

# CBCS SCHEME

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21MATCS41

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024

## Mathematical Foundations for Computing, Probability & Statistics

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.  
2. Use of Data tables are permitted.

### Module-1

- 1 a. Define Tautology. Verify that  $[P \rightarrow (Q \rightarrow r)] \rightarrow [(P \rightarrow Q) \rightarrow (P \rightarrow r)]$  is a tautology. (06 Marks)
- b. Using the laws of logic, prove the following logical equivalence:  
 $[(\neg P \vee Q) \wedge \{P \vee (P \wedge Q)\}] \Leftrightarrow P \wedge Q$  (07 Marks)
- c. Write down the following proposition in symbolic form and find the negation,  
“For all integers n, if ‘n’ is not divisible by 2 then ‘n’ is odd”. (07 Marks)

### OR

- 2 a. Given that P, Q, R are propositions having truth values 0, 0, 1 respectively. Find the truth value of the following propositions :  
(i)  $P \rightarrow (Q \wedge r)$ .  
(ii)  $(P \vee Q) \vee r$   
(iii)  $(P \wedge Q) \rightarrow r$  (06 Marks)
- b. Write the following argument in symbolic form and then establish the validity :  
If A gets the supervisor’s position and works hard, then he will get a raise.  
If he gets a raise, then he will buy a car.  
He has not purchased a car.  
Therefore he did not get the supervisor’s position or he did not work hard. (07 Marks)
- c. Write (i) A direct proof and (ii) An indirect proof  
“If n is an odd integer, then (n+9) is an even integer”. (07 Marks)

### Module-2

- 3 a. If  $A = \{a_1, a_2, a_3, a_4\}$  and  $B = \{b_1, b_2, b_3\}$ . Find the following :  
(i) Number of function from A to B as well as B to A.  
(ii) Number of onto functions and one-one function from A to B. (06 Marks)
- b. Let  $A = \{1, 2, 3, 4, 6\}$  and R be a relation on A defined by  $aRb$  if and only if ‘a’ is a multiple of b. Represent R as a set of ordered pairs. Draw the digraph and matrix representation of R. (07 Marks)
- c. Prove the following for the graph  $G = (V, E)$  :  
(i)  $\sum_{v \in V} \deg(v) = 2|E|$ .  
(ii) The number of vertices of odd degree must be even. (07 Marks)

OR

4 a. Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be defined by,

$$f(x) = \begin{cases} 3x - 5 & \text{if } x > 0 \\ -3x + 1 & \text{if } x \leq 0 \end{cases}$$

Find  $f(1)$ ,  $f\left(-\frac{5}{3}\right)$ ,  $f^{-1}(3)$ ,  $f^{-1}([-5, 5])$ .

(06 Marks)

b. Let  $A = \{1, 2, 3, 4\}$ , let  $R$  be a relation on  $A$  defined by  $xRy$  iff  $x/y$  and  $y = 2x$ . Write down the following :

- (i)  $R$  as a relation of set of ordered pairs.
- (ii) Digraph of  $R$ .
- (iii) Indegree and Outdegree of the vertices in the graph.

(07 Marks)

c. Define Graph isomorphism. Determine whether the following graphs are isomorphic or not.

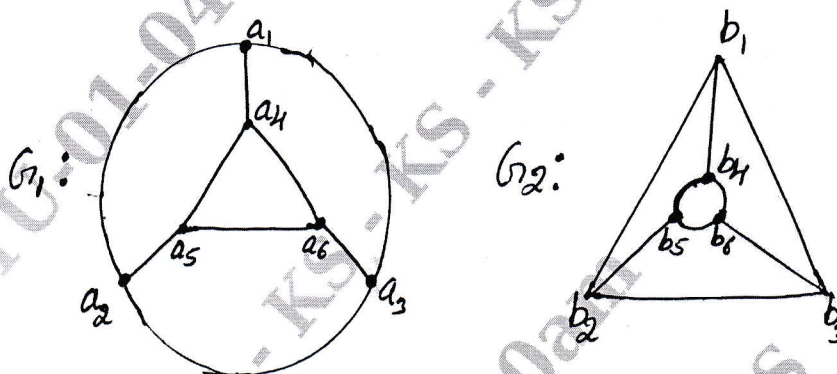


Fig. Q4 (c)

(07 Marks)

**Module-3**

5 a. The following are the marks of 8 students in statistics and mathematics.

Marks in statistics	25	43	27	35	54	61	37	45
Marks in Mathematics	35	47	20	37	63	54	28	40

Calculate the rank correlation coefficient.

