

Registration No :

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Total Number of Pages : 02

Course: MCA
Sub_Code: MCA01001

1st Semester Regular/Back Examination: 2022-23

SUBJECT: Discrete Mathematics

BRANCH(S): MCA (2 Years)

Time : 3 Hour

Max Marks : 100

Q.Code : L586

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions : (2 x 10)

- Show that the conditional statement $(p \wedge q) \rightarrow (p \rightarrow q)$ is a tautology.
- Find the five term of the sequence defined by the recurrence relation $a_n = a_{n-1}^2, a_1 = 2$.
- Let n and r be nonnegative integers with $r \leq n$. The show that $C(n, r) = C(n, n - r)$.
- How many relations are there on the sets with 5, 7 and 9 elements.
- Using Warshall's algorithm find the transitive closures of the relation $\{(a, c), (b, d), (c, a), (d, b), (e, d)\}$.
- Prove that any tree with at least two vertices has more than one vertex of degree one.
- Prove or disprove that matrix multiplications are commutative.
- Show that every subgroup of an abelian group is normal.
- How many different Boolean functions of degree n are there?
- Determine whether the partial order set $(P(S), \subseteq)$ is a lattice?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- How many ways are there for 10 women and 6 men to stand in a line so that no two men stand next to each other.
- Using mathematical induction prove that $n^3 - n$ is divisible by 3 whenever n is a positive integer.
- Solve the recurrence relation $a_n = a_{n-1} + 2a_{n-2}, a_0 = 2, a_1 = 7$.
- Let R be the relation on the set of real numbers such that aRb if $a - b$ is an integer. Is R an equivalence relation? Justify your answer.
- Prove or disprove that there is no connected Eulerian simple graph that has even number of vertices and odd number of edges.

- f) If G is minimally connected then prove that G is a tree.
- g) In S_3 show that there are four elements satisfying $x^2 = e$ and three elements satisfying $y^3 = e$.
- h) Show that every cyclic group is commutative.
- i) Let $f: G \rightarrow G'$ be a homomorphism. Prove that $\text{Ker } f$ is a normal subgroup of G .
- j) Find the dual of the Boolean expressions: (i) $\bar{x}\bar{y}$ (ii) $xyz + \bar{x}\bar{y}\bar{z}$.
- k) What is lattice? Let $X = \{2, 3, 6, 12, 24, 36\}$ relation such that X divides Y . Draw the hasse diagram.
- l) Find the dual of the Boolean expressions: (i) $\bar{x}\bar{y}$ (ii) $xyz + \bar{x}\bar{y}\bar{z}$.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** a) Solve the following recurrence relation using generating function (16)
 $a_n - 2a_{n-1} - 15a_{n-2} = 0$ for $n \geq 2$ and $a_0 = 0, a_1 = 1$.
- b) Define generalized Pigeon-hole principle. Students are awarded 4 grades A, B, C, and D. How many students must be there in a group so that at least 6 students get the same grade?
- Q4** a) Using Kuratowski's theorem, determine whether the Peterson's graph is planar or not. (16)
- b) How many reflexive relations are there on a set with n elements? Define transitive relations with an example.
- Q5** Define integral domain. Show that every field is an integral domain but converse is not true. When an integral domain becomes a field? Explain the answer in details. (16)
- Q6** Define Boolean algebra. Show that the power set $P(S)$, of a set S is a Boolean algebra under the set operations, where 0 and 1 are respectively the null set and universal set. (16)

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Total Number of Pages : 03

Course: MCA
Sub_Code: MCA01002

1st Semester Regular/Back Examination: 2022-23

SUBJECT : Computer System Architecture

BRANCH(S): MCA

Time : 3 Hour

Max Marks : 100

Q.Code : L598

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions:

(2 x 10)

