

- b) Draw a parallel diagram of workflows and programs. $4+10=14$
5. a) How do we reduce the response time and capture new state?
- b) How you can tell that the zookeeper service supports the finite state machine model? $5+9=14$
6. a) Write the sequence of Map Reduce function at the time of program invokers.
- b) What are the striking similarity between the life cycle of a workflow and that of a traditional computer program? $8+6=14$
7. a) What do you understand about co-channel Interference? Describe briefly about the working principle of co-channel Interference.
- b) Why is cell sectoring needed? How many types of Cell Sectoring? What are the advantages of Cell Sectoring? $(3+4)+3+2+2=14$
8. a) Describe briefly about Frequency Reuse.
- b) What is Cell Splitting? Why is Cell Splitting needed? What is the advantage of Cell splitting? $7+(2+3+2)=14$

2017

Computer Science & Engineering

Paper : Data Structure (MCA-201)

Full Marks : 70

Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answer whenever necessary.

Answer any five questions.

1. a) Write an algorithm or a function to convert an infix expression into postfix expression.

b) Let P_1 and P_2 be two polynomials of degree m and n respectively. Design an algorithm or a function to multiply P_1 and P_2 , where P_1 and P_2 are in memory. 6+8=14

2. a) Write an algorithm or a function to delete a node after a node pointed by pointer variable p into a singly linked list in memory.

b) Implement the basic operations of stack using linked list.

[Turn over]

c) Two linked lists L_1 and L_2 are in memory, write an algorithm or a function to concatenate L_1 and L_2 . $5+5+4=14$

3. a) Consider a data set S of size n where the number of distinct data in S is m such that n is very large compared to m . Write an algorithm or a function to create a linear linked list L to store S such that L has exactly m nodes.

b) A doubly linked list is in memory; write an algorithm or a function to insert a node in the right of a node whose address is p .

c) Explain briefly the advantages of circular list over linear list. $6+6+2=14$

4. a) What are the different ways of representing a binary tree? State the merits of linear representation of a binary tree.

b) For a non-empty strictly binary tree having n leaf nodes, prove that the total number of nodes is $(2n - 1)$.

c) Draw an almost complete binary tree which is not a strictly binary tree.

d) Calculate the total number of non-leaf nodes in a complete binary tree of height h .

- c) What is the maximum height in a binary tree containing n nodes? $(2+2)+4+2+3+1=14$
5. a) Write an algorithm or a function to insert an element into a binary search tree in memory.
- b) Write recursive algorithms or functions to find the maximum element and minimum element in a binary search tree.
- c) Given a node p in a binary search tree, find the successor of node p determined by inorder tree walk.
- d) Suppose numbers between 1 and 1000 are present in a binary search tree and we want to find 363. The following sequences of nodes are examined. Check whether the sequences are correct or not.
- 2, 399, 387, 219, 266, 382, 381, 278,
363
 - 924, 220, 911, 244, 898, 258, 362, 363
- $$5+3+4+2=14$$

6. a) Convert the following array to a Max-heap:

$$A = \{16, 4, 7, 1, 12, 19\}.$$

Now sort A using Heap sort algorithm.

- b) Explain the working principle of Binary Search. Compute the time complexity of binary search algorithm. $(4+4)+(3+3)=14$
7. a) How does a merge sort algorithm work? Write merge sort algorithm to sort a data set of size n .
- b) Write the working principle of selection sort algorithm. $(3+7)+4=14$
8. Write short notes on (any four): $3.5 \times 4 = 14$
- a) Polynomial representation
 - b) Growth functions
 - c) Priority queue
 - d) Tree traversal
 - e) Strictly binary tree versus almost complete binary tree
 - f) Representation of graph
-

2017

Computer Science & Engineering

Paper : Numerical and Statistical Computing (MCA-202)

Full Marks : 70 **Time : 3 Hours**

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answer whenever necessary.

Answer any five questions.