(06 Marks)

b. Fit a best fitting curve in the form  $y = ax^b$  for the following data :

x	350	400	500	600
y	61	26	7	26

(07 Marks)

c. Fit a second degree parabola,  $y = ax^2 + bx + c$  in the least square method. For the following data and hence estimate  $y$  at  $x = 6$ .

x	1	2	3	4	5
y	10	12	13	16	19

(07 Marks)

OR

6 a. Fit a straight line in the form  $y = ax + b$  by the least square sense for the following data :

x	5	10	15	20	25
y	16	19	23	26	30

(06 Marks)

b. Fit a best fitting parabola  $y = ax^2 + bx + c$  for the following data:

x	1	2	3	4	5	6	7	8	9
y	2	6	7	8	10	11	11	10	9

(07 Marks)

- c. The following table gives the heights of fathers (x) and sons (y) ;

x	65	66	67	67	68	69	70	72
y	67	68	65	68	72	72	69	71

Calculate the coefficient of correlation and lines of regression.

(07 Marks)

**Module-4**

- 7 a. A random variable X has the following probability function :

x	0	1	2	3	4	5	6
P(x)	K	3K	5K	7K	9K	11K	13K

Find K, and evaluate ;  $P(x \geq 5)$  and  $P(3 < x \leq 6)$ .

(06 Marks)

- b. Find the mean and standard deviation of Poisson distribution. (07 Marks)
- c. In a test on electric bulbs, it was found that the life of a particular brand was distributed normally with an average life of 2000 hours and S.D of 60 hours, if a firm purchase 2500 bulbs find the number of bulbs that are likely to last for,
- More than 2100 hours.
  - Less than 1950 hours.
  - Between 1900 to 2100 hours.

(07 Marks)

**OR**

- 8 a. Find the value of K such that the following distribution represents a finite probability distribution. Hence find its mean and standard deviation.

x	-3	-2	-1	0	1	2	3
P(x)	K	2K	3K	4K	3K	2K	K

(06 Marks)

- b. Find the mean and standard deviation of binomial distribution. (07 Marks)
- c. If the probability of a bad reaction from a certain injection is 0.001 determine the chance that out of 2000 individuals more than two will get a bad rejection. (07 Marks)

**Module-5**

- 9 a. Determine (i) Marginal distribution (ii) Covariance between the discrete random variable X and Y of the joint probability distribution :

	Y	3	4	5
X				
2		$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$
5		$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$
7		$\frac{1}{12}$	$\frac{1}{12}$	$\frac{1}{12}$

(06 Marks)

- b. A machinist is making engine parts with axle diameter of 0.7 inch. A random sample of 10 parts shows mean diameter 0.742 inch with a S.D of 0.04 inch. On the basis of this sample would you say that the work is inferior? (07 Marks)
- c. A die is thrown 264 times and the number appearing on the fact (x) follows the following frequency distribution ;

x	1	2	3	4	5	6
f	40	32	28	58	54	60

Calculate the value of  $X^2$ .

(07 Marks)

OR

- 10 a. Explain the terms : (i) Null hypothesis (ii) Confidence intervals  
(iii) Type I and Type II errors. (06 Marks)

- b. Four coins are tossed 100 times and the following results were obtained :

No. of heads	0	1	2	3	4
Frequency	5	29	36	25	5

Fit a binomial distribution for the data and test the goodness of fit ( $\chi_{0.05}^2 = 9.49$  for 4 d.f)

(07 Marks)

- c. The nine items of a sample have the following values : 45, 47, 50, 52, 48, 47, 49, 49, 53, 51.  
Does the mean of these differ significantly from the assumed mean of 47.5? (07 Marks)

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21CS42

## Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Design and Analysis of Algorithms

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- Design an algorithm to search an element in an array using sequential search. Discuss its efficiency in best, worst and average cases. (08 Marks)
  - Give the general plan for analyzing any non recursive algorithm. Write an algorithm to check whether array elements are distinct. Discuss its efficiency. (08 Marks)
  - Define Big Oh (O) and Big Omega ( $\Omega$ ) notations. (04 Marks)

OR

- Discuss the various steps in algorithm design and analysis process with the flow diagram. What are the criteria satisfied by any algorithm. (08 Marks)
  - Give the general plan for analyzing any recursive algorithm. Write and solve the recurrence relation to find the solution for Tower's of Hanoi problem. (08 Marks)
  - Write an algorithm to sort 'n' number using selection sort method. (04 Marks)