- a) State and explain Amdahl's law.
- b) The memory access time is 1 nanosecond for a read operation with a hit in cache, 5 nanoseconds for a read operation with a miss in cache, 2 nanoseconds for a write operation with a hit in cache and 10 nanoseconds for a write operation with a miss in cache. Execution of a sequence of instructions involves 100 instruction fetch operations, 60 memory operand read operations and 40 memory operand write operations. The cache hit-ratio is 0.9. Compute the average memory access time (in nanoseconds) in executing the above sequence of instructions.
- c) Write the procedure of optimal page replacement with a suitable example.
- d) Define arithmetic pipelining.
- e) What do you mean by Cache coherence?
- f) The content of the top of a memory stack is 5320. The content of the stack pointer SP is 3560. A two-word call subroutine instruction is in memory at address 1120 followed by the address field of 6720 at location 1121. What is the content of PC, SP, and the top of the stack?
- g) Give an example of data hazard in a pipeline architecture.
- h) A four-stage pipeline has stage delays as 150, 120, 160 and 140 ns respectively. Registers are used between the stages and have a delay of 5 ns each. Assuming constant clocking rate, calculate the total time taken to process 1000 data items on this pipeline.
- i) Distinguish between Superpipelined and Superscalar processor.
- j) Differentiate between Microprogramming and Hardwired control unit

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 × 8)

- a) Design the control unit of a basic computer. A computer has 16 registers an ALU with 32 operations and a Shifter with eight operations all connected to common Bus system.
 - (a) Formulate a control word for a microoperation.
 - (b) Specify the number of bits in each field of control word and give an encoding scheme
- b) A computer uses chips of 1024x1 capacity.
 - (a) How many chips are needed and how should their address lines be connected to provide a memory capacity of 1024 bytes.
 - (b) How many chips are needed to provide a memory capacity of 16 K bytes? Explain in words how the chips are to be connected to address bus.
- c) Consider the following instruction sequence where register R1, R2 and R3 are general purpose and MEMORY[X] denotes the content at the memory location X.

Instruction	Semantics	Instruction Size (bytes)
MOV R1, (5000)	R1 ← MEMORY[5000]	4
MOV R2, (R3)	R2 ← MEMORY[R3]	4
ADD R2, R1	R2 ← R1 + R2	2
MOV (R3), R2	MEMORY[R3] ← R2	4
INC R3	R3 ← R3 + 1	2
DEC R1	R1 ← R1 - 1	2
BNZ 1004	Branch if not zero to the given absolute address	2
HALT	Stop	1

Assume that the content of the memory location 5000 is 10, and the content of the register R3 is 3000. The content of each of the memory locations from 3000 to 3010 is 50. The instruction sequence starts from the memory location 1000. All the numbers are in decimal format. Assume that the memory is byte addressable. Find the content of memory location 3010 after the execution of the program.

- d) Assume a cache miss penalty is 100 clock cycles, and all instructions take 1.0 clock cycles. Let the average miss rate is 2%, there is an average of 1.5 memory references per instructions, and the average number of cache misses per 1000 instructions is 30. What is the impact on the performance and calculate the impact using both misses per instruction and miss rate?
- e) What is virtual memory? How is a logical address mapped to physical address in virtual concept? Explain with example and diagram.

- f) What is a Pipeline Hazard? How is control hazard detected and resolved? Explain with example.
- g) Define demand paging? Explain the various page replacement techniques.
- h) What are the criteria on which memory hierarchy is formed? What information it conveys? Differentiate between main memory and cache memory
- i) What is the basic working principle of VLIW processor? What are the advantages of a VLIW processor?
- j) Compare the features of Array Processor and Vector Processors.
- k) Explain memory consistency issue in shared memory architecture.
- l) Write short notes on cluster computing.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** Define the term pipelining? Distinguish between Instruction pipeline and Arithmetic Pipeline. Explain different types of hazards that occur in instruction pipeline and how to handle them. **(16)**
- Q4** Explain the role of cache in memory hierarchy. Explain direct, associative, and set-associative cache mapping techniques with suitable examples. C A block-set associative cache consists of a total of 64 blocks divided into 4 blocks sets. The main memory contains 4096 bocks, each consisting of 128 words.
 i) How many bits are there in the main memory address?
 ii) How many bits are there in each of the TAG, SET and WORD fields? **(16)**
- Q5** Discuss the basic concepts for increasing Instruction-level Parallelism. A superscalar processor has 5 issue slots which can be filled up in a single clock cycle. During execution of a certain application consisting of 1000 instructions the following are observed:
 10% of the instructions were issued by filling up exactly 1 issue slot only, 20% of the instructions were issued by filling up exactly 2 issue slots only, 20% of the instructions were issued by filling up exactly 3 issue slots only, 48% of the instructions were issued by filling up exactly 4 issue slots only, and the remaining instructions were issued by filling up all the slots. But due to some reason it was found that a total of 500 clock cycles were consumed while issuing all these 1000 instructions. Find out the speedup factor in issuing instructions when there is zero vertical waste as compared to with vertical waste in the above-mentioned scenario. **(16)**
- Q6** Write the taxonomy of parallel architectures with neat diagram. Compare and contrast centralized shared- memory architecture and distributed shared memory architecture. **(16)**