1. a) Consider the problem of dividing a polynomial $a_n x^n + \dots + a_1 x + a_0$ by $(x-r)$ where r is a root of the original polynomial. If we call the reduced polynomial by $b_{n-1} x^{n-1} + \dots + b_1 x + b_0$ after dividing by $(x-r)$ then design an algorithm to compute the reduced polynomial.

b) Which are basic questions relevant to all iterative methods for computing a root of an equation?

c) Use Newton-Raphson technique to calculate

$$7+2+5=14$$

[Turn over]

2. a) How the computational labour is reduced in Birge-Vieta method to find a root of a polynomial equation?
- b) Use any iterative method to find a root of the equation $x^4 - 4x^3 + 3x^2 + 8x - 10 = 0$. The computed root must be correct upto three significant digits. $8+6=14$
3. a) How pivotal condensation is used in Gauss Elimination method to solve a system of linear equations?
- b) Use Gauss Elimination method to solve the following system of linear equations:
- $$x_1 + x_2 + x_3 = 3$$
- $$2x_1 + 3x_2 + x_3 = 6$$
- $$x_1 - x_2 - x_3 = -3 \quad 6+8=14$$

4. a) If $f(x)$ happens to be a polynomial of degree m then prove that the m -th difference would

c) Given the following table:

x	1	2	3	4	5
$f(x)$	6	5	-2	3	6

Find $f(x)$ at $x = 1.3$.

$$3+6+5=14$$

5. a) Explain Simpson's method for numerical integration and write the algorithm corresponding to this method.
- b) A rocket is launched from the ground. Its acceleration measured every 5 seconds is tabulated below. Find the velocity of the rocket at $t = 20$. Use Trapezoidal as well as Simpson's rules. Compare the answers.

t	0	5	10	15	20
$a(t)$	40.0	45.25	48.50	51.25	54.35

$$(5+3)+(3+3)=14$$

6. a) Use least squares method to fit a quadratic curve through n points. Extend least squares method to fit k -th order polynomial.
- b) Find the solution of the differential equation $dy/dx + xy = 0$, $y(0) = 1$ from $x = 0.0$ to 0.25 with step-value $h = 0.05$. $(5+4)+5=14$

- 7.
- a) Relative and Absolute error
 - b) Trapezoidal rule
 - c) Lagrange interpolation
 - d) Linear regression
 - e) Numerical differentiation
 - f) Euler's method
-

2017

Computer Science & Engineering**Paper: Computer Organization & Architecture (MCA-203)**

Full Marks : 70

Time : 3 Hours

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in
their own words as far as practicable.**Illustrate the answer whenever necessary.***Answer Q. No. 1 and any four from the rest.**

1. Answer any five questions: 5×2

- a) Distinguish between computer organization and computer architecture.
- b) Which binary representation scheme is most efficient to perform arithmetic operations on the numbers and why?
- c) What is the use of instruction register?
- d) Why is address bus always unidirectional?
- e) How many bits are necessary to address 4 MB byte addressable memory?

- f) How many times does the CPU access the memory for executing the instruction $ADD R, M$? Here R and M denote a register and a memory location respectively, and the result is stored in M .
- g) What is busy waiting in program controlled I/O?
2. a) Represent, the decimal number -24 in signed 2's complement representation in 8 bits.
- b) A computer system uses 32 bit address and word size is 16 bits. If the memory is word-addressable, what is the maximum size of the memory?
- c) Distinguish between big-endian and little-endian memories.
- d) Write the purpose of each of the following registers:
- Program Counter
 - Memory Data Register
 - Status Register
 - Stack Pointer
- $2+3+2+(4\times 2)$
3. a) What is implicit addressing mode? Give an example.

- b) Write instruction sequences to compute

$$Z = \frac{A \times B - C}{A + C} \quad \text{in one-address and three-}$$

address instructions only. Each symbol represents a memory location.

