linked stack O
4. Terminate process in linked stack R	8. Initiate process P8 (R)

3. (a) What do you mean by schedule in the context of concurrent execution of transactions in RDBMS? What is serializable schedule? Consider the following given schedule and check the serializability: (15)

S1: R1(A), W1(A), R2(A), W2(A), R1(B), W1(B), R2(B), W2(B)

- (b) What is the instruction pipeline? How to measure the performance of the instruction pipeline? An instruction pipeline of five stages will allow overlapping of all instructions except branch instructions. In the case of a branch instruction, the target is not fetched until current branch instruction is completed. There are 15% instructions belongs to branch. How many clocks on average required for instruction with this pipeline. (15)

- (c) Minimizing the following Boolean expressions: (10)

(i)  $AB + A(CD + CD') + A'B'$

(ii)  $[D' + AB' + C + AC'D + A'C'D']'$

4. (a) A microprogrammed control unit uses a horizontal microgram. It supports 128 instructions. Each instruction consumes 16  $\mu$  operations. The system having 48

1-address control instruction

Condition	Control Signal	Address
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control signals and 16 flag conditions. Answers the following if one address control instruction is used for sequencing the control word. (10)

- (i) How many bits are required for each control word?
- (ii) How much space is required for control memory in bytes?

(b) A binary tree T has 9 nodes. Draw the binary tree T by considering following in-order and pre-order traversals of T: (10)

In-order: E A C K F H D B G

Pre-order: F A E K C D H G B

(c) What do you mean by height balance tree? Construct the height balance tree using the following data and perform appropriate rotations to rebalance the tree. (10)

OS/2, LINUX, DOS, UNIX, XENIX, MAC, CENTOS, WINDOWS

(d) What is an algorithm? What are the characteristics of a good algorithm? Write pseudocode to merge the two sorted linked lists having the same type of information. (10)

#### SECTION-II

5. (a) What is the process? The arrival time, priority and durations of the CPU and I/O burst for each of three processes P1, P2 and P3 are given below: (20)

Process	Arrival Time	Priority	Burst durations (CPU, I/O, CPU)
P1	0	2	1, 5, 3
P2	3	3 (Lowest)	3, 3, 1
P3	4	1 (Highest)	2, 2, 3

Each process has a CPU burst followed by an I/O burst followed by another CPU burst. Assume that each process has its own I/O resource. When pre-emptive priority scheduling is used then calculate:

- (i) Finish time of each process
- (ii) Average Turn-around time and Average waiting time

(b) Consider six memory partitions of sizes 200 KB, 400 KB, 600 KB, 500 KB, 300 KB, and 250 KB, where KB refers to kilobytes. These partitions need to be allotted to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in the given order. Answer the following: (10)

- (i) If the best-fit algorithm is used, which partitions are NOT allotted to any process?
- (ii) If the worst fit algorithm is used, which processes are NOT allotted to any partition?
- (c) Consider the context-free grammar: (10)  
 $S \rightarrow S S + \mid S S * \mid a$
- (i) Show how the string  $aa+a^*$  can be generated by this grammar.
- (ii) What is the language generated by this language? Justify your answer.
6. (a) What do you mean by the critical section problem? What are the necessary conditions to satisfy the critical section problem? Suppose ten processes ( $P_1, P_2, \dots, P_{10}$ ) are ready to execute in the system. The code of the first nine processes ( $P_i, 1 \leq i \leq 9$ ) are as follows. (15)
- ```

While(true) {
    P(MUTEX)
    //Critical section
    V(MUTEX)
}

```
- The code for process  $P_{10}$  is identical to the previous process except it uses  $V(MUTEX)$  instead of  $P(MUTEX)$ . What is the largest number of processes that can be resided in the critical section, at any movement? Explain.
- (b) Suppose the following disk request sequence (track numbers) for a disk with 100 tracks is given: 45, 20, 90, 10, 50, 60, 80, 25, and 70. Assume that the initial position of the R/W head is on track 50. Calculate the additional distance that will be traversed by the R/W head when the Shortest Seek Time First (SSTF) algorithm is used compared to the SCAN (Elevator) algorithm (assuming that SCAN algorithm moves towards 100 when it starts execution). (15)
- (c) Write the algorithm to display two dimensional, cubic Bezier curves, given a set of four control points in the X-Y plane. (10)
7. (a) Construct the parsing table for the grammar and find the moves made by predictive parser on input  $id+id*id$  and find FIRST and FOLLOW. (15)
- ```

 $E \rightarrow E + T \mid T$ 
 $T \rightarrow T * F \mid F$ 
 $F \rightarrow (E) \mid id$ 

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- (b) Given a 3x3 homogeneous matrix to rotate the image clockwise by 90 degrees. Then shift the image to the right by 5 units. Finally, scale the image twice as large. Take a sample grayscale image of size 10x10 and demonstrate all these transformations as they performed one after another in sequence. (10)
- (c) What is the COCOMO model? What are the levels of the COCOMO model? Determine the effort required to develop the software product and nominal development time assuming the size of an organic software product has been estimated to be 25K times of code. (15)
8. (a) Construct a parse tree for the input string  $w=cad$  using a top-down parser by considering the following productions. (10)
- $$S \rightarrow cAd$$
- $$A \rightarrow ab \mid a$$
- (b) A computer on a 10Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 2Mbps. It is initially filled to capacity with 16Megabits. What is the maximum duration for which the computer can transmit at the full 10Mbps? (10)
- (c) In a packet-switching network, packets are routed from source to destination along a single path having two intermediate nodes. Calculate the optimum packet size If the message size is 24 bytes and each packet contains a header of 3 bytes. (10)
- (d) Explain the following with respect to Raster Graphics: (10)
- (i) Scan conversion
  - (ii) Filling and clipping

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