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Total Number of Pages : 02

Course: MCA
Sub_Code: MCA01003

1st Semester Regular/Back Examination: 2022-23

SUBJECT : C and Data Structure

BRANCH(S): MCA (2 Yrs)

Time : 3 Hour

Max Marks : 100

Q.Code : L614

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- Convert $(FEE)_{16}$ to decimal form, followed by octal form.
- What is the ternary operator? Write its syntax and the actual code that it means.
- Define data type. Explain primitive data types supported by C language.
- Given base address 4000, what is the address of element $A[5]$ in an integer array $A[]$? Assume that memory is byte addressable and the size of integer is 4 byte.
- Write any three library functions to read from a file. If `fopen()` functions is not able to open a file, what does it returns?
- Suppose a circular queue of capacity n elements is implemented with an array of n elements. Assume that the insertion and deletion operation are carried out using `REAR` and `FRONT` as array index variables, respectively. Initially, `REAR = FRONT = -1`. Write the conditions to detect queue full and queue empty.
- Explain the meaning of the following declaration.
`int *fun (char *, int *);`
- What is the difference between call by value and call by reference?
- What is the significance of dynamic memory allocation? Differentiate the syntactical difference between `malloc()` and `calloc()`.
- Evaluate the postfix expression `< 7, 6, 3, 4, +, 9, *, +, 4, +, * >`

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- Define constant. List the different types of C constants.
- An electricity board charges the following rates for the use of electricity: for the first 150 units Rs 1 per unit; for the next 100 units Rs 2 per unit; beyond 250 units Rs 3 per unit. All users are charged a minimum of Rs. 75 as meter charge. If the total amount is more than Rs 300, then an additional surcharge of 12.5% of the total amount is charged. Write a program to read the number of units consumed and print out the charges. Use single-line comments to denote the charge ranges.
- Distinguish between entry-controlled loop and exit-controlled loop. Write a program to find the sum of all prime numbers from 1 to n (taking n as user input).
- What is recursion in C functions? Define a recursive function that takes input as number of terms ' n ' and returns the n^{th} Fibonacci term.

- e) Write a program to print the values of $\sin(x)$ in the interval 0 to 180 degrees in steps of 15 degrees. x is in degree. Do not use any library functions. The accuracy of $\sin(x)$ must not be less than 0.00001.
- f) Write the syntax of different branching statements and explain their working with examples. Write a C program to print all the leap years between 1 to 2000.
- g) Write a C program to multiply two matrices of dimension $n*n$ and store the result in another matrix.
- h) Write a program in C to reverse a string by using pointer.
- i) Write a program in C to read a text file named input.txt consisting of meaningful sentences (at least 1000 words). Count total number of words and display the most frequently occurred word along with its count.
- j) How do you push and pop elements in a stack. Show the content of an initially empty stack after performing each of the following operations: push(10), push(20), push(30), pop, push(40), pop, pop, push(30)
- k) Why do we use asymptotic notations in the study of algorithms? Describe commonly used asymptotic notation and give their significance.
- l) What are the queues? Write down algorithm for inserting and deleting elements from a circular queue implemented using arrays.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** Explain the syntax of user defined functions with a suitable example. Explain the different types of functions based on parameters. Write a C function to arrange the elements of an input array in ascending order. **(16)**
- Q4** Discuss the various operators used in C programming with suitable examples. Illustrate the declaration and initialization of one-dimensional and two-dimensional array. Write a C program to calculate the sum of top 3 elements of an input two-dimensional array. **(16)**
- Q5** What is a structure? Explain the components of a structure. Distinguish between structure and union with suitable examples. **(16)**
 Define a structure called cricket that will describe the following information:
 - player name
 - team name
 - batting average
 Using cricket, declare an array player with 50 elements and write a program to read the information about all the 50 players and print a team-wise list containing names of players with their batting average.
- Q6** What is postfix notation? Explain with an example. Write the algorithm for converting from infix to postfix. Show the detailed steps to convert given infix to postfix: **(16)**
 $p + q*r + (s * t + u) * v$