- c) What is the use of link register? Why is it not suitable for nested subroutine calls? Explain how nested subroutine calls are implemented.

$$(1+1)+(3+3)+(2+1+4)$$

4. a) Write the sequence of control steps required showing the active control signals in each step to perform the following tasks in a single-bus CPU organization:

- i) Transfer the content of memory location pointed by register R_2 into register R_1 .
 - ii) Multiply the contents of registers R_1 and R_2 and send the result to a memory location pointed by R_3 .
 - iii) Add the content of register R_1 with the address of the next instruction and store the result in register R_2 .

- b) Compare and contrast between the followings:
- i) Horizontal Microprogramming and vertical microprogramming.
 - ii) Hard-wired control unit and microprogrammed control unit.
- (3×3)+(2×3)
5. a) Show that direct cache mapping and associative cache mapping are special cases of set-associative cache mapping.
- b) A two-way set associative cache has lines of 16 bytes each and a total cache size of 8 KB. The 256 MB main memory is byte addressable. Calculate the number of bits in each of the TAG, SET and WORD fields of the main memory address formats.
- c) Distinguish between *write back* and *write through* caches.
- d) Show that average memory access time (AMAT) for a memory system with single cache is given by:

$$AMAT = h + mr \times mp.$$

where h , mr and mp denote cache hit time, cache miss ratio and average miss penalty, respectively.

2+6+3+4

- 6.
- a) Compare among different types of ROMs.
 - b) Consider the following block reference string:
1 2 3 4 1 2 5 1 2 3 4 5. If the cache contains 4 lines organized in associative manner, what will be the lower bound of number of faults (cache misses)? Explain. How many misses will be there if LRU block replacement algorithm is used?
 - c) Explain why interleaved memory performs better than non-interleaved memory.
- 4+(3+4)+4
- 7.
- a) What do you understand by memory-mapped I/O?
 - b) What is program controlled I/O? Explain this using an example with respect to data transfer between a processor and a display device.
 - c) Discuss the daisy chain arrangement for determining the source of interrupt with suitable diagram.
 - d) Explain the concept of cycle stealing DMA.

8. Write short notes on the following (any three):

5x3

- a) Instruction Execution Cycle
 - b) Organization of multiple-bus CPU
 - c) Microprogrammed control unit
 - d) Types of interrupts
-

4(MCA)

MCA/Part-I/2nd Sem./MCA-204/17

2017

Computer Science & Engineering

Paper : Microprocessor (MCA-204)

Full Marks : 70

Time : 3 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in
their own words as far as practicable.

Answer Q. No. 1 and any five from the rest.

1. Answer any ten: $2 \times 10 = 20$

- a) Why the power consumption of a microprocessor is low?
- b) What is the function of READY pin of 8085 microprocessor?
- c) How many handshaking signals are needed if

- c) What is the function of ADSTB signal of 8257?
- f) What is End-of-Interrupt? In how many forms it can be issued?
- g) To execute an instruction, what are the maximum numbers of machine cycle needed in 8085? Give an example of an instruction that needed six T-states in first machine cycle.
- h) What is the function of instruction decoder?
- i) Define T-State.
- j) What do you mean by "PSW"? What will be the content of flag register after the execution of instruction XRA A?
- k) In 8085 microprocessor, what happens when a HLT or a RST instruction is executed?
- l) How many "Restart" instructions are available in 8085? What are they?
2. a) Which program parameters are affected by the number and types of registers of MPU? Describe with example.
- b) Why limited number of GRPs can be used in MPU?

