Total No. of Printed Pages—8

5 SEM TDC STSH (CBCS) C 12 (N/O)

2024

(November)

STATISTICS

(Core)

Paper : C–12

(Statistical Computing Using C Programming)

The figures in the margin indicate full marks for the questions

(New Course)

Full Marks : 55

Pass Marks : 22

Time : 3 hours

1. Choose the correct answer from the following alternatives : 1×6=6

(a) Who is the father of C language?

(i) Bjarne Stroustrup

(ii) James Gosling

(iii) Dennis Ritchie

(iv) W. A. Shewhart

(b) How many keywords are there in C?

(i) 0

(ii) 32

(iii) 48

(iv) 255

(c) Which of the following will not return a value?

(i) void

(ii) int

(iii) null

(iv) char

(d) Nesting is allowed for which of the following statements?

(i) if

(ii) if else

(iii) switch

(iv) All of the above

(e) Where should the default values of parameter be specified?

(i) Function call

(ii) Function definition

(iii) Function prototype

(iv) None of the above

(Continued)

(f) Which of the following operations is allowed to be performed on a pointer variable?

(i) ptr + 1

(ii) ptr – 1

(iii) ptr + + and ptr – –

(iv) All of the above

2. Answer the following questions in brief : 2×6=12

(a) What is the difference between pre-increment and post-increment operations?

(b) What are the disadvantages of do-while statement?

(c) Explain the purpose of recursion function.

(d) What is static memory allocation?

(e) Differentiate between for loop and while loop.

(f) What is pointer variable?

3. Answer any *two* of the following questions : 8×2=16

(a) Write a short history of C programming. What are the advantages and disadvantages of C programming? 4+4=8

(Turn Over)

(b) What do you mean by identifiers? State the rules for naming identifiers. Give some examples of valid and invalid identifiers. 2+3+3=8

(c) Explain the basic data types supported by C language and discuss their features. 4+4=8

4. (a) What is a loop? Compare the three loop control structures used in C with examples. 2+6=8

Or

(b) What is an array? Explain different types of array with syntax. 2+6=8

5. (a) What is function prototype? Write a recursion function algorithm to find a factorial of a number. 2+5=7

Or

(b) Distinguish between library function and user-defined function. Explain in detail the storage classes available in C language with examples. 2+5=7

6. (a) Distinguish between pointers and arrays. How to declare and initialize a pointer? Explain with examples. 3+3=6

Or

(b) What is dynamic memory allocation? Explain malloc( ) and calloc( ) functions. 3+3=6

(Old Course)

Full Marks : 50

Pass Marks : 20

Time : 2 hours

1. Choose the correct answer from the following alternatives : 1×5=5

(a) Who is the father of C language?

(i) Bjarne Stroustrup

(ii) James Gosling

(iii) Dennis Ritchie

(iv) W. A. Shewhart

(b) How many keywords are there in C?

(i) 0

(ii) 32

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(iv) 255

(c) Which of the following will not return a value?

(i) void

(ii) int

(iii) null

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(d) Nesting is allowed for which of the following statements?

(i) if

(ii) if else

(iii) switch

(iv) All of the above

(e) Which of the following operations is allowed to be performed on a pointer variable?

(i) ptr + 1

(ii) ptr – 1

(iii) ptr + + and ptr – –

(iv) All of the above

2. Answer the following questions in brief : 2×5=10

(a) What is the difference between pre-increment and post-increment operations?

(b) What are the disadvantages of do-while statement?

(c) Explain the purpose of recursion function.

(d) What is static memory allocation?

(e) What is pointer variable?