### Module-2

- Design an algorithm to sort 'n' numbers using Quick sort. Apply the algorithm for the data 35, 20, 15, 45, 10, 60, 15, 70. Each time, show the splitting position. (08 Marks)
  - Discuss the general Divide and Conquer method along with control abstraction. Write the recurrence relation for divide and conquer. (06 Marks)
  - Write an algorithm sort the numbers using insertion sort. Discuss its efficiency. (06 Marks)

OR

- Obtain the Topological sequence for the following graph using i) Source removal method ii) DFS based algorithm. [Refer Fig.Q4(a)]

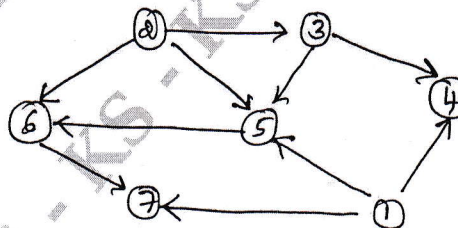


Fig.Q4(a)

- Design an algorithm to sort numbers using merge sort. Write the complexity of merge sort. (07 Marks)
  - Write recursive algorithm to find maximum and minimum element in an array. Construct tree of recursive call for the data, 22, 13, -5, -8, 15, 60, 17, 31, 47 (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

**Module-3**

- 5 a. Write an algorithm to solve Greedy knapsack problem. Find an optimal solution to the knapsack instance  $n = 7, m = 15, (P_1, P_2, \dots, P_7) = (10, 5, 15, 7, 6, 18, 3)$  and  $(w_1, w_2, \dots, w_7) = (2, 3, 5, 7, 1, 4, 1)$  using Greedy method. (10 Marks)
- b. Design Prim's algorithm to find the minimum cost spanning tree. Apply Prim's algorithm to construct heap using Bottom-up approach. Apply both bottom-up and Top down method to construct the max heap for the data 12, 23, 45, 28, 55, 15, 67, 33. (10 Marks)

OR

- 6 a. Design Prim's Algorithm to find the minimum cost spanning tree. Apply Prim's algorithm for the following graph in Fig.Q6(a).

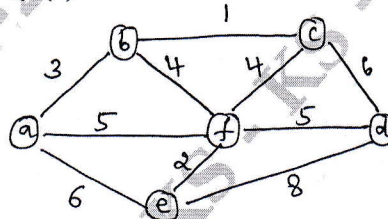


Fig.Q6(a)

- b. Write Huffman's algorithm. Construct Huffman tree and find the code for each character.

Characters :	A	B	C	D	E
Probability :	0.4	0.1	0.2	0.15	0.15

(10 Marks)

**Module-4**

- 7 a. Write Floyd's Algorithm to solve all pairs shortest path problem. Apply Floyd's algorithm for the following graph in Fig.Q7(a).

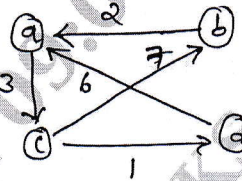


Fig.Q7(a)

- b. Write the pseudocode for comparison counting sort. Discuss its efficiency. (06 Marks)
- c. Write Bellman and Ford Algorithm to compute the shortest path. (04 Marks)

OR

- 8 a. Discuss general dynamic programming approach. Find the optimal tour for the salesperson if he starts from city 1, using dynamic programming. Graph and the distance matrix are given. [Refer Fig.Q8(a)]

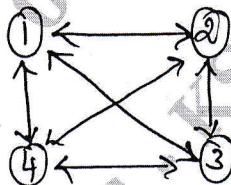


Fig.Q8(a)

	1	2	3	4
1	0	10	15	20
2	5	0	9	10
3	6	13	0	12
4	8	8	9	0

- b. Write pseudocode for Horspool's string matching algorithm. (06 Marks)
- c. Write Warshall's algorithm to compute Transitive closure. (04 Marks)

**Module-5**

- 9 a. Discuss general Backtracking technique. Construct state space tree to solve Four Queens problem. (08 Marks)
- b. Discuss the following :
- Graph coloring problem and its solution using Backtracking.
  - Branch and Bound technique to solve knapsack problem. (12 Marks)

**OR**

- 10 a. Discuss general branch and bound technique. Construct state space tree to solve the following assignment problem with 4 jobs and 4 persons. Assignment cost is given.

$$C = \begin{matrix} & \begin{matrix} 1 & 2 & 3 & 4 \end{matrix} \\ \begin{matrix} a \\ b \\ c \\ d \end{matrix} & \begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix} \end{matrix}$$