6+4

3. Explain the following instructions of 8085:

$$2.5 \times 4 = 10$$

i) PUSH PSW

ii) RRC

iii) CMP M

iv) RET

4. a) Why DMA mode of data transfer technique is necessary?

b) What are the extra features needed to the microprocessor for DMA mode of data transfer technique?

c) Draw the flow chart of block DMA mode data transfer technique.

$$2+3+5$$

5. a) Write the different steps of a fetch cycle.

b) Distinguish between the following instructions:

i) LDA 2000H & LDAX B

ii) JMP 4000H & CALL 4000H

$$5+5$$

6. Write a 8085 assembly language program to find out the number of zero elements from a block of data where the length of the data is in memory

onwards. State the number of zero elements at memory location 5000H. 10

7. a) Describe how 8255 A can be used as output port in mode 1.
- b) What are the necessities of 2nd and 3rd INTA signals in 8259 Programmable Interrupt Controller?
- c) What is an I/O port? 5+3+2
8. Write short notes on (any two): 5×2=10
- i) Mode 4 of 8253.
 - ii) ICW's of 8259
 - iii) Timing and Control section of 8085.
 - iv) Addressing mode
-

2017

Computer Science & Engineering**Paper : Mathematical Foundation-II (MCA-205)**

Full Marks : 70

Time : 3 Hours

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.***Answer Q. No. 1 and any four from the rest.**1. Answer any **seven**: $2 \times 7 = 14$

- i) A discrete random variable X has the following probability mass function:

Values of $X : x$	0	1	2	3	4	5	6	7	8
$P(x)$	k	$3k$	$5k$	$7k$	$9k$	$11k$	$13k$	$15k$	$17k$

Find the value of k .

- ii) Find the probability that exactly one of the events A and B happens.
- iii) The probability that a teacher will give a surprise test during any class meeting is $\frac{1}{5}$. If

[Turn over]

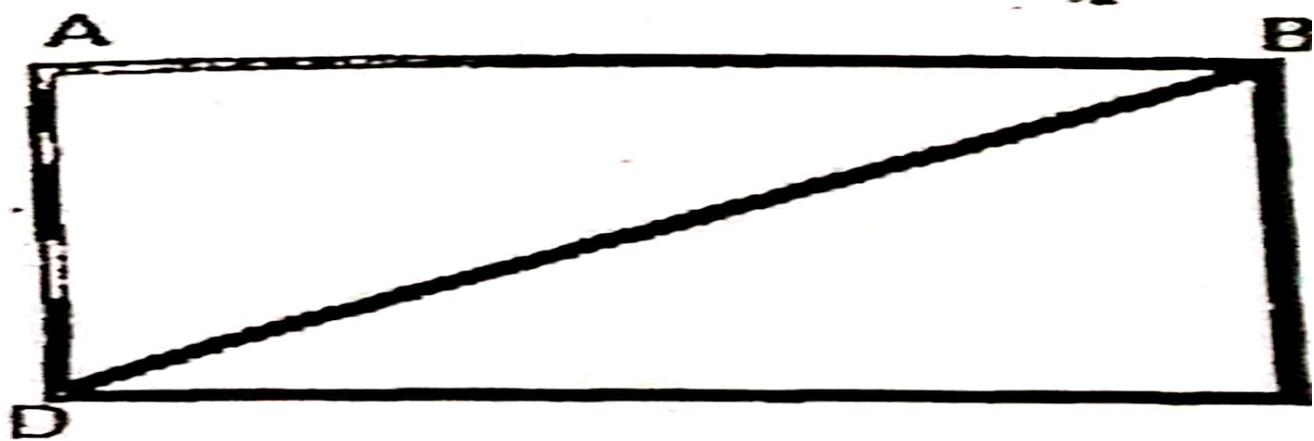
a student is absent on two days, what is the probability that he will miss at least one test?

- iv) Define probability mass function of Poisson Distribution and probability density function of Normal Distribution.
- v) Draw the graph whose vertex connectivity, edge connectivity and degree of each vertex are 3, 4 and 5 respectively.
- vi) If X is a Poisson variate with parameter μ and $P(X = 0) = P(X = 1)$, find μ .
- vii) A regular graph G determines 10 regions, degree of each vertex being 4. Find the number of vertices of G .
- viii) Find an explicit formula for the sequence defined by the recurrence relation $a_n = a_{n-1} + 3$, $n \geq 1$, $a_1 = 2$.
- ix) Define chromatic number of a graph with example.
- x) Show that the function $f(x)$ is given by

$$f(x) = \begin{cases} |x| & , -1 < x < 1 \\ 0 & , \text{ elsewhere.} \end{cases}$$

Is a possible probability density function.