3. Answer any *two* of the following questions : 7×2=14

(a) Write a short history of C programming. What are the advantages and disadvantages of C programming? 3+4=7

(b) What do you mean by identifiers? State the rules for naming identifiers. Give some examples of valid and invalid identifiers. 1+3+3=7

(c) Explain the basic data types supported by C language and discuss their features. 3+4=7

4. (a) What is a loop? Compare the three loop control structures used in C with examples. 2+6=8

Or

(b) What is an array? Explain different types of array with syntax. 2+6=8

5. (a) What is function prototype? Write a recursion function algorithm to find a factorial of a number. 2+5=7

Or

(b) Distinguish between library function and user-defined function. Explain in detail the storage classes available in C language with examples. 2+5=7

6\. (a) Distinguish between pointers and arrays. How to declare and initialize a pointer? Explain with examples. 3+3=6

Or

(b) What is dynamic memory allocation? Explain malloc( ) and calloc( ) functions. 3+3=6

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5 SEM TDC STSH (CBCS) C 11 (N/O)

2024

(November)

STATISTICS

(Core)

Paper : C–11

(Stochastic Processes and Queuing Theory)

The figures in the margin indicate full marks for the questions

(New Course)

Full Marks : 55

Pass Marks : 22

Time : 3 hours

1. Choose the correct answer from the following alternatives : 1×7=7

(a) Consider a Markov chain $\{X_n, n \geq 0\}$ with discrete state space. If the transition probabilities are independent of n, then the Markov chain is said to be

(i) independent

(ii) homogeneous

(iii) reducible

(iv) non-homogeneous

(b) If two states of a Markov chain are accessible from each other, then they are

(i) communicating states

(ii) transient states

(iii) absorbing states

(iv) periodic states

(c) Following is the t.p.m. for a Markov chain :

$$\begin{array}{c|ccc} & 1 & 2 & 3 \\ \hline 1 & & & \\ 2 & & & \\ 3 & & & \end{array} \quad \begin{bmatrix} 1-2a & 2a & 0 \\ a & 1-2a & a \\ 0 & 2a & 1-2a \end{bmatrix}$$

Then the

(i) value of a is any real number

(ii) value of a is any positive real number

(iii) value of a is less than 0·5

(iv) value of a is in [0, 0·5]

(d) If $\{N(t)\}$ is a Poisson process, then the correlation coefficient between $N(t)$ and $N(t+s)$ is

(i) $\{t(t+s)\}^{3/2}$

(ii) $\dfrac{t}{t+s}$

(iii) $\left\{\dfrac{(t+s)}{t}\right\}^{1/2}$

(iv) $\left\{\dfrac{t}{(t+s)}\right\}^{1/2}$

(e) If $N_1(t)$ and $N_2(t)$ are two independent Poisson processes with parameters λ_1 and λ_2 respectively, then $N_1(t)-N_2(t)$ is

(i) a Poisson process with rate $\lambda_1+\lambda_2$

(ii) a Poisson process with rate $\lambda_1-\lambda_2$

(iii) a Poisson process with rate $\dfrac{\lambda_1}{\lambda_2}$

(iv) not a Poisson process

(f) $M/M/1$: model follows

(i) geometric distribution

(ii) exponential distribution

(iii) Poisson distribution

(iv) negative exponential distribution

(g) The term 'jockeying' in queuing theory refers to

(i) not entering the long queue

(ii) leaving the queue

(iii) shifting from one queue to another parallel queue

(iv) None of the above

2. Answer the following questions in brief : 2×6=12

(a) Define a stochastic process with an example.

(b) State Chapman-Kolmogorov theorem.

(c) Define irreducible Markov chain and closed set.

(d) Define transient and persistent states.

(e) Prove that the interval between two successive occurrences of a Poisson process $\{N(t), t \geq 0\}$ having parameter λ has a negative exponential distribution with mean $\frac{1}{\lambda}$.

(f) What do the letters in the symbolic representation $(a / b / c) : d / e$ of a queuing model represent?