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Total Number of Pages : 03

Course: MCA
Sub_Code: MCA01004

1st Semester Regular/Back Examination: 2022-23

SUBJECT: Operating System

BRANCH(S): MCA (2 Yrs)

Time : 3 Hour

Max Marks : 100

Q.Code : L625

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions : (2 x 10)

- What do you mean by spooling? Give one example.
- Differentiate between hard real time and soft real time operating system.
- What is problem of priority scheduling? Write down its solution.
- Write the difference between light weight process and heavy weight process.
- At a particular time of computation, the value of a counting semaphore is 7, then 20 P-operation and 15 V-operation were completed on the semaphore. What is the resulting value of semaphore?
- What is spinlock? Write down its advantages.
- What is Belady anomaly? Why it occurs?
- Let an instruction takes i ms and page fault takes additional j ms. If the average page fault after k instruction what is the average instruction time.
- If page size is 4KB and logical addresses 22 bits, what is the number of entries in page table?
- Differentiate between direct access and sequential access of file accessing method.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- Define thread. What are similarities and differences between thread and process?
- Differentiated between deadlock and starvation. State four conditions of deadlock.
- Define process. Explain different states of a process with the help of state diagram.
- What is race condition? What are all the conditions that should hold good for its solution?
- Distinguish between multiprogramming and multiprocessing. What is the key motivation for the development of each one?
- Consider a system with main memory access time of 100ns and TLB access time=20ns TLB hit ratio=95%
What is effective memory access time with and without TLB?
- Explain the structure of a disk with neat diagram.
- Write the difference between paging and segmentation.
- How does the system detect thrashing? Once it detects thrashing, what can the system do to eliminate this problem?

- j) Explain contiguous linked and index allocation of disk space with its relative advantages and disadvantages.
- k) Given a memory partition of 200k, 500k, 300k and 600k (in order). How would each of first-fit, best-fit, worst-fit algorithms place processes of 212 k, 417 k, 112 k and 426 k (in order)? Which algorithm makes the most efficient use of memory?
- l) Define virtual memory. What are the implementation techniques of Virtual memory

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** a) What are the major activities of an operating system? What are the main advantages of layered approach to system design? **(8)**
- b) Consider the following set of processes, with the arrival times and CPU burst time given in ms **(8)**

Process	Arrival Time	Burst Time
P1	0	5
P2	1	3
P3	2	3
P4	4	1

What is average turnaround time (average waiting and average response time) for these processes with the Shortest Remaining Processing Time First?

- Q4** a) What is the producer consumer problem? Write down solutions for producer consumer problem? **(8)**
- b) Consider the following snapshot of a system **(8)**

P\R	ALLOCATION					MAX					AVAILABLE			
	A	B	C	D		A	B	C	D		A	B	C	D
P ₀	0	0	1	2		0	0	1	2		1	5	2	0
P ₁	1	0	0	0		1	7	5	0					
P ₂	1	3	5	4		2	3	5	6					
P ₃	0	6	3	2		0	6	5	2					
P ₄	0	0	1	4		0	6	5	6					

Answer the following questions using the Banker's algorithm:

- (i) What is the content of matrix Need?

Is the system in a safe state? If yes, what is the safe sequence? Show the detailed steps as per Banker's Algorithm

Q5 a) Suppose we have a disk with 512 cylinders, and the disk is currently at cylinder 110 (and has previously just processed a request for cylinder 105) and the disk queue contains read/write requests for sectors on cylinders 84, 302, 103, 96, 407 and 113. (Cylinders start at number 1). How far must the read travel to satisfy the requests in the queue using FCFS, SCAN, CSCAN and SSTF? **(8)**

b) A process has been allocated 3 pages frames. Assume that none of pages of the process are available in the memory initially. The process makes the following sequence page reference **(8)**

1	2	1	3	7	4	5	6	3	1
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What is number of page fault occurs in FIFO, LRU and Optimal Page replacement algorithm?