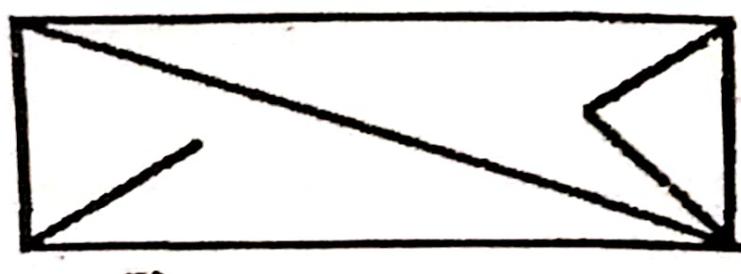
- 2.
- i) The determinant of the incidence matrix of a graph is 0, prove this. 6
 - ii) Prove that, the sum of degrees of odd vertices is an even number.
 - iii) Examine whether the graphs given below are isomorphic or not:



- 3.
- i) State and prove Bayes' theorem.
 - ii) If A and B are two events such that $P(A) \neq 0$, prove that A and \bar{B} are independent.
 - iii) There are two identical boxes. One box contains 4 white, 3 black and 2 red balls. The other box contains 3 white, 4 black and 3 red balls. A box is chosen at random and a ball is drawn from it. The ball drawn is white. Find the probability that the ball was drawn from the first box.

If the ball drawn is found to be white, calculate the probability that it is drawn from the first box? 5

4. i) Define dual of a graph . Find the dual of the following graph. 2+3

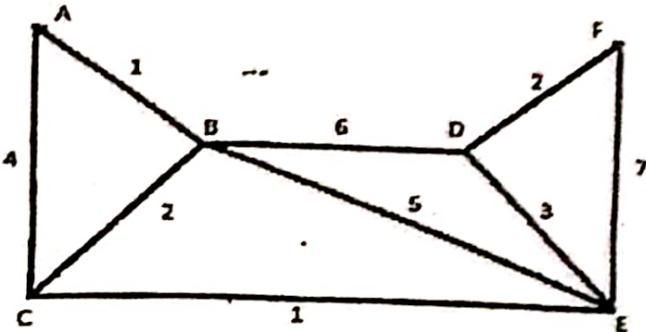


- ii) Draw the graph whose incidence matrix is

$$\begin{bmatrix} 0 & 0 & -1 & -1 & 0 & -1 \\ -1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & -1 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

3

- iii) Applying "Dijkstra's procedure", find the shortest path and the length of the shortest path from A to F in the following graph: 6



5. i) Solve by characteristic root method, the recurrence relation

$$H_n = 4H_{n-1} - 4H_{n-2}, \text{ given } H_0 = 1 \text{ and } H_1 = 1.$$

Hence find H_{10} 5

- ii) Using generating function solve the recurrence relation

$$a_n = 7a_{n-1} - 10a_{n-2}; \forall n > 1 \text{ and } a_0 = 3 \text{ and }$$

$$a_1 = 3. \quad \quad \quad 6$$

- iii) Find the explicit formula for the sequence

$$\{S: 0, 1, 3, 6, 10, 15, \dots\} \quad \quad \quad 3$$

6. i) Determine the value of k such that $f(x)$ defined by

$$f(x) = kx(1-x), \quad 0 < x < 1$$

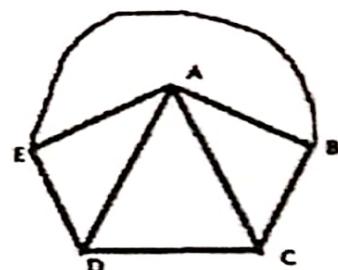
$= 0, \quad \quad \quad \text{elsewhere}$ is a probability density function. Find the Corresponding distribution function. 5

ii) If the probability density function $f(x)$ of a random variable X is defined by