3. (a) (i) Define bivariate probability generating function. Given the bivariate p.g.f. of (X, Y) as

$$P(s_1, s_2) = \exp[-a - b - c + as_1 + bs_2 + cs_1 s_2]$$

Find the p.g.f. of $X + Y$ and identify the distribution. 1+1=2

(ii) The r.v. X has logarithmic series distribution if

$$p_k = P(X = k) = \frac{Xq^k}{k}; \; k = 1, 2, 3, \ldots$$

$$X = -\frac{1}{\log p}; \quad 0 < q = 1 - p < 1$$

Find the p.g.f. of X. Also, find mean and variance. 3

Or

(b) If $\{N(t)\}$ is a Poisson process and $s < t$, then prove that

$$P\{N(s) = k / N(t) = n\} = \binom{n}{k}\left(\frac{s}{t}\right)^k \left\{1 - \left(\frac{s}{t}\right)\right\}^{n-k}$$ 5

4. Answer any *four* questions from the following : 4×4=16

(a) Interpret the Gambler's ruin problem as a Markov chain.

(b) Consider the Markov chain with three states $S = \{1, 2, 3\}$, that has the following transition matrix :

$$P = \begin{bmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$$

(i) Draw the transition diagram of the Markov chain.

(ii) If $P(X_1 = 1) = P(X_2 = 2) = \frac{1}{4}$, then find $P(X_1 = 3, X_2 = 2, X_3 = 1)$. 2+2=4

(c) Let $\{X_n, n \geq 0\}$ is a Markov chain with t.p.m.

$$P = \begin{bmatrix} \frac{1}{2} & \frac{1}{2} \\ \frac{1}{3} & \frac{2}{3} \end{bmatrix}$$

and initial distribution $P(X_0 = j) = \frac{1}{2}$; $j = 0, 1$

Compute—

(i) $P(X_1 = 1)$;

(ii) $P(X_1 = 0)$;

(iii) $P(X_2 = 1)$;

(iv) $P(X_2 = 0)$. 1+1+1+1=4

(d) Define ergodic state in Markov chain. Let $\{X_n, n \geq 0\}$ be a Markov chain having state space $s = \{1, 2, 3, 4\}$ and t.p.m.

$$\begin{bmatrix} \frac{1}{3} & \frac{2}{3} & 0 & 0 \\ 1 & 0 & 0 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} & 0 \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} \end{bmatrix}$$

Show that state '1' is ergodic. 1+3=4

(e) Define periodicity of a Markov chain. Show that the states of the Markov chain with t.p.m.

$$P = \begin{bmatrix} 0 & 1 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 1 & 0 \end{bmatrix}$$

are periodic and persistent non-null. 1+3=4

5. (a) (i) Show that the sum of two independent Poisson processes is a Poisson process. 2

(ii) State the differential-difference equation of linear growth process and hence using the equation, show that $M'(t) = (\lambda - \mu) M(t)$, where $M(t) = \sum_{n=1}^{\infty} n \cdot P_n(t)$, λ and μ are respectively the birth and death rates of the process $\{X_t\}$. 5

Or

(b) Show that if the intervals between successive occurrences of an event E are independently distributed with a common exponential distribution with mean $\frac{1}{\lambda}$, then the event E forms a Poisson process with mean λt. 7

6. (a) Define a queuing system. Discuss the basic features which characterize a queuing system.

"Queue is a management of congestions." Elucidate the statement. 4+4=8

Or

(b) In case of $(M / M / 1) : (N / FCFS)$ queuing model, derive the steady-state probability distribution and obtain the expression for—

(i) expected number of customers in the system;

(ii) expected number of customers in the queue. 6+2=8

(Old Course)

Full Marks : 50

Pass Marks : 20

Time : 2 hours

1. Choose the correct answer from the following alternatives : 1×6=6

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4+3=7

(Turn Over)

Or

(b) In case of $(M/M/1):(N/FCFS)$ queuing model, derive the steady-state probability distribution and obtain the expression for—

(i) expected number of customers in the system;

(ii) expected number of customers in the queue. 5+2=7

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