(08 Marks)

- b. Discuss the following :
- Sum of subset problem and solution using backtracking.
  - P, NP and NP complete problem. (12 Marks)

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21CS43

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024

## Microcontroller and Embedded Systems

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

### Module-1

- 1 a. Explain with neat diagram, about ARM core data flow model. (10 Marks)  
b. Define RISC architecture. Compare with CISC processors. (10 Marks)

OR

- 2 a. Define pipelining? Explain how it helps the program execution. (10 Marks)  
b. Explain the major design rules related to RISC philosophy implementation. (10 Marks)

### Module-2

- 3 a. Write a program to find sum of first 20 integer numbers. (10 Marks)  
b. Explain about load store instructions in ARM with example. (10 Marks)

OR

- 4 a. Write a program to find the factorial of a number. (10 Marks)  
b. Write a program to find largest and smallest number in an array of 16 numbers. (10 Marks)

### Module-3

- 5 a. Write a program to arrange a series of 32 bit numbers in ascending/descending order. (10 Marks)  
b. What are the different types of memories used in Embedded system design? (10 Marks)

OR

- 6 a. Write a program to count the number of ones and zeros in two consecutive memory locations. (10 Marks)  
b. Write a program to display 'Microcontroller' message using Internal UART. (10 Marks)

### Module-4

- 7 a. Explain classification of embedded systems. (10 Marks)  
b. Write a program and explain about interface of DC motor. (10 Marks)

OR

- 8 a. Explain the characteristics of embedded systems. (10 Marks)  
b. Write a program to demonstrate the use of external interrupt to toggle an LED on/off. (10 Marks)

### Module-5

- 9 a. With neat diagram, explain operating system architecture. (10 Marks)  
b. Explain steps involved in selecting RTOS. (10 Marks)

OR

- 10 a. Explain the concept of dead lock with example. (10 Marks)  
b. Explain types of operating systems with example. (10 Marks)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
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21CS44

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024

## Operating System

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

### Module-1

- Define Operating System. Explain the role of operating system with respect to user view and system view. (06 Marks)
  - With a neat diagram, explain dual mode operation. (06 Marks)
  - Briefly explain the services provided by the operating system that are helpful to the user. (08 Marks)

OR

- Define process. Explain the different characteristics of scheduling criteria. (06 Marks)
  - Differentiate between long term and short term schedulers. (04 Marks)
  - Define IPC. Explain shared memory and message passing mechanisms. (10 Marks)

### Module-2

- With a neat figure, discuss various multi-threaded models. (06 Marks)
  - List out different threading issues. Explain any two. (06 Marks)
  - Consider the following set of processes.
    - Draw the Gantt chart showing the execution of these processes using non-preemptive SJF and SRTF scheduling algorithms.
    - Compute turn around time and waiting time.
    - Compute the average turn around time and average waiting time.

Process	Arrival time	Burst time
P <sub>1</sub>	0	8
P <sub>2</sub>	1	4
P <sub>3</sub>	2	9
P <sub>4</sub>	3	5

(08 Marks)

OR

- What are the three requirements to be met by a solution to the critical section problem? Explain. (06 Marks)
  - Briefly discuss monitor solution to the dining philosopher problem. (08 Marks)
  - Write a short note on semaphores. (06 Marks)

### Module-3

- Define deadlock. Explain the necessary conditions to arise deadlock. (06 Marks)
  - Consider the following snapshot of a system.

	Allocation			Maximum			Available		
	A	B	C	A	B	C	A	B	C
P <sub>0</sub>	0	1	0	7	5	3	3	3	2
P <sub>1</sub>	2	0	0	3	2	2			
P <sub>2</sub>	3	0	2	9	0	2			
P <sub>3</sub>	2	1	1	2	2	2			
P <sub>4</sub>	0	0	2	4	3	3			

Answer the following question using Bankers Algorithm.