$f(x) = \frac{1}{2}e^{-|x|}$, $-\infty < x < \infty$. Find mean and variance. 4

iii) Find the mean and variance of Binomial distribution. 5

7. i) Find the chromatic polynomial of the following graph and then find its chromatic number: 5



ii) Prove that the chromatic number of a non-null graph is two if and only if the graph is bipartite. 6

iii) If $G(p, q)$ be a planar graph in which every face is an n -cycle, then prove that

$$q = \frac{n(p-2)}{(n-2)}.$$

3

8. i) Prepare a frequency distribution table with class intervals 60-79, 80-99, 100-119 and so on, (tally marks must be shown) from the following data:

96	130	63	115	145	99	118	104	126	72
77	87	151	81	142	122	110	131	98	96

Also draw the frequency polygon and histogram for the given distribution on plane paper.

6

- ii) Draw a Ogive (less than type) for the following data given below:

5

x:	1	2	3	4	5	6	7
f(frequency):	5	9	12	17	14	10	6

- iii) For any two events A and B then prove that

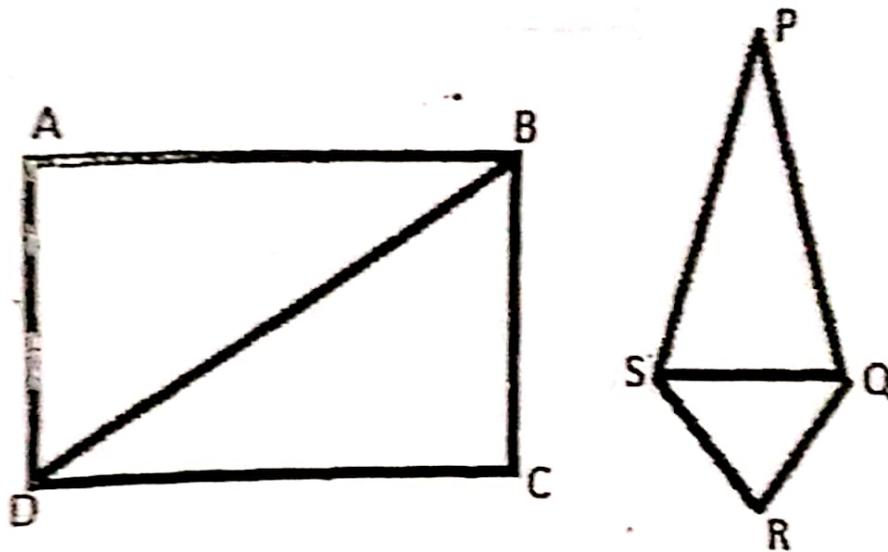
$$P(A \cup B) = P(A) + P(B) - P(AB). \quad 3$$

- If a student is absent on two days, what is the probability that he will miss at least one test?
- iv) Define probability mass function of Poisson Distribution and probability density function of Normal Distribution.
 - v) Draw the graph whose vertex connectivity, edge connectivity and degree of each vertex are 3, 4 and 5 respectively.
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 - x) Show that the function $f(x)$ is given by

$$f(x) = \begin{cases} |x| & , -1 < x < 1 \\ 0 & , \text{ elsewhere.} \end{cases}$$

Is a possible probability density function.

- Q. i) The determinant of every square sub-matrix of the incidence matrix A of a digraph is 1, -1 or 0, prove this. 6
- ii) Prove that, the sum of number of the degrees of odd vertices is an even number. 3
- iii) Examine whether the following graphs are isomorphic or not: 5



- Q. i) State and prove Bayes' Theorem. 6
- ii) If A and B are two independent events , then prove that A and \bar{B} are also independent. 3
- iii) There are two identical boxes, the first box contains 4 white, 3 red balls and the second box contains 3 white, 7 red balls. One box is chosen at random and a ball is drawn from it.

(SMCA)

[3]

[Turn over]