Q6 a) Define RAID. Explain different level of RAID with its relative advantages and Disadvantages. **(8)**

b) Consider a Unix system **(8)**
10 direct block pointer
One single indirect Pointer
One double indirect pointer
Block Size = 8KB
Disk Size = 8KB
Block Pointer Size = 8B
What is the Maximum file size?

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Total Number of Pages : 02

Course: MCA
Sub_Code: MCA01005

1st Semester Regular/Back Examination: 2022-23

SUBJECT : Database Engineering

BRANCH(S): MCA (2 Yrs)

Time : 3 Hour

Max Marks : 100

Q.Code : L644

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions : (2 x 10)

- a) In Relational model what do you mean by cardinality?
- b) Explain the following constraints: Primary Key and Foreign key with an example of each
- c) How can you map a conceptual model to a relational model?
- d) Differentiate between the following: Theta Join, Equi Join, Natural Join and Outer Join.
- e) A primary key if combined with a foreign key creates what?
- f) Differentiate between:
 - a) Procedural and non procedural DML
 - b) Catalog and meta data
- g) What is ACID property?
- h) A primary key if combined with a foreign key creates what?
- i) What is the possible violation if an application program use isolation level "Repeatable Read"
- j) Define the properties of a transaction and who ensures them?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- a) What do you understand by a data model? Explain the difference between conceptual data model and the internal model.
- b) What are the basic operations for a relational language? How are basic operations represented in relational algebra and SQL?
- c) What is the use of DML in DBMS?
- d) Which protocol always ensures recoverable schedule?
- e) Does a relation in a 3rd Normal form satisfy the properties of Lossless decomposition and dependency preservation? Explain with an example
- f) Given R with FD set $F = \{A \rightarrow B, BC \rightarrow D, D \rightarrow BC, DE \rightarrow \emptyset\}$ Find the number of redundant FDs in F.
- g) Given R(ABCDEFGH) with FDs $F = \{A \rightarrow C, B \rightarrow D, E \rightarrow F, G \rightarrow H, C \rightarrow G\}$. How many number of candidate keys are there? Which normal form R is in ?
- h) Why do query optimizers consider only left-deep join trees? Give an example of a query and a plan that would not be considered because of this restriction.
- i) What is normalization? Explain the first and second normal forms using appropriate example.

- j) What is the possible violation if an application program use isolation level "Repeatable Read"
- k) Explain the entity integrity and referential integrity constraints. How they are use full in database Design?
- l) Explain with the help of examples, the concept of insertion anomalies and deletion anomalies

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** a. Describe the various database recovery techniques in brief. **(8x2)**
- b. Consider the relations:
 PROJECT(proj#, proj_name, chief_architect)
 EMPLOYEE(emp#, emp_name)
 ASSIGNED(proj#, emp#)
 Use relational algebra to express the following queries:
 (a) Get details of employees working on project COMP33.
 (b) Get the employee number of employees who work on all projects.
 (c) Get details of project on which employee with name 'RAM' is working.
- Q4** a. Explain various locking technique for concurrency control. **(8x2)**
- b. How multiversion timestamp ordering and multiversion two-phase concurrency control schemes execute concurrent transactions in controlled manner?
- Q5** a. Discuss the correspondence between the E-R model construct and the relational model construct. Show how each E-R model construct can be mapped to the relational model using suitable examples? **(8x2)**
- b. Define a view in SQL. Construct a view for the above relations which has the the S#, SNAME, P#, PNAME renamed as SNO, NAME, PNO, PNAME.
- Q6** a. Suppose that we decompose the schema R = (A, B, C, D, E) into R1 = (A, B, C) and R2 = (A, D, E). Show that this decomposition is lossless-join and not dependency-preserving if the following set of functional dependencies F holds: **(8x2)**
- A → BC
 CD → E
 B → D
 E → A
- b. Consider the following relations:
 S (S#, SNAME, STATUS, CITY)
 SP (S#, P#, QTY)
 P (P#, PNAME, COLOR, WEIGHT, CITY)
 Give an expression in SQL for each of queries below:
 (a) Get supplier names for supplier who supply at least one red part
 (b) Get supplier names for supplier who do not supply part P2.