- Is the system in a safe state?
- If a request from P<sub>1</sub> arrives (1, 0, 2) can the request be granted immediately. (10 Marks)
- "A safe state is not deadlock state but a deadlock state is an unsafe state". Explain. (04 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
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OR

- 6 a. With a neat diagram, explain paging hardware with TLB. (08 Marks)  
 b. Define address binding explain multi-step processing of a user program. (06 Marks)  
 c. Given five memory positions of 100 KB, 500 KB, 200 KB, 300 KB and 600 KB (in order), how would the first fit, best fit and worst-fit algorithms place processes of 212 KB, 417 KB, 112 KB and 426 KB (in order)? Which algorithm makes the most efficient use of memory? (06 Marks)

Module-4

- 7 a. Define demand paging. With a neat diagram explain the steps in handling page fault. (08 Marks)  
 b. Consider the following page reference string  
 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6  
 How many page faults would occur for the LRU, FIFO and optimal page replacement algorithms? Assume frame size is 3. (12 Marks)

OR

- 8 a. Define file. Explain different operations can be performed on the file. (07 Marks)  
 b. Explain different file access methods. (09 Marks)  
 c. List out different allocation methods. Explain any one. (04 Marks)

Module-5

- 9 a. Suppose that a disk has 5000 cylinders numbered 0 to 4999. The drive is currently serving a request at cylinder 143 and the previous request was at cylinder 125. The queue of pending requests, in FIFO order is,  
 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130  
 Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms?  
 i) FCFS    ii) SSTF    iii) SCAN    iv) LOOK (12 Marks)  
 b. Write a short note on Access Matrix. (08 Marks)

OR

- 10 Write a short note on the following :  
 a. Components of Linux system  
 b. Process Management  
 c. File System  
 d. Interprocess communication (20 Marks)

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## Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024 Biology for Engineers

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. Explain the structure and classification of carbohydrates, focusing on monosaccharide, disaccharides and polysaccharides. Discuss their biomedical importance of carbohydrates. (10 Marks)
- b. Explain the construction, properties and importance of cellulose-based water filters. (05 Marks)
- c. Discuss the properties, engineering applications and environmental impact of pHA and PLA as bioplastics. (05 Marks)

### OR

- 2 a. Discuss the importance and potential applications of DNA and vaccines using rabies as an example. Explain how DNA vaccines work. (10 Marks)
- b. Explain the properties, advantages and engineering applications of RNA vaccines, specifically for COVID-19. (05 Marks)
- c. Discuss the benefits and uses of plant-based proteins as alternatives to animal-based proteins. (05 Marks)

### Module-2

- 3 a. Compare and write architecture of the human brain as a CPU system with that based on their characteristics. (10 Marks)
- b. What is EEG? Write the application of EEG. (05 Marks)
- c. Eye act as camera. Explain with diagram. (05 Marks)

### OR

- 4 a. Describe the architecture of the heart as a pump system. Discuss the function of each chamber. (10 Marks)
- b. Discuss the reasons for blockages in blood vessels and their implications for cardiovascular health. (05 Marks)
- c. Discuss the different shapes, materials, coating and expansion mechanisms used in stent design. (05 Marks)

### Module-3

- 5 a. Explain the architecture of the lungs as a purification system. Discuss the different parts of the respiratory system and their role in filtering harmful substances and facilitating gas exchange. (10 Marks)
- b. Discuss the principle and working of spirometry as a diagnostic test for evaluating lung function. Explain how spirometry results can be interpreted and used in the diagnosis of lung conditions. (05 Marks)
- c. Explain the concept of abnormal lung physiology. Focusing on Chronic Abstractive Pulmonary Disease (COPD) as an example. (05 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
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OR

- 6 a. Describe the architecture of the kidney and its functional units. Known as nephrons. Discuss the role of each component of the nephron in the filtration, reabsorption and secretion processes. (10 Marks)
- b. Discuss the types of muscle and contract of muscle. (05 Marks)
- c. Explore the bioengineering solutions being developed for osteoporosis. (05 Marks)

**Module-4**

- 7 a. Explain the working principle of ultrasonography and discuss its advantages and limitations in medical imaging. (10 Marks)
- b. Discuss the history of technological echolocation. (05 Marks)
- c. Explain components of bionic leaf. (05 Marks)

OR

- 8 a. Compare between Birds and Aircrafts with GPS technology for Navigation and discuss. (10 Marks)
- b. Discuss the principle of super hydrophobic surfaces. (05 Marks)
- c. Discuss the materials and examples of self cleaning surface. (05 Marks)

**Module-5**

- 9 a. Elucidate the difference between 3D printer and Bioprinter. (10 Marks)
- b. Discuss technological importance of 3D printing of Human Ear. (05 Marks)
- c. Discuss materials used in 3D printing of Bone. (05 Marks)

OR

- 10 a. Evaluate the importance of 3D printing in the food industry. (10 Marks)
- b. Discuss the technological importance of self healing bio concrete. (05 Marks)
- c. Evaluate the advantages of bioremediation and biomining. (05 Marks)

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